THE NEW MEXICO BOTANIST Special Issue Number 6 April 2017

PROCEEDINGS OF THE SIXTH

Natural History of the Gila Symposium

February 25–27, 2016

Western New Mexico University

Silver City, New Mexico

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2017

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Introduction

In 2016 the Gila Natural History Symposium showcased the biological diversity of the greater Gila region with almost 50 scientific papers, posters, and creative voices. The symposium steering committee has had numerous discussions about drawing parameters on the footprint area for this biennial event. Is it the Gila National Forest and adjacent natural resources? Is it for scientific researchers only? From the first symposium in 2006 to the present, that discussion has continued, in an ever-expanding way.

The symposium started out as a platform for local (southwest New Mexico) researchers to showcase their work. As soon as an envelope was identified, however, the organizers and interested parties began to stretch it. The greater Silver City community has a reputation for being inclusive, and as each new idea came forward, a way was found to accommodate it.

The platform we have today includes the "greater" Gila Region. Silver City is Tucson's cool-weather playground. It is a diverse community set off from the interstate corridors that embraces elements of Arizona and Mexico and extends east at least to the Rio Grande corridor.

The steering committee is dedicated to maintaining the symposium's research element and, in highlighting our local/regional research efforts, providing opportunities to students—from college undergraduates to post-doctoral candidates—to share their work. We realize that some "researchers" may not have college degrees. We recognize them as people who work with the land in all capacities and realize that some of the best ecosystem information comes from people who work with shovels and backhoes, exploring best management practices that can be re-created in riparian habitats. And some of the most inspiring natural resource specialists are those who may never develop a hypothesis or engage a statistical test but instead work with their pens and creative voices; they may never plant a tree but they write about its beauty.

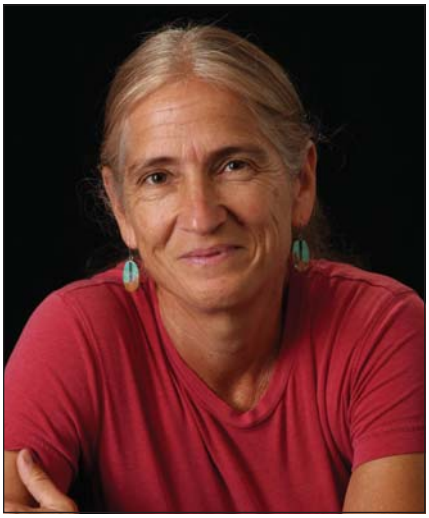
The 2016 collection of abstracts presents a working landscape, with the Gila National Forest and its vast wilderness areas as a centerpiece. The Gila footprint extends along the Gila River through Arizona and flows out to university partners across state boundaries who perfect the art of creating better sampling models; this includes ranchers working to restore riparian habitats, and water harvesters working within the city limits; it includes a team from the US Forest Service preparing a new Forest Management Plan; it includes researchers looking at climate change and wildfire impacts. And it includes political issues related to a potential diversion on the Gila River. All of these subjects are presented by an array of individuals who care for the land: ranchers, students, professors, full-time researchers, and state agency partners . . . with the occasional poet entering the mix.

Looking back on 2016 and past symposia, it is apparent that diversity is our strength. As we go forward, there is an ever-increasing need for citizen science and engagement of a broader community in the conservation of our natural and cultural resources. The steering committee of the Gila Natural History Symposium aims to engage science and recognize that it comes from many sources.

—Joneen S. Cockman, on behalf of steering committee members: Adrienne Booth, Jony Cockman (BLM), Richard Felger (U of A Herbarium), Amy Ganguli (NMSU), William Norris (WNMU), Jessee Page, Ted Presler (WILL), Susan Teller-Marshall (GCEC), Art Telles (USFS), and Kathy Whiteman (WNMU)

Lifetime Achievement Award: Sharman Apt Russell

Richard Felger



Sharman Apt Russell.

Sharman Apt Russell is a nature and science writer living at the edge of the Gila River floodplain west of Silver City, New Mexico. Professor emeritus in the Humanities Department of Western New Mexico University and on the faculty of Antioch University, her continued writings and teaching outshine the best of us. A role model for greatness and graciousness, Sharman is my favorite author.

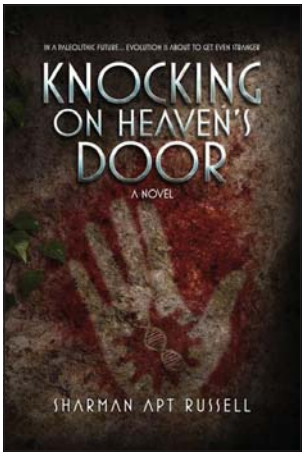
Sharman is the daughter of test pilot Milburn "Mel" G. Apt, the fastest man on earth in 1956, traveling 35 miles per second when he was killed testing the Bell X-2 rocket. She was two years old at the time.

Sharman's father, test pilot Milburn "Mel" G. Apt.

Sharman's essay "Letter to My Father" sets the stage for her view beyond the ordinary. Test pilots of her father's day engaged in the world's most daring dangerous deeds. Sharman continues the tradition as a daring writer. One of her writer friends says she is a dangerous writer, powerful against forces she chooses to battle. Her essay "People Who Live Inside Us," published in the *Threepenny Review*, uses some of the "Letter to my Father" and moves on to new territory. "People live inside us. Sometimes they live in the darkness of the body. . . . Sometimes they appear in bright color, as if on another planet or dimension. . . . The occipital cortex sees with the eyes closed."

Sharman's topics cover her sense of place in the Gila Wilderness, the earth, and the cosmos, of unreality made real. Writings too numerous to mention, including a richness of books. Sharman writes, "It's fair to wonder why I range so widely in my writerly interests. I think of John Muir's quote that everything in the universe is hitched to everything else. Somehow, it's all connected."

The latest book, *Knocking on Heaven's Door*, is a sci-fi fantasy in the "23rd century Paleo-Future." Social norms wear away at an eco-friendly life. A bi-gender loner and a mutated dire wolf commune. Cloned mammoths. A telepathic saber-tooth tiger, "I love you but still want to eat you."

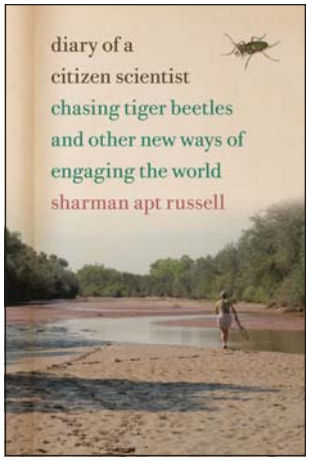


Sharman's latest book, *Knocking on Heaven's Door*.

J. J. Amaworo Wilson writes, "Is there anything Sharman Apt Russell cannot do on the printed page?" Sharman's awards are too numerous to mention in an hour or more. Her works are translated into more than a dozen languages. Sharman says, "The thrill—and befuddlement—of seeing my words in Chinese ideograms." At the time of this award presentation, Sharman was in Montana as Distinguished Visiting Writer at the University of Montana.

Diary of a Citizen Scientist: Chasing Tiger Beetles and Other New Ways of Engaging the World was awarded the 2016 John Burroughs Medal for Distinguished Nature Writing, sponsored by the

Western red-bellied tiger beetle. Photo: Cary Kerst.

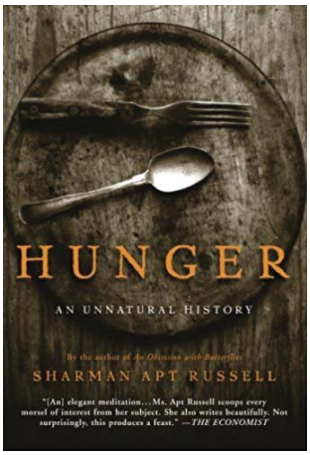


***Diary of a Citizen Scientist* was awarded the 2016 John Burroughs Medal for Distinguished Nature Writing.**

American Museum of Natural History. The medal goes back to the 1930s and its winners include Aldo Leopold and Rachel Carson.

Tiger beetles, more fearsome than saber-tooth tigers but mercifully smaller, provided a year-long quest for Sharman. I have been fascinated with these predators ever since I watched a spotted tiger on a desert beach attack a much larger insect.

Hunger: An Unnatural History is an essential read. This clinical topic is a real page-turner. For example, how to refeed people suffering from starvation. Did you realize there is more to it than just refeeding starved children? Sharman describes how a society that is slowly starving functions and falls apart, such as the residents of the Warsaw Ghetto and the Ik tribe in Africa. Starvation affects thinking and acting.

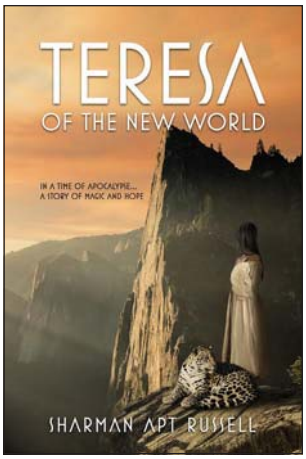


An essential read.

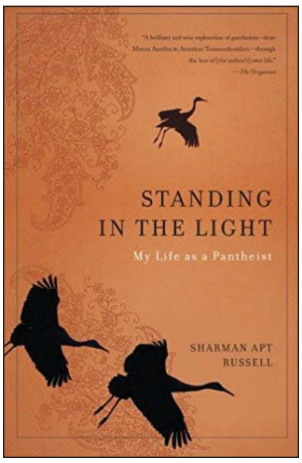
Teresa of the New World is a story of magic and hope. Cabeza de Vaca and his daughter, conjured up by Sharman, venture across the uncharted continent. A journey into imagined probability of factual history. I couldn't close the book, wandering in the desert of 1536. Although this book is advertised for "young adults," I can't help thinking: Are we still young enough? I think this is my favorite Sharman book, but I can't decide.

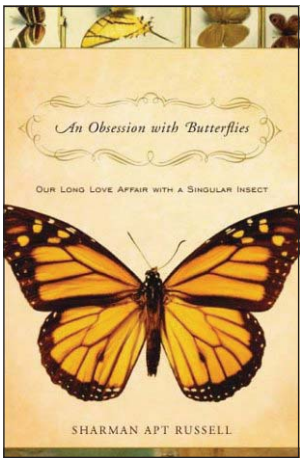
As I delve deeper into Sharman's writings, I am awed by gentle heroic writing of daring, danger, and fun.

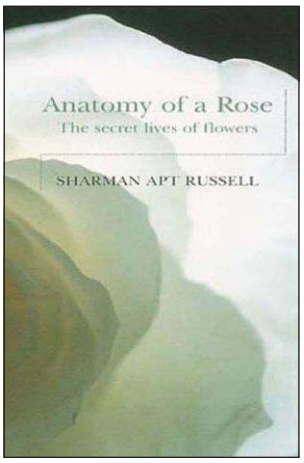
It is a privilege to present this award to Sharman Apt Russell.

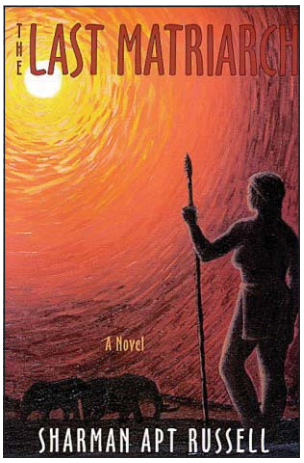


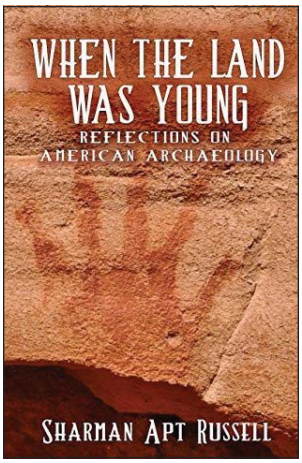
A journey into imagined probability of factual history, *Teresa of the New World* is a story of magic and hope.

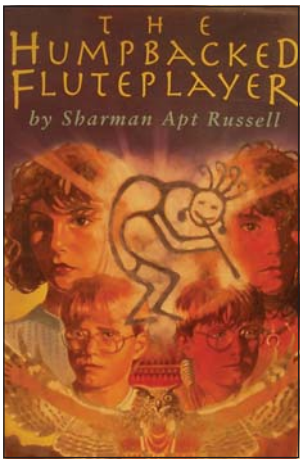


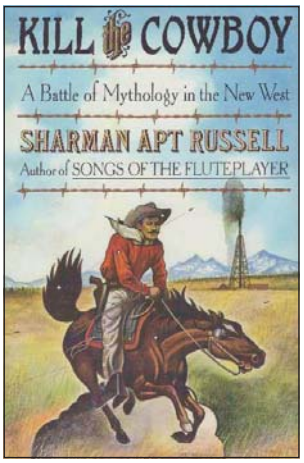


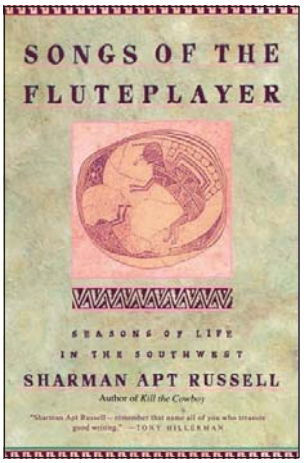












Sharman's other books.

Lifetime Achievement Award: T & E, Inc.

Kathy Whiteman

The 2016 Gila Natural History Symposium Steering Committee awarded one of two Lifetime Achievement Awards to T & E, Inc., a small nonprofit organization that has had a tremendous positive impact on the protection and preservation of our natural world. When many nature lovers hear or read the letters *t* and *e*, they automatically think "threatened and endangered," but in this case, T & E doesn't stand just for that but also for two incredible conservationists, Tom and Eleanor Wootten.

The Woottens were early supporters of the Natural History of the Gila Symposium and they both treasured the biodiversity of the Gila region. For those who don't know the Woottens, it may be helpful to review the articles on Tom Wootten published in the First Proceedings of the Natural History of the Gila Symposium* and the Native Plant Society of New Mexico Newsletter†; much of the content for the brief story below was derived from those sources. (Additional information came from visiting with Eleanor.)

Throughout their lives, the Woottens have been tireless supporters of conservation. Described as driven, kind, humble, generous, and enthusiastic people, they are indeed special, and many among us count them as dear friends. Eleanor and Tom were conservationists from the heart, always acting on their love of the natural world and their recognition that people will not conserve what they don't understand. The Woottens made countless efforts for plant and wildlife conservation, natural-land protection, scientific research, and public education and, over the last 40 years, have given their support to many groups, including the Center for Biological Diversity, New Mexico Wilderness Alliance, The Nature Conservancy, the Audubon Society (at the state, local, and national levels), the New Mexico Department of Game and Fish, the Gila Conservation Education Center, the Native Plant Society of New Mexico, and K-12 science education programs.

The 2016 Lifetime Achievement Award is one of many awards the Woottens have received in recognition of their influence in the arena of environmental conservation. For example, Tom was given the Aldo Leopold Award by The Nature Conservancy, and in 1998, both he and Eleanor received the Charles Callison Award from the National Audubon Society. In 2007 the Woottens received an honorary lifetime membership to the Native Plant Society of New Mexico. In 2011, Eleanor was the first woman recognized by Audubon New Mexico as a Southwest Woman in Conservation.

Tom and Eleanor are natives of the southwestern United States, and a sense of connection with and love of the land was inculcated into each from an early age, he growing up on a ranch and she in a family that camped often and promoted nature. They met in the 1950s as students at New Mexico State University (NMSU) in Las Cruces. In 1961, following their graduation and courtship, the two married. Shortly thereafter, Tom served a few years in the US Army, and by 1962 Tom and Eleanor had begun a family with the birth of their oldest son, Tom Jr. In 1963 they moved from New Mexico to Kansas, where Tom began working as a banker and wisely invested funds that later guaranteed financial security for the family. The family continued to grow, with the births of three more children: Marianne, in 1965; David, in 1968; and Margaret, in 1971. The children kept Eleanor and Tom busy, and although Tom had moved up in rank through the bank's trust department, by the mid-1970s he realized that the stress associated with his job was not rewarding. He left the bank, and the family moved back to Las Cruces, where, in 1976, Tom decided to go back to school at his alma mater, pursuing a degree in horticulture. During his second stint at NMSU, he expanded his interest in environmental issues, taking classes with prominent NMSU biology professors, including Richard Spellenberg and Sandy Dick-Peddie. In 1978, Tom graduated with a Bachelor of Science in Agriculture.

Meanwhile, Eleanor was engaged in conservation initiatives, in 1978 becoming a charter member of the Mesilla Valley Audubon Society. By the early 1980s, the Woottens were growing native plants in their backyard and selling them at the Las Cruces Farmer's Market. In 1983, they decided to open a native plant nursery of their own, Dry Country Plants. Tom's degree in agriculture paid off and the nursery helped to educate people about the value of using xeric-adapted plants in home landscapes.

After seven years, and with their children grown, Tom and Eleanor closed their plant nursery and began spending significantly more time doing conservation-based volunteer work. Eleanor continued to be active with Audubon, holding positions as chapter president and vice president, field trip chair, coordinator for the annual Christmas Bird Count, and representative with the New Mexico Audubon Council. She also headed the committee that ran the New Mexico Hummingbird Connection and served on the New Mexico Game Department's advisory committee for Share with Wildlife. Tom logged many hours with the group that became the New

*Gene Jercinovic, "Tom Wootten: A Great Friend," *New Mexico Botanist*, Special Issue 1: Natural History of the Gila, A Symposium (2008): 9–11.

†Gene Jercinovic and Jack Carter, "Tom Wootten," *Native Plant Society of New Mexico Newsletter* 32(4) (Oct.–Dec. 2007): 10–11.

Mexico Wilderness Alliance and served on the Board of Trustees of The Nature Conservancy. Tom and Eleanor believed in The Nature Conservancy's mission and made generous donations toward land purchases for conservation purposes, including, locally, what is now the Lichty Ecological Research Center along the Gila River in Cliff, New Mexico.

In the 1990s, as the Woottens devoted more of their time and resources to conservation-based initiatives, they began to recognize that universities were shifting educational emphasis and research dollars toward microbiology and cell biology and away from field-based ecological studies. The Woottens understood that ecological studies provide data invaluable to environmental conservation and they wanted to do something to encourage ecological research. They approached the head of the biology department at NMSU to discuss the possibility of their funding student-driven research projects throughout the southwestern United States and northern Mexico. As a result of the meeting, Tom and Eleanor founded T & E, Inc., in 1995. The success of the organization has been phenomenal; between 2000 and 2014, T & E has provided financial assistance to at least 293 individual students, representing 17 different universities in California, Utah, Oregon, New Mexico, Arizona, Nevada, Washington, and northern Mexico. Tom passed away unexpectedly in 2007, yet the T & E legacy continues through Eleanor and their four children; T & E funds roughly 12–20 student-driven ecological research projects each year.

Following the Woottens' example, in 2007 the Native Plant Society of New Mexico established the Tom Wootten Environmental Fund to support the advancement of ecological research and education. Eleanor and her family continue to advocate for protection and conservation of the imperiled Gila River and its flora, fauna, and associated ecosystems. It is true, as Gene Jercinovic wrote,* that "greatness is accrued by some through quiet ignorance of their own importance, through dedication to service without song, and through the simple honesty of their giving."

The Wootten family has given its support for the love of the land and continues to have a major impact on the study of plants, animals, and the ecology of this place. The steering committee of the 6th Natural History of the Gila Symposium is proud to recognize the lifetime achievements of T & E, Inc.



The Wootten Family: (A) Eleanor and daughter Marianne; (B) Tom; (C) son David and daughter Margaret. Today, Eleanor, Marianne, Margaret, and David manage the T & E, Inc. legacy. (Not pictured is son Tom Jr., who lives in the Philippines.)

Student Environmental Education Award in memory of Ella Jaz Kirk, Michael Sebastian Mahl, and Ella Sala Myers

Adrienne Booth

The Student Environmental Education Award is new this year, an addition to our traditional Lifetime Achievement Awards. The symposium committee wants to use this opportunity to acknowledge and encourage the work of young people in environmental science and education that focuses on the Gila region.

In this, its first year, we present the Gila Symposium Student Environmental Achievement Award posthumously to local high school students Ella Jaz Kirk, Michael Sebastian Mahl, and Ella Sala Myers.

* * *

"Lifetime achievement" is often measured in decades, when we honor our colleagues at the end of long, fruitful careers. But not all lives are long. Some lives are meteoric, brief and full of light, full of promise. Some people accomplish much in a very short time.

This is the first Gila Symposium since our community lost three of its brightest young stars, Ella, Michael, and Ella, who were killed in a plane crash in 2014.

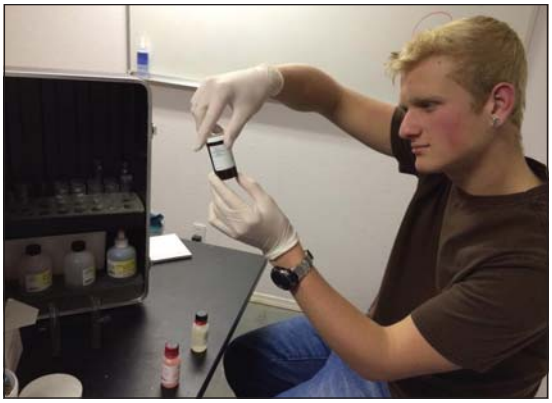
Left to right: Ella Sala Myers, Michael Sebastian Mahl, and Ella Jaz Kirk.

In the months since their passing, the community has honored their memory many times. These young people were accomplished musicians, writers, and artists, and they served their community in many ways during their brief lives. Today's memorial is different, because we specifically acknowledge their work in the realms of citizen science, research, and environmental education, all focused on the Gila region.

In my role as manager of the Gila Conservation Education Center (GCEC), I had the honor of working with these three students when they served as environmental educators at GCEC's Children's Water Festival on the Gila River in the spring of 2014. Ella and Ella were the sole staffers of the Water Quality Monitoring learning station that day; Michael was prepared to use the "Watershed Trailer" to teach about runoff, and he staffed the festival's first-aid station and pitched in to help wherever needed. All three shared their knowledge and love of the river with 250 fifth-grade students. They took professional responsibility as educators, from developing lesson plans and providing learning materials to ensuring that the 20-minute class rotations stayed on schedule. They developed educational "trunks" (self-contained, portable environmental education units) for GCEC, and they taught high school peers as well as adults—including me—how to use the trunks as teaching tools. It's not a stretch to say that these three young people taught many of us how to be better researchers, better educators, better people.

Ella, Michael, and Ella were young, but they were serious researchers. Their final hour was spent on a flight to observe the burn scar of the Signal Peak fire, but they had also studied the effects of wildland fire on Boston Hill and in the Whitewater–Mogollon Baldy burn area. Michael, in particular, studied soil chemistry; Ella Myers was fascinated by forests, ecosystems, wildlife; and all three were passionate about the Gila River and its watersheds. Ella Kirk took her passion for the river all the way to the New Mexico Statehouse, where she and her young colleagues demonstrated a more complete understanding of the science of the Gila River than the legislators did, I'm told. As part of the Polecats team from Aldo Leopold High School, Ella, Michael, and Ella competed in the 2014 New Mexico Envirothon, a two-day hands-on environmental problem-solving contest for high school students. Envirothon questions included the categories of soils and land use, aquatic ecology, forestry, wildlife, and current environmental issues; the Polecats took home the First Place trophy.

So today, we honor the achievements of Ella Jaz Kirk, Michael Sebastian Mahl, and Ella Sala Myers as student-scientists and environmental educators who made outstanding contributions to our understanding of, and stewardship of, the Gila region. Ella, Michael, and Ella, thank you for your leadership.



Clockwise from top: Teaching in an elementary school classroom using materials from their Gila Trunk; presenting at the Children's Water Festival; Michael in the lab; Ella Sala, Ella Jaz, with water samples; collecting data in the Gila River.

Three Poems

Catalina Claussen

She Taught Me About Gossamer

She taught me about gossamer
It's everywhere
Floating, knitting sunlight to starlight
Granite cliff faces to precarious spiders
weaving
willows to the banks of
The West Fork

And then she said
Shhh
Bring your children
So they can hear themselves
Play weaving inspiration into motion
Making bark boats and racing them downstream

Keep a watchful eye
On giggling shouts of triumph
And lizards bathing in midday streams
Of sunlight warming round rocks
That roll away uncertainty
Not found in the present moment.

The Song of the Middle Fork

The silent twist of ghost white
Butterflies in a joyful dance
Wrought by the updraft
Of fragrance from vetch, mullein, and artemisia
A scintillating pollen cloud
En plein air, pleasantly exhausted
Wings inhale and exhale
Precariously perched in sunshine
That glints and glimmers
Off the spiraling surface, tempestuous tornadoes that reel,
Gather, and tumble downstream
In boundless playground laughter
Turned whitewater in its race around the lazy bend that captures
You and me smiling,
Mirrored on the surface.

In a Circle of Eight

In a circle of eight
Anticipation of the three-night adventure into the wild rises
Glittering in his brown eyes
That gaze upon the patchwork scrabble of the barrio on the daily
And glancing off her fair squared shoulders
Sculpted by hours spent with her cross-country teammates

Backpacks rise above their heads
"Who can point out where we are?"
Eager fingers trace contour lines and backcountry roadways
Reading the strata
Layer upon layer
Caught in the cross-hairs
Where geologic time meets human existence

"Where are we going?"
There, where Diamond Creek meets the East Fork
In a moving prayer that circles back, taking us all home again.

Picking our way through a muddy corral,
Into a field of late August blooms
Indian paintbrush, firecracker penstemon, self-heal, and mullein
Edged in cottonwoods and then junipers
Rising high above the creek
We trace contour lines with hushed footsteps
The warmth of the sun pressed up against our skin
We begin
Mountain Pose

Descending the granite cliff face
Into the embrace of fecund pools
Teeming with pollywogs
And bursts of "Wow, Cat, look at that"
And "I lost my shoe"

And the creek goes on sure of each step
Cenozoic, Mesozoic, Paleozoic, Precambrian
Pushing through sand and gravel
Steady onward
To greet the swift and serpentine East Fork

From *Ross Calvin: Interpreter of the American Southwest*

Ron Hamm

Chapter Ten—*River of the Sun*: The Gila

River of the Sun: Stories of the Storied Gila—Calvin's second major book—met with immediate critical success, nearly equal to that of *Sky Determines*. That one had the Macmillan publicity machine behind it. This one had only the promotion efforts of a regional university press. The book resonated with critics and readers alike as it spoke of a "muddy, deep, and reedy mysterious" *storied* river. *River of the Sun* was accessible; it was also entertaining and educational. In a far-ranging menu of topics, beginning with the river's discovery by the Spaniards, through the bloody wars with the Apache, Calvin told the Gila's history in tracing its impact upon New Mexico and Arizona for four hundred years. He wrote of people not that long gone and occasionally bridged past and present with interviews of people still alive. He was practicing a form of oral history before it became a commonly accepted practice. Parts of the book read like an adventure novel, except that it is factual, not fiction.

The book is divided into ten chapters, each an independent story or sketch, so the reader can dip into it nearly anywhere. Four tell the stories of individuals: Coronado, Kit Carson, Geronimo, and cattleman Tom Lyons. The opening and closing chapters deal with the river itself, and the remainder are about the desert and the river and the efforts to tame them. Each chapter is about fifteen pages in length.

Calvin could take on a preachy tone (appropriately enough, given his primary vocation), as he did when calling the Gila the river of the Apache, who were enabled by right to fight for it—even if the ongoing battles sometimes resulted in a "Roman holiday of blood." The settlers with European roots might call the Apaches perpetual war-mongering savages unable to distinguish between peace and war. Calvin saw it differently: "They lived by [the Gila's] waters in aboriginal times, and they are still here." His implication was that this is their just due.

As much as Calvin admired the Apaches, he also held high regard for the Mormons. His esteem shines through in passages describing their attempts to use the river to irrigate the desert. Sometimes the efforts had unwanted results. In addition to the farmers' constant battle to bring water to the Gila Valley, they also had to guard against those creatures seeking to share the resultant bounty: "Wherever their industry created a succulent, green oasis, there the famished creatures of the desert kept a nocturnal rendezvous." The Mormons also worked with other faiths on other enterprises when needed. The result was that "intelligence brought its own rewards."

Where things had gone wrong, he affixed blame where he thought it belonged. He observed that erosion and its causes had provoked "many short-sighted conservationists" to picture ranchers as the "greediest, most unprogressive lot . . . in American history." Not so, he countered; many times this was, in fact, far from the truth. He had another culprit in mind. Calvin viewed administration of the public domain upon which many ranchers graze their cattle as a "national stupidity," an opinion he had first articulated two decades earlier. In his "Use/Misuse" article for the Soil Conservation Service, he had termed such actions "the *unwisdom* of the nation." He wrote then that the country was beginning to understand that erosion and flooding were not acts of God, but largely "results of men's folly."

The story of how the book was crafted is fascinating. We are fortunate that Calvin provided a record of the process. In a "Parson" column July 15, 1946, for *Clovis News-Journal* on "How a Book Is Born," Calvin described researching, writing, fact-checking, and all the mechanical steps involved in its design and production. He offered his own standards for rendering judgment on the book's value: "If the book is remembered by name, read and respectfully consulted ten years after publication—well, you've written something that is altogether exceptional."

When *River of the Sun* was ready for publication, Calvin was a recognized figure in Southwestern literature. He did not have to go hat in hand seeking a publisher. Unlike Macmillan, the University of New Mexico Press was more than willing to publish his new book without asking for a buy-in. Perhaps even more important, the press chose honored book designer Carl Hertzog for the all-important task of crafting the book's physical appearance. Calvin was delighted. He wrote an admirer in early 1946 that as an example of bookmaking the book was "a honey"; design, paper, and typography came together to make *River of the Sun* "something pretty choice." Calvin added that he hoped the contents "don't prove unworthy of the package." Hertzog, who saw book design as a form of the fine arts, set out to print books "of his choice in the style of his choice." This he did with *River of the Sun*. With Hertzog involved, both the printing profession and reviewers greeted its physical appearance with enthusiasm.

Virginia Kirkus, founder of the influential *Kirkus Review*, praised the efforts of both men. She wrote that the book's scholarly approach surpassed previous attempts on the subject. It was, she observed, "more sober, more scientific," with greater human interest. At the same time, *River of the Sun* was "one of the finest pieces of bookmaking of the year." The *Chicago Tribune* called it an "exquisitely printed book" and "one of the handsomest of the year." *Forth*, a lesser-known journal, called it "beautiful to handle, charming to read, authentic as to fact." The printing profession was likewise

complimentary. The American Institute of Graphic Arts designated it as a monthly selection for "typographic design and excellence." Willard Hougland, editor of *Southwest Review*, said Calvin's new book "can well take its place along . . . *Sky Determines*" and complimented the UNM Press for its "fine production." Several reviewers thought it worthwhile to mention the inclusion of ten black-and-white photographs (all but one provided by Calvin or his wife) depicting life along the river.

John Weld commented in the *New York Times*, "Truly the Gila deserved a chronicler and truly the Rev. Ross Calvin was the man to write it." Weld wrote that Calvin believed the Gila to be the "most beautiful spot on Earth" and "he rises to rhapsodic heights" to say so. *Arizona Monthly* devoted eight pages, with a reproduction of the book's cover and half a dozen photos by both the Calvins and renowned photographer Joseph Muench. Its attempt at critical commentary was to quote an unidentified source: "To limn the turbulent stream from its fount to its juncture . . . and from the time when the memory of man runneth not to the contrary to this day." The book ranked as high as number two in the *New York Herald Tribune Weekly Book Review*.

Unlike the denser, more thought-provoking *Sky Determines*, *River of the Sun* is for the most part easy and pleasant reading, yet informative to even an unschooled readership. That was Erna Fergusson's view when, in her review for the *New York Herald Tribune Weekly Book Review*, she called it "altogether . . . an authentic book, valuable as an introduction to a region of strange beauty." Calvin's prose was as beautiful as the country he was writing about. His words could sing; they could be eloquent—he wrote with "the fervor of a poet." She went on, "The Gila is little known though its legends are legion," but *River of the Sun* is packed with Calvin's "close observations" delivered with "the kindness of a friend." Thinking of *Sky Determines*, she told her readers that Calvin "has done it again." To her the Gila was an important river in the history of not only its own watershed but the United States as well.

Joseph Henry Jackson reminded readers of his widely read *San Francisco Chronicle* "Bookman's Notebook" that "white men saw the Southwest [and the Gila] . . . long before Plymouth or Jamestown." He wrote that Calvin was "eminently suited" for the task of writing *River of the Sun* and the book richly deserved its appellation. "More Americans like him [Calvin] should be writing . . . regional books," he declared. If this were the case, "more would come out of regionalism." Jackson held that Calvin's prose "is first rate" and his observations "shrewd," allowing him to approach his topic in a "pleasant leisurely fashion" while employing a "quiet gentle reflectiveness." He saw Calvin as "a curious blend of poet, scientist, historian and essayist," making the combination "ideal for the job he . . . sets out to do." Calvin's kind of writing gives the reader "all the liveliness he could ask," for Calvin always "balances his book excellently."

With his new book, it was inevitable there would be comparisons with the first one. Thus Calvin must have been pleased at Stanley Vestal's words in the *Saturday Review of Literature*: "Ross Calvin does not turn out a book nearly as often" as his readers would like, so when a new book of his appears, it is "worth waiting for." He pointed out how Calvin displayed his subjects by topics, with "each chapter having its own chronology, background, and incident." The *Christian Century* agreed with Vestal's estimation of the book's worth. While *Sky Determines* was "one of the best books ever written" about New Mexico, it held *River of the Sun* was of "the same quality." The book was "a scholarly and readable account" of "an old and storied land."

Back home, the *Clovis News-Journal* called it "another great book" on the Southwest, particularly of the Gila River country, "a scholarly book." *New Mexico Magazine*, in its lukewarm three-inch mention, allowed that it was a "very readable" book and a "really fine" contribution to the Southwestern canon. *El Palacio*, the Museum of New Mexico's journal, by contrast, offered a more complete, sympathetic view. It printed a full synopsis, observing that Calvin had "painted a vivid and sympathetic picture" of life along the Gila. Calvin's prose, the reviewer wrote, "moves with the flow" of the river.

University of Arizona historian Frank C. Lockwood, in writing of the book for the *Arizona Daily Star*, offered another balanced, penetrating view. Like Fergusson, he acknowledged Calvin's ability to convey a "certain magic" when writing of the Southwest. Lockwood wrote that *River of the Sun* combined "a rare degree" of scholarship and literary style and that it was "a delightful work, pleasant to look at, to handle, and to read." He faulted only what he perceived as the book's unevenness in its "proportion and balance." Lockwood believed Calvin devoted too much attention to New Mexico and not enough to Arizona, through which the river makes much of its way to its confluence with the Colorado. It may rise in New Mexico's Mogollons, he conceded, but the Gila is chiefly an Arizona river. Lockwood also saw the book lacking in "organic principle," its "proportion and balance" not that good. Instead of the chapters being "bright marbles in a bag," they would have been better conceived as "a cluster of grapes on its parent vine."

Lockwood also considered the chapter on Tom Lyons, which attracted such controversy from within Lyons's family, to be "extraneous in both spirit and matter." Lockwood thought Lyons "a sensational resident of Silver City" but "insignificant as an individual." Someone said Calvin's problem with the Lyons clan was that he had provided "an unvarnished account" of the man. Lyons might have been colorful, but he did not do enough in developing the cattle industry and the Southwest to merit the attention he received. Lockwood suggested other subjects more worthy of inclusion, most of them from Arizona. Lockwood tempered his criticism by acknowledging that Calvin was "an original thinker" about the Southwest and that he knew of "no other book that contains so much in so little" and was so delightfully written.

The Tom Lyons sketch, in fact, brought cries of outrage from his family as "a cruelly false and distorted account." Lyons's family would have agreed with Lockwood that the chapter should have been omitted, but because they thought it defamed their kinsman. "It was with horror and amazement that I read your outrageous chapter," read one charge.

Calvin's depiction of Lyons was a perpetuation of "a cruelly false and distorted account," said another. "A vicious article of truths [perverted into] half-truths, insinuations, and prevarications," said still another. These observations are illustrative of the outrage voiced much later by Lyons relatives Ida Foster Campbell and Alice Foster Hill in their *Triumph and Tragedy: A History of Thomas Lyons and the LCs* (2003).

River of the Sun engendered misstatements and misunderstandings from still other sources. A history of the Church of the Good Shepherd notes that Calvin published *River of the Sun* to pay for a furnace for the rectory to keep his family warm. The book came out in 1946; the Calvins had departed Silver City in January 1942. Many years later, Calvin recorded having installed a gas furnace in the rectory on November 4, 1936, with the notation that "we paid for it!" The church history also alleges that a parishioner had obtained an injunction to stop Calvin from selling any copies. There is no record of such. Perhaps the church historian was thinking of the time an attorney for the Lyons family advised them to avoid doing anything that would make the book more widely read.

Calvin had soldiered on, and his perseverance made it worthwhile. In writing of the Gila, he became its tutelary. The inspiration the book engenders bears that out. The Gila is a treasured source of live-giving water for Arizona and New Mexico. Its history, beauty, and mystery attract people of all backgrounds—artists, hikers, outdoorsmen, and those seeking solitude and quietude. Today, as New Mexico's last wild river, the Gila is a magnet for those who would tame it for their use but equally a source of passion for those who would leave it as it is. It has an important place in the region's collective psyche.

Bill Toth, professor of English at Western New Mexico University, who writes on Southwestern literature, believes the Gila still has not received the literary acclaim it is due. "Other Southwestern rivers have their literary champions," he notes. "The Gila . . . has precious few." Many authorities believe the Gila to be "the quintessential" Southwestern river, he observes. With its own ecosystem, the Gila is "unique" in its ecology: "There's really nothing else quite like it in all of the American Southwest . . . [and] yet so few have written about it competently." Among Toth's "few" are Edwin Corle, author of *The Gila: River of the Southwest* (1965), and M. H. "Dutch" Salmon, long a defender of the Gila, who has written *Gila Libre!* (2008) and *Gila Descending* (2009). Toth calls Corle's Gila "a fine book," but believes *River of the Sun* is "the better" of the two. He further argues that *River of the Sun* and *Sky Determines* are two of the "most critically important investigations" of Southwestern ecology and human history ever written. "Nothing surpasses them." In Toth's view, Calvin has "long deserved" more critical attention than he has received.

The Books of the Colorado River and the Grand Canyon: A Selective Bibliography (1953) praised *River of the Sun* for its "unusual insight" into the character of the region. In 1958, *Arizona Highways* included it in *A Southwestern Century: One Hundred Definitive Books Which Best Tell the Story of the Southwest*, compiled by Calvin's champion Lawrence Clark Powell. Thomas C. Donnelly, later the tenth president of New Mexico Highlands University, predicted that *River of the Sun* "will live a long time."

Sometimes I Look at Sunlight

Hiram Lewis

Sometimes I look at sunlight
hitting the ground and reflecting up into a tree, and
I fall down.
I forget for a moment how to walk.
I lose my balance even though I feel in perfect accord
with nature humming all around me.
I bought a dog
I thought a dog might aid me, might keep enough of my attention
to avoid bruises.
As we passed a field of grass
bent over with the dew's weight. Each blade held a single drop
which falling catapulted fine spray into the dawn.
The dog and I fell down,
and the field rose like mist.
The field rose like mist,
as the dog and I fell down.

Walking Boston Hill

Hiram Lewis

Every morning, just before sunrise, my dogs, Zelda and Conan, and I walk Boston Hill. I have the entire Gila Wilderness, yet I'm satisfied with the many paths and permutations of Boston Hill. I have seen deer, snakes, horned toads, coyotes, javelinas, tarantulas, a coatimundi, birds, and a couple of years ago I saw many black chipmunks that looked like pieces of burnt paper sailing among the rocks.

Zelda lives to meet other dogs to play with or to find carrion in which to roll like a teenage girl at a Nordstrom's cosmetic counter. Conan lives for bicycles and runners, whom he tries to herd. He waits for them to pass, then he closes fast nipping at heels and barking frantically. Conan is not very popular. A man the other day thought I should put him down. I thought that if I'd had a pistol I could have drawn and shot Conan through the head there on the spot. I wonder if the man will open his mouth in the future.

Last fall we came across a woman with three dogs. Two were very friendly and enthusiastic. The other was a dignified Greyhound rescue. One, a playful bitch, jumped on me and raked my leg, which, because of my aspirin regime, bled freely. Blood was running into my shoe, so I grabbed some dry grass and slapped it on the wounds. I had little hope that this would help, as turmeric did little and toilet paper was less than useless. I held the grass in place for ten seconds and let go. It stuck and the bleeding had stopped. I brushed the grass off my leg. Not only had the bleeding stopped, but the cuts were closed. I collected a pocketful and put it in a jar. I wrote "clot grass" and "blood clot" on the jar.

No one was able to name the grass for me. Everyone had a different name, yet it seems to be the most common grass on Boston Hill. It is distinctive. It starts as a small bunch. As it ages the center dies and the outer edges spread like a wildfire, creating circles, ovals, and at times, designs as intricate as a Mandelbrot set, with coastlines as convoluted as any coast on earth. The other day I called it Jesus grass. A man told me that he once knew its name but could not bring it to mind. Another man said it was bunch grass, another deer grass, and another, round muhly. My friend John, who illustrated botanical books, said that grasses are extremely complex.

I finally made it to the library. On page twenty-three of *Common Grasses of Grant and Catron Counties, New Mexico*, I found it. Ring muhly, ringgrass, *Muhlenbergia torreyi*, "a tufted perennial grass 10 to 30 centimeters tall . . . Stems slender, curving upward to erect from a reclining base."

Perhaps all the muhly grasses have similar astringent and anti-inflammatory properties. I don't know. I do know that none of them are touted for that. Yarrow is given kudos. Turmeric has a large following. I have tried turmeric and it does not work well; it is sloppy, unsightly, and messy. Turmeric makes you look sick and diseased. Styptic pencils sting and are not reliable. Yarrow leaves I have not tried, yet I cannot imagine that they work more efficiently than ring muhly, and yarrow is not a native plant in the Southwest.

Ring muhly stanches bleeding within seconds, closes the wound, and promotes healing faster than anything I have ever seen. There is no scientific analysis on my part. My observations and conclusions are purely pragmatic. If you live in the Southwest between four and seven thousand feet in the Pinyon-Juniper zone, you know of this grass. If you are a rancher, you dislike this grass. It indicates that you have overgrazed your land. It is poor feed for your cattle. Still, it can save your life. I have not tried it on arterial bleeding, but I have faith in it, hence the name Jesus grass, but back to the hill.

Boston Hill is a complex of hills that cover about nine square miles. This area lies a few blocks east of my house on Bremen Street in Silver City, New Mexico. Silver City is nestled 6,000 feet high between the Burros, both Big and Little, to the south and the Gila Wilderness to the north. The Kneeling Nun wobbles in the east propped up by Freeport-McMoRan's Chino Mine, a large open-pit copper mine. Boston Hill was another mining site. The earth was ripped open and despoiled, then ignored and left unclean.

There is not much mankind can do with such a place, but Nature has a better imagination. She reclaimed the hill. She decorated the wounds with new vegetation and softened the scars. She gave the area back to animals and to the folks who hold their worship there.

Occasionally the town becomes liability-conscious and drives a bulldozer up the hill to fill a mine shaft or two. Mostly officials are content to surround the shafts with chain-link fences, all of which have been broached. The place is a haven and a hope for would-be suicides and close-to-home nature walkers alike.

I have walked the hill for almost fifteen years. I have seen heavy rains, graffiti, remains left by poachers, and trail crews. There is a labyrinth on the hill made from carefully placed rocks. This clever construction lies in a spot that becomes a pond during the big rains and then only the stone tops of the maze peep out.

I have painted four oils and hundreds of quick loose watercolor sketches on Boston Hill. I've painted the Hurley stacks and the void left after they were taken down. The stacks had been left over from the Kennecott smelter. They dominated the town of Hurley and provided a welcoming landmark for people driving from Deming. Now, when I look east toward Hurley, I feel a wrongness as though something were forgotten or overlooked.

Many residents of the area believe that Boston Hill was

known for silver mining. This is not true. There was scant silver on Boston Hill. The big silver was at Chloride Flat and Fleming Camp. According to Joseph Gendron, in his "Boston Hill Mining History," the mines on the hill provided the flux for the smelter furnaces in the form of manganiferous iron ore, which turned out to be very important to the steel industry, and Boston Hill was raped repeatedly during World Wars I and II. The ore was ripped from the hill from 1916 until 1970. A major staging point for the ore was on the east side near the cemeteries. This site is still messy with black dust that my dogs track into the car.

Beyond the nasty dust are gravel paths that wander through a complex maze gouged from the earth. These paths eventually connect to the main path that circles the hill. Near the center of the hill is a vast cut that runs from south to north. A trail runs through this and is the last refuge for snow on the rare snow days. This trail has a steep scramble, and I would suggest that it is safer to move from south to north than the reverse.

Golden eagles, turkey buzzards and other large raptors sail silently above. Ravens make "tok tok" noises and strange gurgles as they fly by. If you walk at night you can hear owls calling each other. The coyote pups yip wildly in the spring, snug in their lairs, and once a mother coyote came out and warned my dogs away with frantic ugly staccato barks.

As you look across the town, veils of rain can sometimes be seen. If they evaporate before hitting the ground they're called virga. They are especially beautiful when colored by a sunrise or sunset.

The other year I saw my first tarantulas on Boston Hill. I had seen their little round holes but did not know what lived there. The people I asked were unsure. Finally I saw two males standing on the edge of the trail, just hanging out. Males are easy to spot because females are shy and seldom seen. You would be safe pointing at a tarantula and saying "he." I thought these two should move for their own safety, but they had different ideas. Every time I moved one he would stomp back to his original position.

A couple of days later I came across a male eying one of the small round holes. He approached and, raising his two front legs, brought them down to tap near the mouth of the hole. He did this a number of times and I caught a glimpse of dainty tarantula feet near the mouth of the hole. The male knocked more impatiently, but the lady retreated and would not be wooed.

Tarantulas worry me. A few years ago my wife and I were returning from Tucson. We had turned north at Lordsburg onto Highway 90. The road appeared to be covered with leaves that flew up into the air with each passing car. To my horror I realized each leaf was a male tarantula moving east to west across the road. I stopped and tried to throw the suicidal spiders across to the west, but they would turn and start back, possibly confused by the flight through the air or perhaps merely stubborn. I got back in the car and tried to dodge them over the next five to ten miles. This did not help at all. If I missed one I hit another.

The Boston Hill area changes daily. It often becomes very cold and the moisture in the hill expands and squeezes out, forming small white curlicues. Snows grace the hills a few times a year and the dogs tear through it. Their eyes are bright and festive. The yuccas wear white caps like Cossacks, and the trees glisten in the sun. Sometimes, in the spring and summer, the grasses appear lavender, greyish green, bluish, all in layers like an expensive cocktail.

The junipers change in the spring. The males blush a rusty red and send pollen out to their surrounding harems. Each reddish tree is circled by a number of green females. When it rains the hill is awash with the smell of juniper, pinyon pine, and aged dog waste, which adds a subtle organic spice. If the monsoons come steadily the grasses grow tall and green. Everything changes in the fall. Plants that looked like other small shrubs and weeds become unique in their seediness. They change colors, odors, and entire appearances. The tall grasses sport silvery seed tufts, so that the slopes appear to be on fire. One area of the hill, up from Cheyenne Street, actually caught fire in 2011. Yuccas could be seen bursting into flame like bombs, and the area smelled like a burnt-out campfire when the fire was over. I wandered the clear areas looking for unusual rocks but they were pretty much the same as the usual rocks. Everything was in shades of black, with occasional green tufts scattered throughout. A year later browns and greens predominate, and the smells are again clean and sharp. The hill seems infinite to me. I love the hill.

Two Poems

Bill D. Toth

Willow Mountain

On the east side of Willow Mountain
the bones of a Forest Service mule
lie scattered near the trail that leads south
to Whitewater Baldy.

In this sky island
firs, spruce and aspens
bear mute witness.

Beyond the bleached bones,
just off the trail,
you see the tree tops sheared
in the shape of a trough,
ragged fractures missing crowns.
Each trunk shorter than the next one to the east.

Then you see why:
The tangled aluminum reflecting the October sun,
the perfect nose wheel still holding air,
a seat, a fading tube of toothpaste,
cylinders with frozen pistons, Plexiglas shards,
and one stained sleeve of a knit shirt
twisting on an aspen snag.

What happened here?

Two years ago
three drug dealers stole this plane in Oklahoma
and headed toward their Phoenix connection.

They didn't make it. Not enough fuel.
This time, no easy money.
The engine still, the plane dropped like a dead goose
slicing silently through the cold night sky, before
crumbling like foil
into the indifferent mountain.

That winter black bears, coyotes, and—I hope—a few wolves
found a windfall of easy protein.

The next spring the Forest Service packed out
a small section of the tail with identification numbers
and also what was left of the three men,
tied snugly to the sides of patient mules.

Witnesses

(for Riley Olsen and Sonya Dixon)

On the east flank of Willow Mountain
at ten thousand feet,
the sky is bluer than you remember.
On the east flank of Willow Mountain,
tiny Bead Spring pushes the Gila River out of the mountain
and on its journey.

It's forest here.
Hudsonian zone.
Blue spruce with furrowed bark so thick
you can dig your fingers into it.
There's fir too. And Engleman spruce,
green year round.

But in the southern Rockies
the aspens own early October.

As we walk the Crest Trail,
the trees divide for us.
A golden canopied corridor—walled by translucent grey trunks.

The aspens hold the summer fullness
of their leaves,
flame orange, yellow.
Waiting till the time is right.

Today is that time.
When sun, sky and wind
converge in a golden ecstasy
of perfect energy.

And then Sonya walks through this cascade of twirling colors.
Riley and I walk maybe twenty yards behind,
out of the picture.
But we see this:

A shower of flame descending
in a wild chaotic orgy of yellowredorange
orangeredyellow. Each leaf perfect and just
where it should be.

Just then Sonya stops, looks up, motionless
and dissolves into what must be
a fine and quiet madness.

Riley and I stop too.
With this, who could keep walking?
I start to say something—it doesn't matter what—but stop.
Riley doesn't need to hear
anything. We just stand and watch.

Today on the east flank of Willow Mountain
we are mute, dumb-struck, crazy accomplices
beyond the reach of any language.
Today on the east flank of Willow Mountain
we witness this poem.

Isla de Gila: M. H. Salmon and the Preservation of the Gila River

Bill D. Toth

The Gila National Forest, the Gila Wilderness, and the Aldo Leopold Wilderness of southwestern New Mexico—and across the state line, the Apache National Forest in Arizona—form one of the nation's most extensive contiguous ecosystems. With elevations ranging from close to 11,000 feet to 3000, the Gila—as locals call it—is a high, cool, moist sky island surrounded by desert and grasslands. And through the heart of this island flows the eponymous Gila River, the only undammed river in New Mexico and one of the few free-flowing rivers in the entire American West.

And it's big. Visualize the state of Massachusetts. The Gila ecosystem—approximately 5.1 million acres or roughly 7800 square miles—is just slightly smaller than Massachusetts. This is country that could easily absorb Aldo Leopold's signature fourteen-day pack trip.

Although three lesser rivers—the Blue, the San Francisco, and the Mimbres—occupy some of this range, it's the Gila River that defines the entire region. From its source, Bead Spring at 10,000 feet elevation on the east flank of Willow Mountain within the Gila Wilderness, the Gila threads its way east, south, and eventually and terminally west for nearly 300 miles, spanning five life zones. Finally, more than 7000 vertical feet later, its physical and spiritual energies depleted by the Coolidge Dam and San Carlos Lake near Safford, Arizona, the Gila simply dries out and gives up its watery ghost, nearly 300 miles short of its original terminus, the Colorado River at Yuma.

However, in New Mexico, in a landscape likewise characterized by searing aridity, the Gila River for the present time is indeed a healthy, lusty, wild river—and an island of verdant riparian vitality and the home of staggering biodiversity. Its three high-elevation branches, the west, middle, and east forks, flow through forests of aspen, spruce, and fir. Damp moss and ferns as long as your arm are common. Not surprising for a biome that receives nearly 40 inches of precipitation per year.

Below 6000 feet, the Gila becomes a green ribbon slicing through grasslands and canyons of bare stone, and lower still, it winds its way through the Chihuahuan Desert's dry undulating hills of mesquite and prickly pear. In short, in its physical and psychological dimensions, the Gila River, as well as its surrounding watershed, is indeed a literal and metaphorical island of diverse flora and fauna. Whether it's at 9000, 6000, or 3000 feet, this river—at least in New Mexico— is always a place apart from its general arid surroundings. High, wet, and cool in summer; high, white, and cold in winter. On an average July day in Phoenix it'll be 115 degrees Fahrenheit. At Bead Spring, nearly the same latitude, it's 75.

In his 1946 classic, Ross Calvin referred to the Gila as "the river of the sun" and called it the quintessential river of all the American Southwest. Five years later, Edwin Corle wrote that "the Gila is literally *the* river of the American Southwest." However, arriving in Silver City back in 1928, well before Corle, the good Doctor Calvin was the Gila River's first champion. Today, there is another.

This man is Silver City's own M. H. Salmon—writer, outdoorsman, conservationist, and arguably the Gila's most visionary and realistic advocate. Through three first-rate books, the novel *Home Is the River* (the first of his Gila trilogy) and two works of nonfiction, *Gila Descending* and *Gila Libre!*, Salmon demonstrates his understanding of the river's numinous spirit and its ecological importance. Simply put, no one anywhere knows more about this river. If you accept this riverine ecosystem as an island in the desert, then Salmon is indeed the Prospero of *Isla de Gila*. This is his *querencia*, and he has devoted much of his life to preserving it through his writings and his work with various commissions and conservation organizations. Sadly, Salmon's writings and his work on behalf of the Gila remain almost unknown to the larger environmental community. This paper, I hope, will help change that.

I've always felt that in order to save something you first have to love it. And someone, I don't remember who, maybe Ed Abbey, once said that you can't really love anything without fully understanding it. If that's the case, then no one is in a better position to save the Gila River than Salmon. Both of his nonfiction books illustrate my point.

To write *Gila Descending*, Salmon traveled the entire river from its trickle of a beginning to its very end, a journey close to 300 miles. Like John Graves and his *Goodbye to a River*, Salmon wanted to see all of the Gila before it was lost to jet skiers and crowded beaches. Think Glen Canyon on a smaller scale, and you get an idea of what was at stake.

Of course, the "surface" justifications for the dam, i.e., recreational opportunities and revenue from concessions, are just that—superficial. The less visible but far more insidious motivation for damming the Gila water is real estate development in the Phoenix area, plus a few million dollars to be made by local New Mexico businessmen. After all, where do you think all that conspicuous water evaporating from those showy fountains in Phoenix comes from?

So Salmon hikes to Bead Spring in the Hudsonian life zone, and begins his journey. Like all good river writing—Abbey's "Down the River" chapter in *Desert Solitaire* and Thoreau's *A Week on the Concord and Merrimac Rivers*, for example—the actual trip provides structure to the book, and its three major sections, subtitled "Sierra del Gila," "Whitewater Gila," and "Desert Gila," capture the essential narrative

trajectory from moist, cool, high country to a mid-elevation river with challenging rapids, and ultimately to a sinuous, slow desert river. However, the substance of *Descending* is Salmon's musings on one topic or another as he saunters along the ever-growing creek, eventually trading in his hiking boots for a Gruman canoe.

The final two-thirds of the book chronicle the journey of Salmon, his dog Rojo, and his cat, as they float their way from the confluence of the three forks to central Arizona where the river is effectively killed by the Coolidge Dam. Along the way, Salmon discusses a host of subjects, ranging from catfish bait to the thorny practice of public lands ranching, and—most important—the intrinsic value of the Gila as an undammed river. After all, New Mexico has six significant rivers—the others being the Rio Grande, the Canadian, the Pecos, the San Juan, and the Chama—and Salmon claims he is "hoping to preserve in its natural state just *one river* out of six. . ." (p. 140).

Salmon ends his book with a brief epilogue in which he reflects on his recent experience and concludes in Thoreauvian fashion that "what you can learn on a river trip is nothing you couldn't have learned long ago on a good day with your eyes wide open" (p. 210).

It's with this "eyes wide open" stance that Salmon launched into *Gila Libre!*, published in 2008, a book that is both a celebration of the Gila and its surrounding wild lands but also a warning of possible dark times to come. But *Libre!* is not a redux of *Gila Descending*. Since there's no river journey to provide a cohesive structure to the book, Salmon instead deftly orchestrates seven informative essays, each one focusing on one aspect of the Gila.

As a celebration of the river, the book reminds us that the Gila determines an astounding biodiversity in large portions of two states. While some folks living in southwestern New Mexico may take the Gila River and its watershed for granted, Salmon doesn't. He knows no river in the American West is safe from one form of impoundment or another.

Gila Libre! also reveals Salmon's realist's bent. He understands people's materialistic maneuverings and warns us that there will be more attempts to dam the river because many people view a free-flowing river as a waste of money—dollars just flowing right on by and into the pockets or bank accounts of someone else farther downstream. To wit, the signing of the Arizona Water Settlements Act in 2004 authorized $66 million for New Mexico's four sparsely populated southwestern counties and, ominously, another $62 million if "a Gila project" is built (p. 124).

Alas, the equation of impounded water and money typifies the old way of thinking of natural resources—and water in particular. Just as Leopold challenged his boss Gifford Pinchot's "highest and best use" dictum, Salmon argues for a new paradigm of "western water management [where] instream flows do have values, economic as well as aesthetic, and sometimes birds and fish and a river running pay off better than one more banal subdivision" (p. 124).

Reading *Libre!* is a bit like canoeing the river with Salmon. This is not slow, flabby water; rather, it's a lean athletic river much like Salmon's style. While the writing is neither sentimental nor preachy, Salmon's polemics are incontrovertible: the Gila is not a commodity but a living river with intrinsic value not measurable by acre feet of water rights or revenue.

That said, my favorite of Salmon's Gila books is the novel, *Home Is the River*. It's the story of one Harley Simmons, a thirty-something man struggling with personal demons and at the same time trying to prevent a proposed dam on the Gila. Superficially, the narrative follows Harley's struggles to come to terms with his divorce and his reluctance to accept the love of Suzie Navarro, a woman he has been seeing casually for some time. He is, you might say, confused.

There is, however, one area of his life where there is no confusion, and that is Harley's relationship with the Gila River and its wild country. What Harley lacks in the relationship department seems offset by his love of the wilderness north of Del Cobre, New Mexico—really Silver City. It's a love fostered in part by his anachronistic hunter/trapper father who early on tells Haley that "There's no place else you can see an elk and a javelina, a red squirrel and a coatimundi, all on the same day" (p. 7). However, the area the old man speaks of is imperiled because, as the elder Simmons cautions, "the water that runs right by our camp, that's all wasted water. A river that runs free, some people can't stand that . . . what they do is build a dam and put that water to use" (p. 8).

Salmon is not resorting to his imagination when he writes of the threats of damnation of the Gila. Due in large part to the Central Arizona Project of 1968, the waters of the Gila River became an irresistible temptation to local developers and politicians. Consequently, the 1970s and the '80s saw two attempts to impound the Gila's water: first the Hooker Dam and later the Connor Dam. In the latter instance Salmon was instrumental in galvanizing public resistance, and in 1982 he cofounded what eventually became known as the Gila Conservation Coalition, the first viable grassroots environmental organization in New Mexico.

But . . . back to our story. Harley's personal journey is defined by two critical epiphanies. The first is related to his guiding a wealthy out-of-state customer on a bear hunt up in the Gila high country. After an exhausting chase with his hounds, he practically has his bear, but by this time his client is too pooped to finish the job, so Harley kills the huge black bear himself. Then in a scene reminiscent of Leopold's dying wolf episode, Harley stands over the dying bruin as it lies "childlike and astonished as the life of him pumped out" (p. 105). And then—WHACK!—it hits Harley like the kick of a .300 magnum, and "there came that sickness that grabbed his stomach and twisted his gut and caught in his throat and he could no longer look at the bear. He turned away and dropped to his knees, folding over on himself, feeling that he must puke or cry, and knowing he would do neither but . . . be sick of himself over what he had done" (p. 105).

For Harley, this is a transformative event, but it does not lead to redemption, not just yet, anyway. He continues to be torn between his loyalties to his "old" family and the scary prospect of his "new" one with Suzie. As a result, he is at home in neither. So he decides to end his life by getting good

and drunk and then lying down in a blizzard. But the Gila is in the southern Rockies; it just wasn't cold enough. The next morning Harley wakes up sober and chilled to the bone but still resolved to finish the job. This time he crawls deep into a remote cave to put a bullet through his brain.

Fortunately, to make sure he's not bitten by a denned-up rattler—not the way he wants to go—Harley lights a match to make sure his final resting place is snake-free. There are no snakes, but he sees something else of profound significance: he sees the decades-old desiccated remains of six wolf puppies "huddled in a heap" (p. 184). Obviously, Harley would have realized this may have been the last litter of gray wolves whelped in the Gila, their parents very likely killed sometime in the late 1940s or early '50s. It's not until he blows out his match and lies there in total darkness that Harley, finally, is able to see. Now, he knows what he has to do, and it has nothing to do with taking his own life.

Soon after, Harley decides Suzie really is the woman for him, and immediately after their reconciliation, he and his two sighthounds head to northern Minnesota, where he buys a trapping license, rents an old farm, and lives the life of a solitary fur trapper. And while Harley does indeed get his share of prime pelts—coyote, fox, fisher, bobcat, and lynx—he has a bigger catch in mind, and he wants more than just fur.

With more than 2000 wolves alive and well, Minnesota, Harley figures, can afford to part with two. So after obtaining canine tranquilizers from a veterinarian, Harley sets off into the frozen landscape and soon identifies an alpha male and a healthy female who, if nature had taken its proper course, would already be pregnant with the alpha's pups. Once he's sure this is the pair he wants, he unleashes Lurk and Geraldine, his prized coursers, and the race is on. Once the female is caught by the dogs, Harley quickly pounces on the wolf, tranquilizes it, tapes its paws together, places her in the camper compartment of his truck and heads back to the farm, where he'd already built a holding kennel. A week later, he catches the male in the same fashion, and not long afterward the pups come. Then, with $4600 from his pelts and his contraband safely in the back of his truck, Harley heads home to the Gila country, where he secretly releases the wild canids in the same cave he nearly died in. As he releases the big male, Harley offers him some human advice:

> Now listen here, Big Boy. . . if a wolf can't make a go of it in this country, there's something wrong with him. . . . there's plenty of game so don't kill too many cows. . . . you just take a run at being what you are, a wolf, and make this country your own. This is wolf country. . . . Take care of your family. They'll need you. These days, we all need you. (p. 239)

Later, Harley tells a wildlife biologist friend that he "thinks" he might have seen wolves in the Gila; the biologist eventually confirms the sighting, and the dam construction is halted—thanks to the federal Endangered Species Act. A Hollywood ending? Not exactly.

Unlike a basketball game whose final buzzer means it's all over, the fight to preserve the Gila River in New Mexico is unending. As long as the water is still there, one group or another is going to try to profit from it. Any victory for conservationists, in this respect, is predictably short-lived. Free-flowing water is just too tempting.

So the schemers and speculators—along with their politicians—will still be here, but so will Salmon—or at least his books—and after him we hope there will be others. If we're lucky, Salmon's final sentence in *Gila Libre!* will prove to be a prophetic one: "Perhaps the most unlikely place for water will be the last to give it up."

Session Abstracts

A Framework upon Which More Data Might Be Hung: 125 Years of New Mexico Botany and the Rise of *Flora Neomexicana*

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A comprehensive manual of New Mexico botany has been an elusive quarry since 1890, when E. O. Wooton set up shop as the territory's first resident botanist at the fledgling New Mexico College of Agriculture and Mechanic Arts. His almost immediate immersion into floristic studies of the state-to-be finally resulted in the prestigious and still very useful *Flora of New Mexico* in 1915, in collaboration with Paul C. Standley. In a now forgotten work, Ivar Tidestrom and Sister Mary Teresita Kittell reunited the former territories in the 1941 *Flora of Arizona and New Mexico*. The evolution of a state floristic manual took a giant leap (in size and weight) with the humongous and hefty *A Flora of New Mexico* by William Martin and Charles Hutchins in 1980 and 1981. We began our work on the New Mexico flora in 2008 with the *Flora Neomexicana* series, initially in three separate volumes: a checklist, a glossary of scientific names, and an identification manual. We have now begun work on a concluding and comprehensive final work, *The Complete Flora Neomexicana*, wherein all the information in the previous volumes will be brought together into a single work, with brief descriptions, synonymy, comments, maps, and illustrations.

The Role of Fish Migration Barriers in Conservation of Gila Trout (*Oncorhynchus gilae*)

James Brooks[1], Andy Dean[2], Joseph McGurrin[3], Jerry Monzingo[4], Dustin Myers[4], David Propst[1], Thomas Turner[1], and Jill Wick[5]

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Isolated reaches of headwater streams of the upper Gila River basin in the Gila Wilderness constituted the only known habitat for Gila trout (*Oncorhnychus gilae*) by the early 1950s. All populations then known occurred upstream of natural waterfall barriers or intermittently dry reaches that prevented or minimized upstream movement of non-native salmonids, primary threat to species survival at the time. Recovery efforts from the early 1970s through the mid-1980s centered on construction of artificial fish migration barriers to establish new or protect existing Gila trout populations. In the late 1990s, recovery emphasis shifted toward establishment of Gila trout from multiple source populations into larger stream systems. Recent wildfire impacts to streams of the Gila Wilderness and associated loss or severe reduction in genetic diversity of several Gila trout populations highlighted the need for conservation efforts to expand beyond isolated headwater streams. The upper West Fork Gila River drainage above a natural waterfall barrier is the prime example of the shift in recovery strategy; mixed results of recovery efforts there are discussed. Isolated headwater populations of Gila trout remain important to species survival and protection of genetically unique populations. Reliance upon fish migration barriers remains integral to Gila trout conservation.

Take Back the Rain: Stream Dynamics and Urban Water-Harvesting in Silver City, NM

Van Clothier and Claire Catlett

Stream Dynamics, Inc., Silver City, NM, www.streamdynamics.us

Urbanization has changed how water drains from the landscape in our cities and towns, and has created new subsets of the natural watershed: the urban sub-watersheds in which streets, roofs, parking lots, and storm systems collect stormwater, altering water flow, transporting contaminants, and impacting the health of our waterways. Stream Dynamics, Inc., is a local business that is guiding our community on how to take back the rain and work with nature through rainwater harvesting in order to beautify our neighborhoods and improve watershed health while turning nuisance stormwater into a valuable resource for the community. Stream Dynamics has been awarded $138,220 by the New Mexico Environment Department for the San Vicente Creek Urban Watershed Restoration project. We are building 80 water-harvesting projects to improve stormwater management, water quality, and overall health for the San Vicente Creek watershed. With water harvesting, urban ecosystems can see reduced flooding, improved base flow, lower water temperature, and a more beautiful environment for people as well. By restoring the San Vicente's watershed, Stream Dynamics is integrating the constraints of the modern-day built environment with the natural watershed's needs. This shall serve as a practical model for other urban streams in New Mexico and the Southwest.

Fluvial Geomorphology of the Gila Box Riparian National Conservation Area in Southeastern Arizona: Historical Perspectives and Today's Condition Assessment

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The Gila Box Riparian National Conservation Area was recognized by Congress under the Arizona Desert Wilderness Act of 1990 to protect 23 river miles of riparian area in southeastern Arizona. It is managed by the Bureau of Land Management (BLM) Safford Field Office. The 1998 Gila Box Management Plan called for deferment of livestock grazing for the life of the plan. In 2013 the BLM partnered with Eastern Arizona College to develop a Living Rivers Program for the Gila Box. College interns have assisted BLM staff with inventory and condition assessment monitoring for each one-mile segment of the Gila Box. Monitoring protocol addresses recovery of the river toward meeting interagency Proper Functioning Condition Standards and identifies causal factors for not meeting standards. Concurrently, the Living Rivers Program was tasked as technical advisory to the Gila River Rapid Assessment Monitoring (RAM) work group to develop RAM protocol for the upper Gila River in New Mexico. This paper addresses a historical perspective of the Gila Box, current condition assessment issues, and Gila River RAM protocol for New Mexico and how it addresses monitoring needs downstream in Arizona.

The Pitchfork Ranch: Restoration and Climate Change

A.T. and Cinda Cole

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Wes Jackson has said, "We live in the most important moment in human history." Habitat restoration has been the main focus of work on the ranch for more than a decade; wildlife habitat and endangered species are an equally important focus. Now our goals include the sequestration of carbon. The talk will include a five-minute drone video summarizing the presentation on ciénagas given four years ago, the status of restoration via satellite imagery of remote sensing based on wetness linear trend analysis, slides of typical grade-control structures, and two new techniques and examples of New Mexico restoration projects ranging in size from residential rental property to 200,000 acres.

Restoration at Moreno Springs

Martha S. Cooper

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The goal of this project was to benefit the recovery of Chihuahua chub and Chiricahua leopard frog, both federally listed as threatened species. Threats to the chub and frog are similar and include predation by non-native organisms, fungal diseases, drought, floods, and degradation and loss of habitat as a result of water diversions and groundwater pumping. Recovery efforts for both species include habitat restoration and protection. The objective of this project was to restore and enhance wetland, riparian, and upland habitat on The Nature Conservancy's Upper Mimbres River Preserve by removing sediments from the springs and invasive woody plants from the uplands. Since 1994 Moreno Spring has experienced an increase in riparian vegetation and a reduction in open water habitat. The pools are slowly filling in with organic debris, and fewer chubs inhabit them now than historically. In spite of limited habitat, Moreno Springs hosts an important population of Chiricahua leopard frogs. The Conservancy and numerous partners designed and implemented habitat improvements. A trackhoe excavator removed silt and debris from Moreno Springs, creating 14 open-water pools. The excavator removed some mature willows and deepened pools to a depth of 1–4 feet. Photos and monitoring data will describe this restoration project.

Modeling the Survival and Movements of Band-Tailed Pigeons in New Mexico

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Survivability estimates and habitat suitability data are critical for effective species management. This project seeks to address the decades-long gap in current demographic and habitat use data to advance the management of New Mexico and greater Four Corners region Band-tailed Pigeons. Our goal is to establish a standardized population monitoring protocol through the novel use of passive integrated transponder (PIT) tag–based mark-resight survivability models. In 2013, we established a capture site located on private land adjacent to the Gila National Forest. Between 2013 and 2015, 318 Band-tailed Pigeons were banded and PIT tagged. Survival models are currently being developed and will be available by the date of the Symposium. Band-tailed Pigeon movement data were collected by satellite platform terminal transmitters (PTTs) fitted to four individuals in summer 2015. Fall migration routes and wintering ground locations will be presented, and represent the first ever collection of detailed migration data for Four Corners Band-tailed Pigeons. These data will also be used in conjunction with biotic and abiotic spatial habitat data to develop Band-tailed Pigeon habitat suitability models for the Gila National Forest. These models will be used to detect trends in bird habitat use in response to management practices and fire. We will also evaluate our suitability models to determine their ability to inform Breeding Bird Survey (BBS) route placement to better detect Band-tailed Pigeons.

Best Available Science as a Basis for Water Resources Management Decisions: A Case Study in the Arid Southwest

Ali Effati

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The New Mexico Interstate Stream Commission (ISC or Commission) has the responsibility to investigate, protect, conserve, and develop New Mexico's waters. In September 2004, the ISC formally adopted a policy when considering uses of water and funding provided to New Mexico, pursuant to the 2004 Arizona Water Settlements Act (AWSA). The three main tenets of the ISC policy were to recognize and mitigate any impacts to the Gila River ecology, to use the best available science, and to provide for current and future water uses. From 2005 to 2014, those tenets of the ISC Gila policy guided a deliberate and extensive evaluation process to acquire baseline ecologic, environmental, and technical information and data that would allow the Commission to make an informed and considered decision. This presentation focuses on this adaptive management plan, which provided a systematic approach to scientifically examine hypotheses and apply the information learned to support decision making.

Trees of the Gila Region of New Mexico: Diversity, Ethnobotany, and the Future

Richard Felger

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Carl Sauer said, "Man is the enemy of the tree." However, trees of the Gila Region Forest have been surprisingly resilient to human impacts until nowadays. This presentation provides a revised listing of the approximately 70 regional tree species and their uses, documented and potential, by people past, present, and future. (A revised checklist and identification key will be available at the conclusion of this presentation at gilaflora.com and other open-access venues.) Of special interest are urban and rural eco-services including food production and landscaping. Fit the tree to the land—go native.

Scientific Simulation of the Water Yield of the NM Unit of the Central Arizona Project

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Two models were prepared to fill the vacuum of publicly available quantitative analysis of the net yield of the New Mexico Unit of the Arizona Water Settlements Act. The models quantify the legally available water available to and produced for beneficial use by a New Mexico Unit of the Central Arizona Project. The first model, written in Excel, calculates the maximum yield of water legally available for diversion pursuant to the Terms of NM Diversions set forth in the New Mexico Consumptive Use and Forbearance Agreement (CUFA) using USGS daily average streamflow and reservoir storage data commencing in October 1936. The second model is based on mass balance principles and is implemented in Powersim Studio. The output of the spreadsheet model is the input to the mass balance model, which calculates, on a daily time step, reservoir storage based on daily diversion inflows, reservoir evaporation losses, reservoir seepage losses, and reservoir releases. Seepage is calculated using reservoir and regional groundwater heads and bedrock hydraulic conductivity. Even with the numerous conservative assumptions incorporated in the mass balance model, the modeling results show that the net yield will be a small fraction of the state of New Mexico's publicly unsupported assertion of 14,000 acre-feet per year.

Defining Ecosystem Water Needs and Assessing Impacts of Climate Change and Water Diversion on Riparian and Aquatic Species of the Upper Gila River in New Mexico

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The substantially natural hydrograph of the upper Gila River supports the largest complement of native fishes and some of the best remaining riparian habitat in the lower Colorado River basin. Changes to the river's flows may significantly degrade the aquatic and riparian ecosystem. The Arizona Water Settlements Act (AWSA) authorizes federal funds to build a New Mexico Unit that could divert up to 14,000 acre-feet annually. The goal of this project was to define the ecosystem water needs of the upper Gila River in New Mexico and to assess the impacts of the proposed diversion and climate change. To achieve this goal, a team of academic partners synthesized existing relevant scientific literature on hydrology, geomorphology, riparian vegetation, wildlife, and flow-ecology relationships and conducted new analyses of groundwater, vegetation, and fish data. A final report was completed in July 2014. An overview of projected impacts of climate change and water diversion on the ecosystem in the Cliff-Gila Valley will be the focus of this presentation.

Assessment of At-Risk Species Occurring in the Gila National Forest

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During the assessment phase of Forest Plan revision, an interdisciplinary team is tasked with identifying and assessing available information relevant to the Gila National Forest for at-risk species. At-risk species consist of federally recognized threatened, endangered, proposed, and candidate species, as well as potential species of conservation concern (SCC). SCCs are species other than already federally recognized species, that are known to occur in the plan area, and the best available scientific information indicates substantial concern about the species' capability to persist over the long term in the plan area. During development of the preliminary SCC list, information was considered from a variety of different sources, including, but not limited to, local knowledge, Gila National Forest data, NatureServe rankings, State of New Mexico Species of Greatest Conservation Need, Partners in Flight rankings, and New Mexico Rare Plants database. Criteria for identifying potential SCCs include species abundance, distribution, threats to persistence, trends in habitat, and responses to management. Relevant information about each species was evaluated to understand the ecological conditions needed to sustain them in the Gila National Forest. The resulting list of potential SCCs will be released for public review and will be updated throughout the revision process as needed.

Effects of Invasive Crayfish on Scarring in Narrow-Headed Garter Snakes (*Thamnophis rufipunctatus*)

Gregor Hamilton

Student, Western New Mexico University

Many freshwater ecosystems encounter stresses from climate change, habitat alteration, and invasive species. Species in freshwater ecosystems of the arid Southwest are particularly susceptible to these stresses. The narrow-headed garter snake (*Thamnophis rufipunctatus*) is a federally endangered piscivorous snake in southwestern New Mexico and central Arizona. This study evaluated the correlation between the presence of invasive species of crayfish (*Procambarus* spp. and *Oronectes* spp.) and the presence and severity of scars on three indigenous species of garter snakes (*T. rufipunctatus, T. elegans,* and *T. cyrtopsis*). To correlate scars with crayfish, four study sites with recent records of populations of these garter snakes (two sites with crayfish and two sites without crayfish) were chosen. Number and area of scars increased with snout-vent length for *T. rufipunctatus* and *T. elegans*, while no significant patterns were obtained for *T. cyrtopsis*. Number of scars for *T. rufipunctatus* increased with crayfish presence, while number and area of scars for *T. elegans* increased with crayfish absence. These results were likely influenced by catastrophic wildfire and associated flooding that have reduced or eliminated crayfish and gartersnake populations in three of four study sites.

New Mexico CAP Unit: Update on Progress and Next Steps

Sean Heath

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The Arizona Water Settlements Act (AWSA) is a complex web of agreements affecting the laws and policies of federal, state, tribal, and local governmental agencies and water management entities in Arizona and New Mexico. The AWSA provides an opportunity for New Mexico to obtain additional funding for development of water resources, including the diversion of Gila River water. This presentation provides a brief overview of the AWSA as it pertains to activities associated with implementation of several AWSA provisions in the Gila River basin, the Bureau of Reclamation's participation in New Mexico's planning process, and next steps resulting from the execution of the New Mexico Unit Agreement by the Secretary of the Interior and the New Mexico CAP Entity on November 23, 2015. The execution of the New Mexico Unit Agreement requires the Secretary to comply with all applicable environmental acts and regulations. This environmental review process will be conducted under the National Environmental Policy Act (NEPA), including the Endangered Species Act, the National Historic Preservation Act, and other applicable environmental laws and regulations. The Bureau of Reclamation, as the lead agency, will work through the NEPA process with the New Mexico Interstate Stream Commission as joint lead as required by the AWSA, with tribes, with other federal and non-federal cooperating agencies, and with the New Mexico CAP Entity as project proponent. The NEPA process will assess possible impacts and necessary mitigation efforts for NM Unit alternatives identified to meet water supply demands in southwestern New Mexico. As part of this NEPA process, the Federal Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies guidelines will be applied, examining technical, economic, and financial aspects of each alternative. The NEPA process will provide multiple opportunities for extensive dialogue with, and input from, stakeholders and the general public.

Creative Coloring: Dye Plants That Grow in the Greater Gila Region

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The roots, bark, stems, leaves, flowers, and fruits of many plants can produce long-lasting and vibrant colors when properly applied to sheep's wool fibers and vegetal basketry materials. From the 1,100 regional plants listed in Vascular Plants of the Gila Wilderness (www.gilaflora.com), more than several dozen provide potential dyestuffs. A number of these dye plants are well documented; some were once used in the American Southwest by pre-Columbian as well as Pueblo, Navajo, and Apache peoples. Others are known anecdotally, and still others have yet to be proved. In this illustrated presentation, we discuss Gila regional plants that could be developed for natural dyeing. Examples may include *Atriplex canescens* (four-wing saltbush) leaves for yellows; *Forestiera pubescens* (New Mexico olive) fruits for light gray; *Juglans major* (Arizona walnut) fruit exocarp (husk) for dark brown; *Prunus serotina* (southwestern chokecherry) bark for purplish brown; *Rumex hymenosepalus* (sand dock) and *Solidago* spp. (goldenrod) leaves and stems for oranges, golds, and browns; and *Rhus trilobata* (sumac) leaves and stems with piñon pitch and yellow ocher for bluish black. From ethnographic evidence and from our own and others' experimentation, we will describe processing of plant parts, application of mordants and dyes, and resulting colors that might be expected.

Plant Community Characteristics of Chihuahua Scurf Pea (*Pediomelum pentaphyllum*), a Rare Legume Petitioned for Listing under the Endangered Species Act

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The genus *Pediomelum* consists of a group of legume plants that are commonly referred to as Indian Breadroots, valued by Native Americans for the starchy, tuberous, fusiform taproot. One species in particular is considered quite rare and, although its historical collection range spans a distance from Arizona to Texas, it has been difficult to locate. Chihuahua scurf pea (*Pediomelum pentaphyllum*) was petitioned for listing under the Endangered Species Act in 2008, at which time only three known population sites existed, two in southeast Arizona and the other in the Bootheel of New Mexico. Under the supervision of Joneen Cockman, students from Dave Henson's undergraduate biological research class have been monitoring and collecting specimen and community data on this plant in three established grid sites of the San Simon valley. The largest of the sites saw 908 plants develop in the spring of 2015 in a 20 × 50 m study plot, making it the largest known find of scurf pea, thus providing a unique opportunity for information gathering, photography, and discussion.

Comparisons of the Population Status of Narrow-Headed Gartersnakes: Effects of Post-fire Flows and Introduction

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During the past 15 years, populations of *Thamnophis rufipunctatus* have declined in Arizona and New Mexico. In 2012 the Whitewater-Baldy Complex Fire burned ~500,000 acres in the Gila and San Francisco River drainages, including Whitewater Creek and Upper Middle Fork Gila River. In 2012, 18 *T. rufipunctatus* from Whitewater Creek were experimentally introduced to Saliz Creek. We evaluated the effect of post-fire ash flows at Whitewater Creek and Middle Fork Gila River, monitored introduced *T. rufipunctatus* in Saliz Creek, and monitored *T. rufipunctatus* along the Tularosa River. The presence of four subadult *T. rufipunctatus* along Saliz Creek in 2015 likely represents reproduction from the original propagule, and suggests introduction is a potential conservation tool. The loss of *T. rufipunctatus* from Whitewater Creek (following declines in numbers of snakes and their weights) and the low weights of snakes along the Upper Middle Fork Gila River indicate catastrophic wildfire and subsequent ash flow and floods are detrimental to *T. rufipunctatus* populations. Variables that might mitigate adverse effects of fire on *T. rufipunctatus* populations appear to be fire severity, position of fires within the watershed, and watershed complexity.

Monitoring Seeding Effectiveness on the 2014 Signal Fire, Gila National Forest

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The Signal Fire started on May 11, 2014, and burned approximately 5,500 acres in the southern portion of the Gila National Forest by the time it was contained on May 23, 2014. A BAER (Burned Area Emergency Response) team was assembled to assess post-fire conditions of life (human health and safety), property, and cultural and natural resources to recommend treatments if emergency conditions existed. Aerial seeding was recommended and implemented on 1,525 acres of high and moderate soil burn severity areas. A three-year monitoring study of treatment effectiveness was initiated to determine effects of post-fire seeding on site/soil productivity, natural recovery, species diversity, and erosion rates on two sites within the burn area. Two monitoring plots (seeded and non-seeded) were established, each with a rain gauge, two sediment catchment traps, cover frequency analytical plot transects, and photo points, and production data was collected. Methodologies and results from the first two years of this three-year study will be presented.

Monitoring the Threatened Mexican Spotted Owl on the Gila and Beyond

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Population monitoring is a critical part of the conservation strategy for many imperiled species. However, designing and implementing a monitoring plan that is effective and efficient across the range of a species can prove to be very difficult. The Mexican Spotted Owl (MSO) was listed as federally threatened in 1993, and in 2012, the MSO Recovery Team recommended an occupancy-based approach to monitor this species. Occupancy modeling is a relatively new statistical method to quantify a species' presence on the landscape while accounting for imperfect detection. In addition, occupancy estimation can be a more practical alternative to abundance estimation, which can prove logistically challenging. The Bird Conservancy of the Rockies, in partnership with the Southwest Region of the US Forest Service, is leading this MSO occupancy monitoring effort on Forest Service lands in Arizona and New Mexico. We present the design of our landscape-scale occupancy monitoring effort, the findings from the first two years of monitoring, and our plans for future analyses.

Current Status of the Mexican Wolf (*Canis lupus baileyi*) Recovery Project in Arizona and New Mexico

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Mexican wolves (*Canis lupus baileyi*) are the rarest and most endangered subspecies of gray wolf in North America. The Mexican wolf was extirpated in the United States in the 1970s and reintroduced in 1998 with the release of 11 captive animals into Arizona and New Mexico. Since then, the wolf population has steadily increased, and 2014 had the highest count, with 110 wolves and 19 packs. However, the original recovery plan, regulations, and management were limiting the goals of a sustainable, free-ranging, and genetically viable population of Mexican wolves. After 17 years of data and experience, the US Fish and Wildlife Service, in cooperation with agency partners, has been addressing issues by revising regulatory mechanisms as well as on-the-ground management.

Spatial Probability Models of Fire in the Desert Grasslands of the Southwestern USA

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Fire is an important driver of ecological processes in semiarid environments; however, the role of fire in desert grasslands of the southwestern United States is controversial and the regional fire distribution is largely unknown. We characterized the spatial distribution of fire in the desert grassland region of the southwestern United States, which includes a large portion of the upper Gila River Watershed. Our objective was to investigate the influence of soil properties and ecological site groups compared to other commonly used biophysical variables for modeling fire probability. Soil-landscape properties significantly influenced the spatial distribution of fire ignitions. Bottomland ecological sites (i.e., soil-landscape classes) experienced more fires than expected in contrast to those with coarse soil textures and high rock fragment content, which experienced fewer fire ignitions than expected. Influences of mean annual precipitation, distance to road/rail, soil available water holding capacity (AWHC), and topographic variables varied between ecoregions and political jurisdictions and by fire season. AWHC explained more variability of fire ignitions in the Madrean Archipelago compared to the Chihuahuan Desert. Understanding the spatiotemporal distribution of recent fires in desert grasslands is needed to manage fire and predict responses to changing climate.

New Mexico Wetlands Rapid Assessment Method (NMRAM): Lowland Riverine and Montane Riverine Field Guides and Analyses for the Gila Watershed

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The New Mexico Environment Department Surface Water Quality Bureau Wetlands Program is developing the New Mexico Wetlands Rapid Assessment Method (NMRAM) in order to classify and assess the condition of New Mexico's wetland resources. In December 2015, the NMRAM Field Guide and data collection worksheets were finalized for lowland riverine (Version 1.1) and montane-riverine wetland subclasses (Version 2.0), based on data collection in the Gila and Mimbres Watersheds. This presentation is an overview of the final field guides and data collection methods for NMRAM. Gila Watershed riverine wetlands provide important ecological information, as one of the few relatively intact watersheds in the arid Southwest. The New Mexico Wetlands Rapid Assessment combines landscape assessment in a GIS platform and a set of observable field indicators to express the relative condition of a particular wetland site. Without assessment information, wetlands resources will continue to decline from a variety of stressors. The NMRAM is designed to provide ecological condition information about wetland subclasses. This information is then used to determine the status of the wetland subclass as a whole, and to determine actions that can minimize future loss and degradation. Preservation of wetland ecological processes that are linked to river health and maintaining wetland function result in both direct and indirect positive effects on environmental quality and human health and welfare.

Update on Repatriation of Gila Chub into Mule Creek, New Mexico

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Reestablishing Gila chub *Gila intermedia* into unoccupied waters in their former range is an important recovery step identified in the Gila Chub Draft Recovery Plan. Gila chub is a federal- and state-listed species that the New Mexico Department of Game and Fish, in cooperation with the Arizona Game and Fish Department, USFWS, and USFS, is working to recover in New Mexico. The process starts by evaluating potential repatriation waters and sources. Mule Creek was chosen as an appropriate site to replicate Arizona's Harden Cienega population. Harden Cienega Gila chub have been stocked into Mule Creek for three consecutive years. To date, a total of 299 Gila chub were stocked using different methods each year. The geographic isolation of the stocking site provides protection for the population but makes access difficult. The preferred method for transferring fish to the stocking location is via helicopter long line, but it is weather dependent, which led to no fish being transferred in 2015. Surveys show Gila chub persisting in Mule Creek despite high-flow events. Additional stockings to ensure robust genetics are planned, as well as ongoing population monitoring. This project has provided many learning opportunities for threatened and endangered fish management.

Ecological Response Units: Ecosystem Mapping System for the Southwest US

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Natural resource analysis requires specialized data and systems of mapping and classification for the organization and stratification of ecosystems. Creating these large datasets from legacy sources requires negotiating obstacles such as variations in collection methods, scales, terminology, format, schemas of the inputs, and seeking consensus between interdisciplinary specialists that contribute to the project. *Ecological Response Units* (ERUs) represent an ecosystem map unit concept currently used by the Forest Service and others in the Southwest for planning, management, and the analysis of natural resources. The ERUs have been developed for all major ecosystem types of the region, based on similarity in site potential and historical disturbance regime. Through several Forest Plan revisions and through collaborative work with agency and external specialists, the Forest Service has developed a regional ERU map product covering all of Arizona and New Mexico. This presentation details some of that process as well as lessons learned from the successes and challenges in developing the final product.

Assessment of Soil and Water Resources on the Gila National Forest

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The assessment of soil, water, and riparian resources on the Gila National Forest utilizes existing information to evaluate current conditions, departure from reference conditions, and trends related to key ecosystem characteristics. Soil characteristics for terrestrial ecosystem analysis include type and distribution, vegetative ground cover, canopy cover by species, soil loss, condition, and soil organic carbon. Water resource characteristics include quantity and distribution of perennial and intermittent streams, springs and seeps, wetlands, waterbodies, and wells. Watershed condition, surface water quality, and groundwater recharge and discharge are also analyzed. Riparian characteristics include vegetative ground cover, canopy cover by species, fire and flood frequency disturbance regimes, and ecosystem function. The results of these analyses will be considered along with system drivers and stressors to identify what risks may exist to the future sustainability of these resources on the Gila. The data sources that underpin the assessment, analytical approaches, and some preliminary results are shared.

Effective Monitoring of One-Rock Dam Structures on Eroding Ephemeral Streams in the Burro Cienaga of the Gila National Forest

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Previous and existing land uses coupled with drought have drastically altered riparian and wetland areas in the southwestern United States. In this arid region ephemeral streams are common and briefly flow during or following rainfall or snowmelt events. These events are often characterized by high-velocity water flows, sediment loss, and the potential for increased erosion. When sediment is lost from one location it can be captured downstream by natural or man-made structures that reduce water velocity and trap sediment, debris, and seeds. A common man-made structure used in this region is based on the concept of Bill Zeedyk's one-rock dams. In the Burro Cienaga of the Gila National Forest, the Pitchfork Ranch is conducting extensive restoration projects on rapidly eroding ephemeral streams, methods including one-rock dams. We are monitoring several of these projects and will present preliminary observations on one stream channel experiencing high levels of erosion due to runoff from a well-traveled road. The goal of this project is to present short- and long-term quantitative and qualitative data on structure integrity and sediment capture/loss associated with each structure.

Wildfire Effects on Genetic Diversity and Recolonization of Longfin Dace (*Agosia chrysogaster*)

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Wildfires are important disturbance events for stream biota of southwestern North America. Whereas wildfire effects on abundance and community composition are relatively well documented, effects on genetic diversity and structure are not. From 2011 to 2013, the upper Gila River basin experienced a series of wildfires with associated ash flows that led to local extirpations of fishes. Longfin dace (*Agosia chrysogaster*) is an abundant and widespread native that exhibits a "boom-bust" ecology and is a rapid colonizer, making it an ideal candidate for evaluating wildfire effects on fishes. We used genetic data collected pre-wildfire (2010), following Whitewater-Baldy Fire (2012), and two years after Whitewater-Baldy (2014) to evaluate changes in genetic diversity and genetic structure that resulted from extirpation and recolonization of habitats. Despite declined abundance, estimates of genetic diversity and genetic effective size did not change appreciably following the wildfires. Changes in genetic structure over time were consistent with expectations of recolonization by dispersal of populations from Cliff-Gila Valley and upstream refuge habitats. Longfin dace appeared to exhibit genetic resilience to wildfires that is facilitated by the unmodified nature of the upper Gila River. Understanding recolonization processes of longfin dace will inform on the same processes occurring for endangered spikedace and loach minnow.

Retrospective Food Web Analysis of the Gila River: Do Native and Non-Native Interactions Intensify during Drought?

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The relatively pristine upper Gila River in New Mexico is a stronghold for endemic native fishes despite the presence of non-native fishes. In other, more severely human-impacted tributaries in the Colorado River basin, non-native fishes are a major factor in native species extirpation. We tested whether negative effects of non-natives on natives are compounded during challenging hydrologic conditions (i.e., drought). Stable isotope analysis (SIA) allows estimation of trophic position and trophic niche width. Fish specimens were selected from natural history collections to represent a time series that encompasses wet and dry years, as well as varying non-native abundances. We estimated "isotopic niche space" by plotting $\delta^{13}C$ vs. $\delta^{15}N$ for native and non-native fishes and statistically compared breadth and overlap in niches among species. During drought periods, isotopic niches of non-natives and natives will overlap, indicating competition, but in wet periods, isotopic niches will diverge significantly as an indicator of resource partitioning. SIA of museum specimens offers the potential to test key hypotheses about the impact of non-native species on an endemic fauna, and provides understanding of the environmental context in which non-native species negatively impact native fishes. Such understanding is important now more than ever for conservation of the Gila River, where climate change and pending water diversion could lead to further decline of native fish abundance and eventual extirpation.

A User-Friendly, Climate Projection Conditioned Yield Model

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To arrive at a robust estimate of reservoir yield, a model must contain at least the following parameters: inflows, outflows or demand, and losses such as seepage and evaporation. We created a simple, Excel-based yield model that incorporates estimates of impacts from climate change and that is directly linked to an inflow model. Stakeholders can modify the model to study yield for any reservoir where requisite parameters are available. The model is based on software accessible to almost all stakeholders. Results are calculated and presented in a fully transparent manner that can aid in stakeholder decisions.

A Bryophyte Inventory of the San Andres Mountains and Jornada Range: A Historical and Disjointed Journey of Diminutive Plants

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Presently, a bryophyte inventory is being conducted on the Jornada Experimental Range and the San Andres Mountains of southern New Mexico. Much of the bryoflora has been historically ignored in this region, leading to the inventory already producing record species for the state (i.e., *Acaulon triquetrum* (Spruce) Müller Hal). Historical collections from the 1930s produced one of the rarest mosses and, arguably, plants in the world: *Fissidens litteli* R. S. Williams, first collected in a gypsum sinkhole on the Jornada Range by the esteemed botanist Elbert Little, and later by botanist Kelly Allred in 1998. We expect to find more interesting bryophytes as the inventory progresses.

A History of Forest Insects and Diseases on the Gila National Forest

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For the assessment phase of the Forest Plan revision for the Gila National Forest, a history of forest insect and disease activity was compiled from Southwestern Region condition reports dating back to 1918, along with aerial detection survey data, field visit reports, and scientific studies. While a few studies in the state look at long-term records, most records of historical insect and disease activity are limited in extent to the early portion of the 20th century. With the exception of a couple of introduced species, the insects and diseases that have been important in forest ecology on the Gila National Forest are native organisms. Outbreaks of bark beetles have been known to occur in the region dating back to the 1920s, with the major events occurring as a result of droughts, particularly during the 1950s and the early 2000s. Overall, the available historical record shows no clear changes in outbreak patterns of native insects and diseases on the Gila National Forest. Risk modeling to examine potential future forest mortality from insect and disease activity has been completed and results are discussed. Non-native organisms and changing climate patterns have the potential to alter insect and disease activity on the Gila National Forest.

An Overview of Forest Plan Revision on the Gila National Forest

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The Gila National Forest is in the early stages of revising its existing Forest Plan from 1986 that will describe the strategic direction for management of forest resources for the next 15 years. These plans are not site specific, but provide broad, overarching guidance for all management activities conducted on the Forest. Plan revision involves three distinct phases: (1) assessment of the ecological, social, and economic conditions and trends; (2) development of a revised plan; and (3) monitoring and implementation of the final approved plan. The Gila National Forest announced the beginning of the Assessment Phase in May 2015, and expects to make the draft assessment report available for feedback in spring/summer 2016. The trends and conditions identified in the assessment will help in identifying the current plan's need for change and aid in the development of plan components. Once finalized, all subsequent proposals, projects, and activities must be consistent with the approved Forest Plan. A variety of communication methods will be available to provide input, collaborate, and stay informed about the status of the process. The Forest will strive for a planning process that is inclusive, collaborative, and science based to promote a healthy, resilient, and productive Gila National Forest.

Analysis of Turtle Mountain Springs in the Eagle Creek Watershed of Southeastern Arizona

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Turtle Mountain in Arizona is home to many springs systems and provides watershed to Eagle Creek, which flows into the Gila River. The Bureau of Land Management in Safford, Arizona, is in partnership with the Museum of Northern Arizona and Spring Stewardship Institute to examine springs on a landscape scale. Springs on the Turtle Mountain and Morenci grazing allotments were examined in 2015. Type of spring, condition of spring, wetland condition, wildlife habitat, causal factors affecting condition, and infrastructure were noted. This report discusses the condition of Turtle Mountain springs on a landscape scale and addresses climate change and implications for BLM management as a new ranch plan is examined. This paper is a student presentation and has been made possible by the Bureau of Land Management/ Eastern Arizona College STEM Partnership.

Vegetation Modeling to Inform National Forest Management Planning

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State-and-transition models (STMs) have been widely used by federal agencies, non-governmental organizations, and university scientists to forecast the future condition of ecological communities. The Gila National Forest and other National Forests in the USFS Southwestern Region are using these models—one per each major ecosystem—to predict future vegetation condition. The STMs under use have been developed by the Forest Service, LANDFIRE, The Nature Conservancy, and the Integrated Landscape Assessment Project. Models are first parameterized for the current management regime, and later for several candidate management scenarios. Each STM is initialized with the number of acres currently in each "state," with states defined by vegetation structure (especially canopy cover, diameter class, and number of stories), and occasionally by species composition. Through model simulations, these acres "transition" to other states through succession, natural disturbances (e.g., wildfire), and management activities. Transition probabilities and effects are integrated from multiple information sources. STMs yield predictions regarding future acreage per state and the roles of various mechanisms in creating this distribution. This work guides Forest planning by highlighting needs for change in management strategies, and later by testing the ability of candidate management scenarios to improve vegetation condition.

AWSA Municipal Water Conservation Proposals

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The ISC recently dedicated $3 million to municipal conservation projects. Proposals received to date include effluent reuse, park irrigation improvements, and water meter replacements. In this presentation, we will discuss each of these mechanisms from an engineer's vantage point. What does the term *water conservation* mean? What is physically happening currently? What is the desired state? How does the proposed mechanism work? Will the proposed mechanism achieve the desired state?

Celebrating Native Interpretations of "Rock Art" on the Gila National Forest

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Commonly known as "rock art," pictographs (pigment on rock) and petroglyphs (images pecked or incised into rock) are much more than art. They reflect the history and values of peoples who once lived here and are a tangible reminder of their connection to the landscape. The Gila National Forest is installing interpretive signage at or near multiple well-known "rock art" sites in celebration of the 50th anniversary of the National Historic Preservation Act (NHPA). These signs, and additional web-based materials, celebrate Native interpretations and provide valuable guidance on how to treat "rock art" so that it survives into the future. As expressed by Curtis Quam (of the Zuni CRAT), "[Projects] like these and experiencing these places is really important … particularly sharing it with the kids." Multiple tribes and pueblos have been invited to participate in the project. Representatives from Zuni, the Mescalero Apache, and the White Mountain Apache have generously shared their interpretations of panels. Working together with the tribes on this project has provided an opportunity for tribes to reconnect with these special places, has been a rewarding experience for Forest personnel, and will enhance visitor experience for years to come.

Patch Size Analysis for Major Ecosystems of the Gila National Forest

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While the sustainability of native species depends on habitat abundance, some species are also affected by the spatial distribution of habitat. Vegetation patch sizes were analyzed for the Gila National Forest (NF) for each major ecosystem type at the meso scale, based on the spatial extent of vegetation in a given structural condition. Spatial overlay analyses of ecosystem mapping for current and reference conditions were performed in GIS to assess the departure of contemporary patch sizes from reference conditions (historical). While reference patch sizes for grassland and shrubland systems were derived from ecological and soils mapping, reference conditions for forests and woodlands were obtained from previous studies and through the interpolation of available research to address remaining information gaps. Results show that patch sizes of grassland systems have declined from historical levels, but not significantly. Likewise, the departure of patch sizes in Ponderosa Pine–Evergreen Oak and Mixed Conifer–Frequent Fire is minor. However, patch sizes of shrublands have decreased significantly. The size of patches in fire-adapted ecosystems, such as Ponderosa Pine Forest, has *increased* with fire suppression and tree canopy closure. Patch analysis provides the Gila NF with an opportunity to address an important landscape metric with future resource planning and management.

A Framework for the Analysis, Planning, and Management of Ecosystems in the Southwest

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The Southwestern Region of the US Forest Service utilizes an ecosystem framework for efficient and consistent evaluation of natural resources. The framework supports a *systems* approach to resource analysis and the sustainability of regional plant and wildlife species. The framework is organized by *Ecological Response Units* (ERUs), a stratification where each ERU depicts site potential and historical fire regime of communities of similar vegetation. The ERU constructs were derived from the Terrestrial Ecological Unit Inventory and other regional datasets and vegetation classification work. The ERU framework is used to facilitate assessment of several core indicators, commonly used in ecological analysis in the West, that reflect basic attributes of ecosystem structure, composition, and process. Various research and data sources are used to determine reference and current condition for each indicator. Future condition is projected for some indicators using state-and-transition modeling, where each ERU is portrayed using a specific model. Several regional products and datasets have been integrated with the ERU framework and will be summarized, including the Climate Change Vulnerability Assessment, R3 Mid-Scale Existing Vegetation Mapping Project, and Forest Inventory and Analysis.

Vegetation Assessment of the Ecological Response Units Occurring on the Gila National Forest

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One of the requirements of the 2012 National Forest System Planning Rule is to conduct an assessment on ecological conditions and trends using existing information. The nearly 3.3 million acres on the Gila NF (GNF) provide a wide range of habitats, both geographical and environmental, to which plants have been able to adapt. To facilitate the terrestrial vegetation assessment and planning, 26 major vegetation types, called ecological response units (ERUs), have been identified and delineated on the Forest. These vegetation types include forests, woodlands, shrublands, grasslands, and riparian plant communities. Ecological integrity was assessed for the upland vegetation communities. Ecological integrity is the quality or condition of an ecosystem when its dominant ecological characteristics (e.g., composition and structure) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence. Twelve ERUs were examined to determine the current extent of their departure from defined historical reference conditions and how these levels of departure and current management activities are likely to affect future trends in relation to the reference conditions. Some causal factors and stressors are also presented and discussed.

A Habitat Suitability Model for the Dusky Grouse in New Mexico

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The Dusky Grouse (*Dendragapus obscurus*) is a large game bird that occurs in boreal forests from southern Canada and Alaska south to isolated mountaintops in Arizona and New Mexico. This species has been ill studied in the American Southwest, where it is a protected game species. Our study aims to develop a habitat suitability map of Dusky Grouse in New Mexico using Maximum Entropy Modeling (MaxEnt). We collected occurrence records of Dusky Grouse from museum collections and the New Mexico Ornithological Society database. We assigned observations error based on the observer's knowledge. We constructed two models, one based on 6 biophysical variables, including elevation, GAP landcover, slope, aspect, distance to streams, and distance to springs, and one based on 19 standard bioclimatic variables. Elevation (87.4%) and landcover (10.7%) were the highest contributors to the biophysical model. The most important landcover types were subalpine grassland and bristlecone pine forest. The highest contributors to the bioclimatic model were annual precipitation (31.2%) and precipitation in the warmest month (23%). The largest and most suitable areas of grouse habitat were the northern mountains, while areas in the southern part of the state were small and fragmented. This could be an area of conservation concern, considering the large-scale fires that recently occurred in these areas. This species could be affected by recent landcover changes and the increasing effects of global warming. Future research will be needed in order to better understand this species and its current status in the American Southwest.