The Black Range Naturalist

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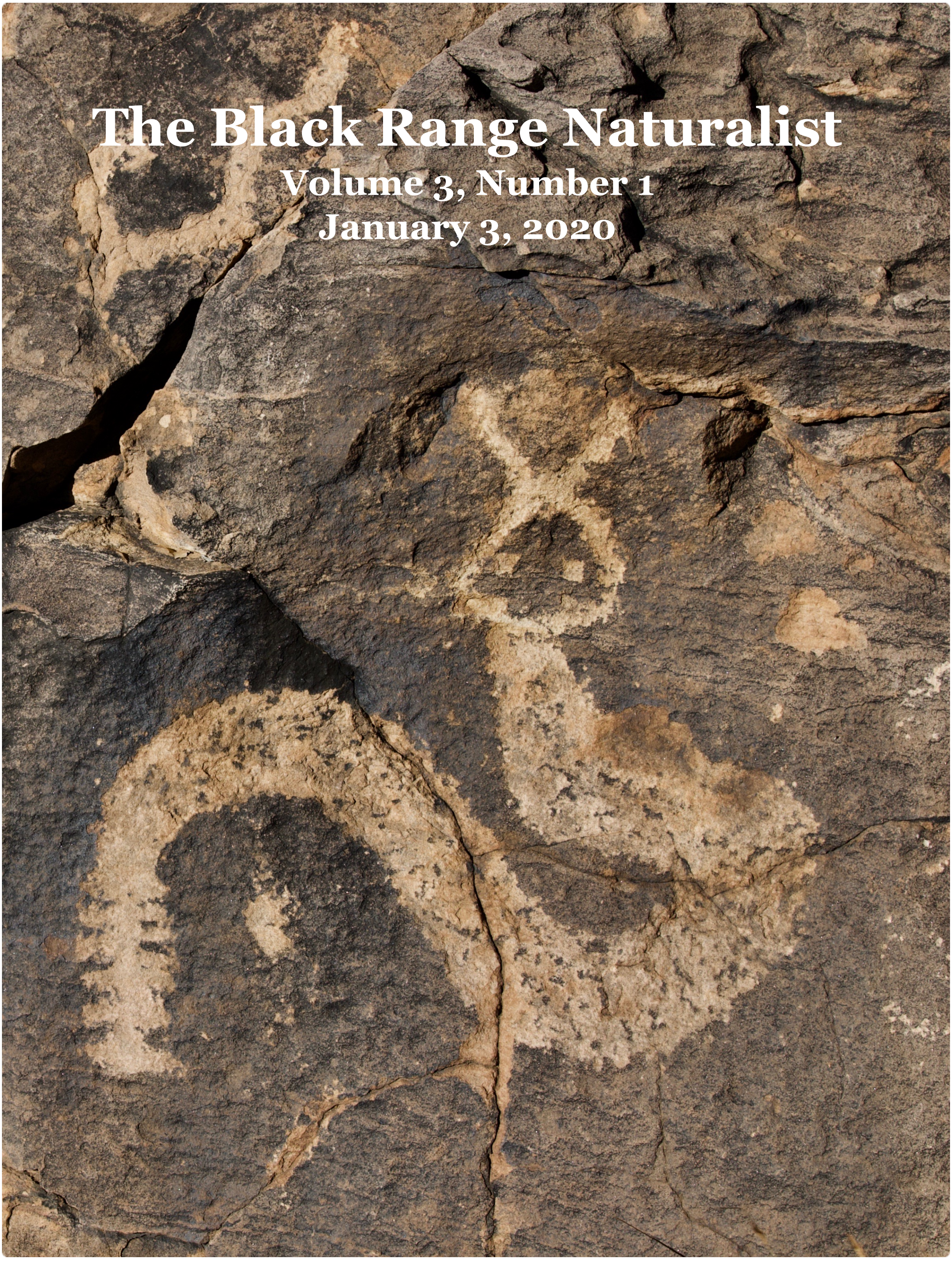

CONTRIBUTORS AND TABLE OF CONTENTS

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ABOUT THE FRONT COVER

This photograph of an (apparent) rattlesnake was taken at the Pony Hills Petroglyph site southwest of Cooke's Peak. It is Mimbres in creation, dating from about 1000 CE. Rattlesnake glyphs are often created with "antennas" - perhaps a stylized version of the facial horns of the snake, or . . . .

Two-eyed Seeing

In our first issue, Harley Shaw explored the development and acquisition of knowledge, in "Lore Versus Science and Natural History". The relationship between the two camps is not trivial, nor is the tendency in some camps of lore and science to downplay the importance of the other. In a very real sense, this magazine seeks to explore natural history through both lenses, the lens of scientific methodology and the lens of common observation.

In *"Two-eyed Seeing" Supports Wildlife Health*[1] Kutz and Tomaselli expound on "the urgency of ethically documenting and effectively using local knowledge for wildlife health surveillance . . . many of the principles that apply to local knowledge held by Indigenous peoples also apply to local knowledge held by non indigenous people around the world" (p. 1135). Their work is in the arctic, and although far away, the lessons being learned there are applicable to the Black Range. "Learning to see from one eye with the strengths of Indigenous knowledges . . . and from the other eye with the strengths of Western knowledge . . . and learning to use both these eyes together" benefits all.[2]

When I had a day job, I made my living dealing with the differences in perspective between "generalists" and "specialists". In the eyes of the generalists, the specialists were often unable to "see the big picture", and in the eyes of the specialists, the generalists were often too dense or political to appreciate the nuances which effectively disproved the point they wanted to make. It was great work, I got to play in the world of both perspectives with people who were at the top of their field and top of their game. They were professionals by training, by attitude, and because of their willingness to appreciate the constraints others faced. I used the phrase "All generalities are false" to describe our work.

Humans have a significant tendency to believe what they believe and damn the facts. That tendency makes the barriers between science and lore, between generalists and specialists, between us and them, all the more resilient, all the stronger. All too often we are presented with an "argument from ignorance" (*argumentum ad ignorantiam*), claims that something is true because it has not been proven false, or vice versa. The best way to address such segregations of thought is to step forward with our best efforts to understand the world. Into this fray enters the concept of "citizen science", generally an aggregation of data from which fact-based determinations can be made.

Looking back into history, the distinctions harped on above become less clear - or at least the distinctions were focused differently (church-science, classical thought-empirical observation, etc.).

In the past, it was (perhaps) easier to delve into all of the areas of knowledge, to be a "renaissance man". Women could not be renaissance men because of gender - they had to settle for being polymaths. There have been great minds throughout history: Euclid of Alexandria, al-Khwarizmi, Leonardo da Vinci, and others dot the landscape. It is, however, in the period between 1700-1900 that I find the great polymaths to whom I look for inspiration. Alexander Humboldt is probably the greatest of the lot in my mind (even when measured against the likes of Charles Darwin, Joseph Banks, Alfred Russel Wallace, James Hutton…) and he was an explorer, perhaps not of the ilk of a Cook, but an explorer of the first caliber.

Stephen T. Jackson notes in "*Humboldt for the Anthropocene*"[3] that Humboldt's contributions to the natural and social sciences rested firmly on "his skillful navigation between the opposing poles of breadth and depth, between minute particulars and far-reaching patterns, and between general theory and brute-force observation."

It is to Humboldt that I dedicate the experiment which is this magazine. (I doubt that he would care; no one is perfect.)

- R. A. Barnes, Hillsboro
December 2019

1. ***"Two-eyed Seeing" Supports Wildlife Health*, Susan Kutz and Matilde Tomaselli, *Science*, 21 June 2019, pp 1135-1137.**

2. **S. K. Denny, L. M. Fanning, *International Indigenous Policy Journal*, 7, 1 (2016)**

3. **"*Humboldt for the Anthropocene - Humboldt's fusion of science and humanism can address contemporary challenges*" by Stephen T. Jackson, *Science*, Volume 365, Issue 6458, 13 September 2019, pp. 1074 - 1076.**

Randy Gray, a periodic contributor to this publication, is currently assisting others in a genetic study of the speciation questions surrounding the Black-tailed Rattlesnake complex. In personal correspondence with the editor on November 11, 2019, he noted that "I have been collecting blood of C. ornatus for DNA analysis to further determine genotype comparison with molossus. The researchers are collecting samples from within the integration zone which occurs from our neighborhood to AZ. I have photographed specimens from the bootheel that are visually very C. molossus. I believe the specimens identified near Gila Cliff Dwellings are most likely C. molossus based on a documented find by one of the researchers if I remember correctly (but note that snake is still being reviewed). However there is still much to learn and we live where the now 2 species come together… though the Mimbres River is indicated as a potential barrier I do not understand that. Water does not stop rattlesnakes."

Dogs and Snakes

by Harley Shaw

Even in good rattlesnake country, you don't go out every day and have a dog bitten. Fortunately, yourself neither. Contrary to nature shows, not much in nature happens fast or often. You have to be out there a lot and endure days of monotonous, ongoing, sameness before you'll get to experience anything extraordinary. Extraordinary, I mean, in the sense that you feel frightened, enlightened, or changed, when the event is over.

Snake bites are extraordinary; snake bites involving dogs, included.

I grew up in the Southwest, ergo rattlesnake country. I clambered over supposedly snake-ridden hills a lot, from my early boyhood to the present, headed for 83. Truth is, considering the time I've spent where rattlers roam, I've seen proportionally few. And I've had only a couple incidents, that I knew of, where a personal bite might have been imminent.

But I want to write herein about my dogs. I've had a bunch, and they have accompanied me, more often preceded me, through snake habitat. This included running a pack of rowdy male puma hounds who weren't particularly interested in snakes or aware of them. So, were they ever bitten? Some were. I never had one die from a snake bite.

Based upon memory, an increasingly poor tool for documentation on my part, I've experienced 3 snakebites on 2 dogs in some 75 years of dog ownership in the desert. Both dogs were trail hounds. Because the hounds ranged over a wide area during my field time, I became aware of their bites several hours after the incident occurred–too late to visit a veterinarian. One, a timid black and tan that I called Shrimp (he was the runt of a litter), seemed the least likely to be bitten. He was scared of his shadow, and would have certainly retreated from a noisy snake. Shrimp became a knowledgeable trail hound as he matured, and he could follow even faint puma scent. However, I probably had started him in the pack too early and he had become intimidated by the older dogs. He would assiduously work a cold track, but never utter a bark or bawl to attract attention. I kept a bell on his collar, so that I could find him when he was trailing. He joined the chase, once a puma was jumped. However, his shy nature made him leery of mixing with the canine mob keeping a puma up a tree, so he'd sit under a nearby tree and bark away, pretending he had a cat there. He was a fine example of the adage, "barking up the wrong tree." It seemed strange, then, that unadventurous Shrimp, of all the dogs, was the one to be hit by rattlers. But he was bitten once in the scrotum and once in the neck. Neither bite particularly disabled him, and he simply developed an open wound for a while around the fang marks. I concluded that neither snake had unloaded much venom. Shrimp was still healthy at age 5, when I had to disband my pack and passed him on to a friend in Flagstaff.

The other hound bitten was a very large Gascony bluetick named Buck. Buck was a pet that came to me after the puma studies were finished. I never hunted with him. While he lived, he became Patty's favorite dog, and she, his favorite human. Buck was bitten one day, when we were loading our horse trailer with fire wood at a ranch north of Prescott. Buck had been sniffing around the premises, while we finished our task. Because we had also filled the bed of the pickup with wood, he had to ride up front in the cab with us. About halfway home, Patty noticed that he seemed lethargic, and kept dropping off to sleep. We worried that he might have ingested something toxic at the ranch. At home, he continued to be drowsy and we decided to wait until the next morning to see if he had slept it off. By morning, we could see some swelling on a shoulder and a closer inspection revealed fang marks. Buck was drowsy for a couple of days, and developed an open wound around the bite, but he, like Shrimp, recovered without treatment. A year or so later, Buck suddenly died of collapsed lungs. There was no apparent cause at the time–he simply came to Patty obviously in stress and was dead before she could drive him the mile to the veterinarian. Knowing that snake bites can have residual effects, we wondered if this sudden death of a still young and apparently healthy dog might have been related to the snakebite. We had no way to know for sure.

Although I owned bird dogs, hounds, and just pets over the years, until recently, I had few opportunities to observe dog encounters with rattlers. My hounds usually ignored them. One memorable exception occurred while I was living on the North Kaibab. At the time, I was working seven male hounds. We couldn't hunt much during the hot summer months, so I took the hounds for evening exercise along a road that ran down a canyon named, appropriately, Snake Gulch. I had a process wherein I hauled the pack 5 miles down the gulch and released them to run ahead of the truck for exercise. There was a stock tank at the end of the 5-mile run, and the dogs knew the drill--I could always round them up and reload them when they stopped to drink at the tank. I had a definite spot I released them each evening, a place I could easily turn the truck around. Normally I'd let them out of the back of the truck in a way that guaranteed they'd hit the ground headed in the right direction. I'd then quickly turn the truck around and catch up with them just around the first bend, where they predictably stopped at their favorite juniper tree, lined up, and emptied their bladders at its base. This particular day, I arrived while they were still lined up, killed the engine to wait, and immediately heard the steady buzz of an upset rattler. I jumped out and started grabbing dogs and stuffing them in the truck. Once I had everyone loaded, I went looking for the snake. It was a midsized version of the reddish-colored prairie rattler of that area, coiled at the base of the tree the dogs used as a scent post. It was drenched. I noticed that its buzz was somewhat muted, being wet. Apparently, every hound had unloaded on it. I checked the dogs over and watched them closely for the next day or so. Not one had been bitten. If the snake had tried to strike, it must have been

off aim, perhaps blinded by urine. My stock punch line in telling this tale is that the snake was totally pissed off because it was totally pissed on. As an aside, this provided a hint regarding how Shrimp might have gotten nailed in the scrotum a couple years earlier.

No doubt my dogs encountered other snakes during the years we chased pumas, but if so, it happened when I wasn't near. As far as I know, they ignored them, much as they had done the wet snake of Snake Gulch. We occasionally saw snakes while hunting horseback and simply rode around them. Contrary to conventional wild west lore, our horses also ignored them. I never saw a horse spook during a rattlesnake encounter.

Harley Shaw and Toasty near Hillsboro, New Mexico.

Some 19 years ago, Patty and I moved to Hillsboro, and our dog/snake encounters multiplied. Hillsboro is in rattlesnake country; they are often encountered right in town and are common in the surrounding desert. Large diamondbacks, mid-sized prairie rattlers, and black-tailed rattlers are common enough that one learns to always be wary. At the time we moved here, our remaining hound was an aging redbone named Shy. Shy was even spookier than Shrimp. She had been given to me by a puma hunter after Buck died. The hunter felt that it was unseemly for me to be without a hound, even though I was no longer doing puma research. He said that Shy didn't seem to be making it as a hunting dog but would probably be OK as a pet. Actually, she didn't rank particularly high as a companion dog, either. After doing my best to make friends with her, I concluded that she was autistic. She simply never warmed up, couldn't relate socially, although she loved to go on daily walks. She was already gray-muzzled and growing deaf by the time we moved to Hillsboro. On one of my early explorations, the first summer we were here, I spotted a 3-foot diamondback crossing the wash up ahead. Shy was headed straight for it. I shouted at her, which was fruitless, because she couldn't hear. The snake kept crawling across the wash and began to buzz as Shy approached. She trotted right over the top of the snake, and kept going. She didn't see it, it didn't strike. You might say nothing happened.

A year or so later, during a hike along North Percha Creek on the national forest, I realized Shy was missing. By this time, she was not only deaf and autistic, but becoming a little senile as well. I stopped and listened and finally heard her faint bark back in the direction from which we had come. It took me perhaps 20 minutes to retrace my steps and find her. She was face to face with a large, coiled and buzzing, black-tailed rattler, which was slowly retreating as she continued to bark in its face. She was well within striking distance and obviously had been for some time. Keeping her between me and the snake, I grabbed her collar, drug her back, and hooked her to a leash. The snake slipped away. I looked her over closely but found no fang marks. I watched her during the remainder of the walk and over the succeeding hours. She obviously had not been bitten. I had to assume that the snake had never struck; Shy was much too large a target and much too close to miss. Go figure.

Shy lived out her last year or so at the residence of Bill and Nolan Winkler. We had by that time taken on a 2-year-old Boxer named Suki, who turned out to be so energetic and assertive that Shy became overly stressed and subdued. Winklers borrowed her as a companion for their aging (even older than Shy) dog, and when it passed, Shy stayed in residence. For a while I dropped by evenings and took her for a walk, but she eventually became too demented to take out. She began to get lost even on short evening treks.

The Boxer, Suki, was all muscle and energy, and covered a lot of miles when we walked. Early on, I was walking on the mesa up by Hillsboro cemetery, when I spotted a coiled prairie rattler about 20 feet away. It was between me and Suki, and I made the mistake of calling her name to alert her of the snake. She thought I meant for her to come, and she did, stepping directly over the coiled rattler. It never moved and never buzzed. I led her around it, and we went on our way. During Suki's lifetime, we encountered perhaps a

dozen rattlers, that I knew of and never had anything that I would consider a close call. She ignored them; I detoured around them. Patty and I mourned her when she died at age 13. For about a year, I seriously considered doing without a dog, but an unexpected day-long visit from a stray blue-tick pup reminded me of how much I missed having a hound. The owner of the pup showed up, and shortly after, I encountered an old friend whose wife was cuddling a Beagle pup in her lap. I was aging and not ever again going to be a puma chaser; keeping a young full-sized hound in town seemed a disservice to the dog and to my neighbors. A Beagle (ergo houndlette) struck me as the perfect compromise. It took a couple months, and the story is too long to tell here, but in May, 2016, Toasty arrived at our house. She was perhaps 8 months old. I began, nervously, to take her on walks. By May, the snakes are out in force; I had no idea how this new dog would react to rattlers. Walking Toasty each evening became a stressful effort to give her some freedom to exercise, while avoiding snake habitat. This became impossible. I had visions of losing our new pup before she reached a year of age.

As it has turned out, although we've seen a few rattlers, the only serious episode to date amounted to a close call for me rather than Toasty. On one of our early walks up Warm Springs wash, I was watching her closely, hoping to spot any snakes before she came too close to one. I was watching her feet so closely that I failed to watch mine, thereby stepping much too close to a 5-foot diamondback. Had this one wanted me I was in range. The snake was polite. It buzzed loudly, raised its head, and looked me in the eyes--briefly only, because I became a moving target and set a record for the standing backward broad jump. All ended well, but the overdose of adrenalin kept me on high the rest of the day.

Since then, I've come to respect Toasty's judgement regarding snakes. Truth is that she is as likely to encounter a rattler in our large, fenced back yard as she is during any of our desert walks. She circles snakes of any species, and is wary of sticks or rocks that resemble a serpent. I've seen her jump back from a cow pie that resembled a coiled rattler. On a couple occasions I've made a point of showing Toasty a snake up fairly close. Both times, she glanced at it, then looked at me with an expression that I interpreted as the doggy equivalent of the human expression, "So?" then trotted off looking for bunny scent, her only true passion. I can't say she'll never be bitten, but then I can't say the same for myself, either.

I don't mean to minimize the seriousness of a rattlesnake bite on dogs or humans. If you are present when a dog gets bitten, or know that it has happened relatively soon after, head for a vet. If the bite is serious, meaning if it isn't a dry bite, the vet will undoubtedly recommend anti-venom. Expensive stuff. Even if you don't discover the bite for several hours, and the dog is still alive, a trip to the vet might still prevent later complications.

A vaccine exists that is supposed to protect the dog from venom of a western diamondback. The two technical evaluations I found online were inconclusive. One study, carried out at the Colorado University Veterinary Hospital, titled "272 cases of rattlesnake envenomation in dogs: Demographics and treatment including safety of F(ab')2 antivenom use in 236 patients," stated that, of 272 rattlesnake envenomations of canines from 5 veterinary emergency centers in Maricopa County, Arizona, 8 bites were fatal; 242 of these dogs were treated with antivenom. (At link above or at DOI: 10.1016/j.toxicon.2015.08.028.) Older dogs were more likely to die. Lapsed time between bite and treatment was also a factor. They saw no clear advantage of prior vaccination.

Another study, titled "Effects of the canine rattlesnake vaccine in moderate to severe cases of canine crotalid envenomation" looked at records of 82 cases at veterinary emergency centers in Southern California. This study did not identify any protective effect of vaccination. (At link above and/or at Doi: https://doi.org/10.2147/VMRR.S69216.)

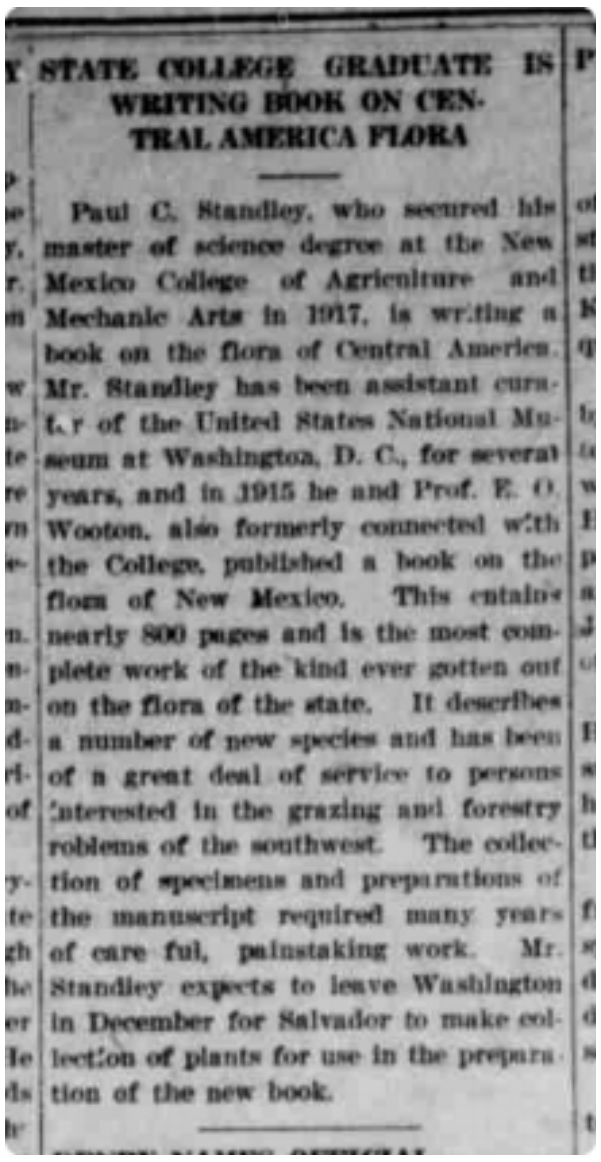
A working veterinarian commented: "in the real world, when faced with a client who knows about this vaccine, it's very difficult to deny them access by saying that there is "no scientific proof" that it works. . . . If the client's dog gets bitten, becomes very sick, and faces death, the client is likely to have recriminations about why you didn't give the vaccine. And that is a situation any veterinarian would want to avoid." (See link above and/or https://www.embracepetinsurance.com/waterbowl/article/rattlesnake-vaccine.)

Another vet commented: "If a dog is bitten by a rattlesnake, they need veterinary attention ASAP, no question. If the dose of venom is high enough, then the dog needs antivenom." Regarding vaccine, he adds: "Could it work? It's somewhat plausible. I would not trust it to save my dog's life. . ." (See link above and/or https://sciencebasedmedicine.org/are-rattlesnake-vaccines-for-dogs-effective/.)

A chapter in Volume II of *Rattlesnakes of Arizona* written by Stephen Mackessy and Todd A. Castoe, titled "Deciphering the evolution of venom and the venom apparatus in rattlesnakes" discloses how complex rattlesnake venoms and their effects really are. Venom composition varies with species, age of snake, current diet, and who knows what else. The process of envenomation evolved as a way to catch prey, with defense being secondary. Snakes don't like to dump their wad unless they feel seriously threatened. Big animals aren't edible prey. Point is, unless you become a threat, you'll probably not get bitten.

In spite of the above assessments, I give Toasty snake shots and boosters regularly. If they had them for people, I'd take them too. They aren't that expensive and anything that might shift the odds even slightly in my favor is cool.

Paul C. Standley
1884-1963



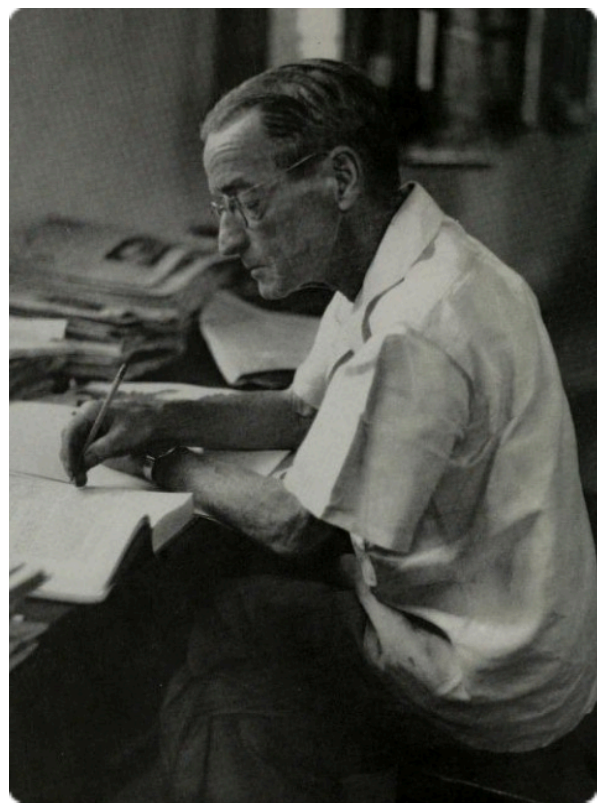
STATE COLLEGE GRADUATE IS WRITING BOOK ON CENTRAL AMERICA FLORA

Paul C. Standley, who secured his master of science degree at the New Mexico College of Agriculture and Mechanic Arts in 1917, is writing a book on the flora of Central America. Mr. Standley has been assistant curator of the United States National Museum at Washington, D. C., for several years, and in 1915 he and Prof. E. O. Wooton, also formerly connected with the College, published a book on the flora of New Mexico. This entails nearly 800 pages and is the most complete work of the kind ever gotten out on the flora of the state. It describes a number of new species and has been of a great deal of service to persons interested in the grazing and forestry problems of the southwest. The collection of specimens and preparations of the manuscript required many years of care ful, painstaking work. Mr. Standley expects to leave Washington in December for Salvador to make collection of plants for use in the preparation of the new book.

The history of naturalists in the Black Range is extensive but often forgotten. Paul C. Standley received his bachelor's degree from New Mexico State College in 1907 and his masters the following year. After graduating, he spent two years there before moving on to the United States National Museum (1909-1922) where he was the Assistant Curator of the Division of Plants. He worked at the Field Museum of Natural History (Chicago) from 1928 to 1950. In 1950 he retired from the Field and taught at the Zamorano Pan-American Agricultural School in Honduras until 1956. He died in Honduras on June 2, 1963.

What was he doing between 1922 and 1928? The answer lies in this article from *The Deming Graphic* issue of October 24, 1921. At that time the first volume of the seminal *Trees and Shrubs of Mexico* had just been issued. He worked on the other volumes until the last was published in 1926.

In 1915, he and E. O. Wooton published *Flora of New Mexico*, the standard botanical work for our area for decades. That work was one of many he was to research/write in a long and illustrious botanical career. He was characterized by many prominent peers as one of the premier botanists of his era.



Standley at the herbarium of Escuela Agricola Panamericana in about 1952. Photo attribution: unknown

Photograph by H. H. Bartlett

STANDLEY ABOUT 1910
At the United States National Herbarium

In December 1911, Wooton and Standley completed *The Grasses and Grass-Like Plants of New Mexico* (published the following year). The life zone map (page 8) and description of the "lower Sonoran" life zone (page 11) from the *Grasses* book are shown here. These two books, *Flora* and *Grasses*, are foundational works for the study of botany in New Mexico. Unfortunately, it is not the people who contribute who are remembered, it is the scoundrels.

Life Zone Map of New Mexico from a Map Furnished by the Bureau of Biological Survey, U. S. D. A., Washington, D. C.

1. Lower Sonoran Zone. This covers the lower plains and mesas and the larger river valleys of the southern third of the State. Characteristic woody plants are the Creosote Bush (*Covillea glutinosa*) (often mistakenly called Greasewood), the Spanish Bayonet or Dagger (*Yucca macrocarpa*), *Zizyphus lycioides*, *Condalia spathulata*, Tornillo or Screw Bean (*Strombocarpa pubescens*), *Acacia constricta*, *Acacia greggii*. Desert Willow (*Chilopsis linearis*) and Valley Cottonwood (*Populus wislizeni*). On the mesas Black Grama (*Bouteloua eriopoda*), Tobosa Grass (*Hilaria mutica*), False Needlegrass (*Scleropogon brevifolius*), Mesquite Grass (*Muhlenbergia porteri*) and several of the true needle grasses (*Aristida* spp.) are characteristic, while in the valleys Salt-grass (*Distichlis spicata*) and Bunch grass (*Sporobolus airoides*) are common, especially in alkaline soils. A number of species of Cacti are also common. This zone is dry all the time and hot in the summer time. The average precipitation is 8 or 9 inches and the maximum summer temperature is from 100° to 106° F.

J. R. Absher of the A-Spear Ranch was able to take a great Bobcat photo on November 25 of this year. His comments: "Only had the opportunity for a real quick single frame in godawful flat light at 8:00 am this morning @1/125 sec. Despite all that, I find this is pretty acceptable, under the circumstances. Full-frame here. No cropping. A hefty fellow. Check out those thick legs and big paws!"

White Barn Owls have more hunting success than reddish-brown Barn Owls when the moon is full, a study published in Nature Ecology and Evolution (Vol. 3) suggests. Researchers found that voles, a favorite prey, freeze in the presence of white barn owls up to five seconds longer than when they see a darker owl. ("Differential fitness effects of moonlight on plumage colour morphs in barn owls" by Luis M. San-Jose, Robin Séchaud, Kim Schalcher, Clarisse Judes, Anastasia Questiaux, Aymeric Oliveira-Xavier, Charlène Gémard, Bettina Almasi, Paul Béziers, Almut Kelber, Arjun Amar & Alexandre Roulin). This Barn Owl was photographed in Hillsboro during June 2019.

Coati Update

Unfortunately we did not see a return of the coati to Kingston this year (2019). It was not a very good year for fruit production either, and the handful of apples, peaches and pluots we did get were mostly picked by fox, raccoon, and deer. A duo of yearling deer seemed to visit every day during the summer, and also munched on the lower limbs of the fruit trees. Catherine Wanek, Black Range Lodge, Kingston

The Archaeology of Animals in Southwest New Mexico, AD 1000 – 1130

by Karen Gust Schollmeyer, Archaeology Southwest

A thousand years ago, southwest New Mexico was home to farmers who grew maize (corn), beans, and other crops on floodplains and in arroyo mouths, gathered wild plants, and hunted local animals. They built pueblo-style buildings out of unshaped river cobbles stacked into masonry walls, and made brown pottery for everyday use. They also made beautiful serving bowls with black designs painted on a white background.

Archaeologists use the label "Mimbres Classic" to describe the period from AD 1000 to 1130 when people were creating these characteristic items. At this time, people made the same types of pottery and houses over a large area stretching from the Rio Grande in the east to the Chiricahua Mountains in the west. We don't know whether the people who lived in the many farming villages throughout this large area considered themselves part of a single cultural group or not, or even spoke the same language. The characteristic material culture (especially building and pottery styles) that archaeologists label "Mimbres" was similar and changed at about the same times and in the same ways across the region.

As an archaeologist, I've long been interested in how people used animals in the past. Thanks to New Mexico's dry climate and soil conditions, animal bones are often well preserved in Mimbres area archaeological sites. The vast majority of these bones are from jackrabbits and cottontails, and are found in contexts like casual trash disposal areas. These were the most common animals in farmers' diets and were probably plentiful on the landscape, especially around fields and gardens that would have been attractive food sources for the animals and convenient places for farmers to catch them in the course of their daily activities. Eating these animals would have added important protein and fat to a largely maize-based diet, and simultaneously helped decrease the local garden pest population.

Figure 1. The Mimbres area comprises the southwest New Mexico portion of the Mogollon archaeological culture area in southwest New Mexico. Map by Catherine Gilman.

Artiodactyls—deer, pronghorn, and elk – were also attractive game animals for ancient hunters. Although these animals would also have been attracted to people's gardens, their bones occur in much smaller numbers in archaeological sites. Archaeological studies have shown that in the environment of the Southwest, these large game species were relatively easy for ancient hunters to capture at rates higher than those at which the animals replaced themselves by breeding or moving around the landscape. By the Mimbres Classic period, artiodactyl populations near villages had already been heavily impacted by humans. Although these animals were still available to hunters, they were not as common as in other time periods, and would often have required long-distance hunting trips to acquire.

Potters during this time period sometimes painted their black-on-white pottery with images of animals, including birds, fish, carnivores, artiodactyls, and "bunnies." Sometimes the potters chose to paint an animal category for purposes of bowl decoration, including painting "bunnies" that combine characteristics of both jackrabbits and cottontails, or depicting generic artiodactyls without showing species-specific characteristics. At other times, they chose to paint animals in a way that shows the characteristics that allow us to distinguish species today, like pronghorn horns versus deer antlers.

Although it is tempting to assume that the animals painted on bowls were the ones people cooked and served out of those bowls, looking at the proportions of images of different animals tells a different story. Among bowls with designs depicting mammals, there is a far higher proportion of artiodactyls to other animals than the proportion of artiodactyl bones to other mammal bones in the archaeological sites from this time. People chose to paint artiodactyls on their bowls much more often than bunnies, even though they ate a lot more bunnies. This shows big game animals meant more to hunters than bunnies in certain ways, and probably had a lot more social status attached to capturing them. This is no surprise to modern hunters; trophy artiodactyl heads are common wall decorations, but we don't tend to mount bunny heads (except for the occasional jackalope). People painted animals on bowls more often when those animals had symbolic importance to them, not in proportion to their importance as food sources.

Several other animals are also rare as bones in archaeological sites but were clearly important to Mimbres area villagers. Images of birds and fish are common on Mimbres bowls, but there are proportionally far fewer in archaeological sites in comparison to mammal bones. The bones (especially wings) of raptors such as red-tailed hawks are sometimes found purposely placed in special locations in archaeological sites such as the floors of pueblo rooms, especially rooms that show other evidence of being used for religious purposes. Such bones are rare in all villages, but are more often found in these "special" deposits than in the casual trash disposal areas where we find so many bunny bones. Fish are even less common archaeologically, despite the fact that most sizable villages were built next to wide areas of river floodplain good for farming. In fact, out of 38 Mimbres Classic period sites with analyzed animal bones, only four contain more than ten fish bones. In later time periods, large numbers of fish bones have been found in a few sites in "special" deposits similar to bird bones, but fish are almost never found in ordinary trash disposal areas. These animals must have had an importance to ancient farmers that was much more symbolic than dietary.

Figure 2. Archaeologists identify fragments of animal bones from archaeological sites by comparing them with modern specimens, like this collection of small mammal mandibles at the Stanley Olsen Laboratory of Zooarchaeology at the Arizona State Museum. Photo by the author.

Figure 3. A Classic Mimbres bowl showing a jackrabbit or cottontail with a staff. After LeBlanc 1999 (Figure 3).

Around AD 1130, things changed dramatically across the Mimbres area. People stopped producing their characteristic black-on-white pottery, and mostly moved out of their farming villages. In some areas, like the upper Gila, it's so difficult to find archaeological sites from the time between AD 1130 and 1300 that most residents must have moved away. In the Mimbres Valley, much of the farming population also left, but small remnant populations stayed in a few of the most important villages. In the area between the Black Range and the Rio Grande, much of the population stayed, but left their villages to build smaller, more scattered hamlets nearby.

The availability of animals to hunt does not seem to have contributed much to people's decisions to change their locations and lifestyles at this time; there is no evidence that access to animals was any different around AD 1130 than it had been over several preceding centuries. Although large game was depleted around villages, it had been that way for generations. People's access to jackrabbits and cottontails does not seem to have changed around that time, either. Conditions for farming were worse than usual due to a drought at this time, but there would have been enough productive farmland in many areas to support the farming population, though probably not as easily as people had grown used to. Archaeologists today prefer multi-causal explanations – a mix of social stress, pressure on the religious system, drought, and people's perceptions of the types of subtle changes in resource availability discussed in this article – for people's decisions to change their way of life so dramatically.

Over the next few centuries, farming populations rose and fell several times in the Mimbres area. Eventually, after about AD 1400, people stopped building farming villages in the area altogether. The farmers moved to other parts of the Southwest where their descendants live in today's pueblos, including Hopi, Zuni, Acoma, and Laguna. Some of the traditions still practiced in these modern pueblos show links to activities centuries ago in the Mimbres area, including things like the symbolic importance of certain animal species (including fish) and the use of raptors in religious practices. By the time of the first written records, the area was home to Apache people who have their own traditions of hunting and animal use.

Mimbres Natural History Art

by Bob Barnes

The Mimbres left many depictions of the natural world in which they lived. Typically these depictions are found on pottery or as rock art. A few are shown here; in several cases the assumed identification to species may be problematic because the depictions are art, not snapshots. That the Mimbres depicted a creature in their art does not mean that the species was common in, or native to, the Mimbres Valley. All photographs in this article are by R. A. Barnes.

Elements of Montezuma Quail, Cyrtonyx montezumae; Scaled Quail, Callipepla squamata; and Gambel's Quail, Callipepla gambelii. Above: Image on a bowl at the Luna Mimbres Museum in Deming New Mexico. Below: (L) Montezuma Quail at Lower Gallinas Campground, Black Range, and (R) Gambel's Quail in Hillsboro.

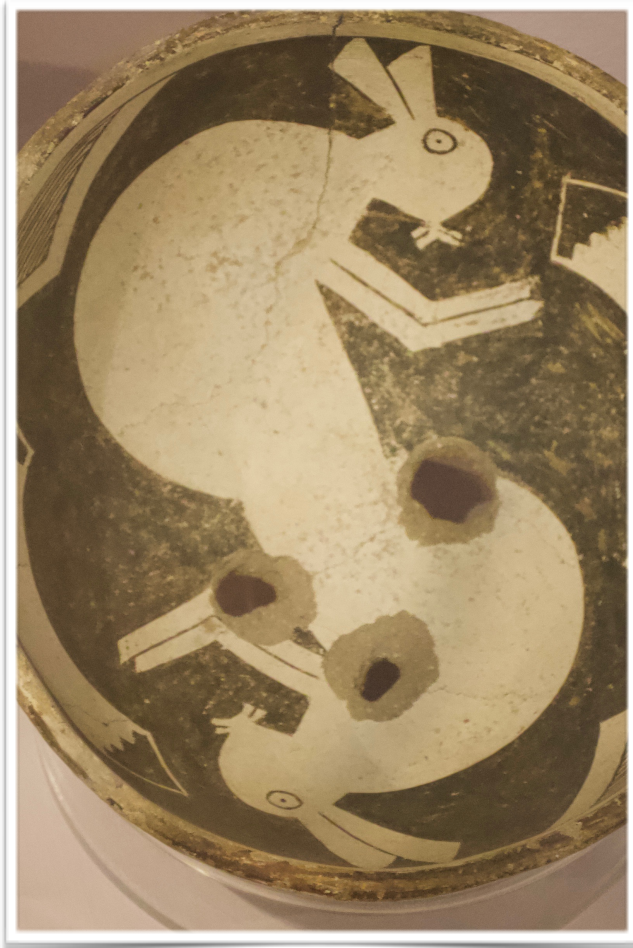
Dr. Schollmeyer's discussion (see previous article) about the relationship between the graphic depictions of animals (and in Mimbres art depictions of the natural world were nearly always animals), the use of those animals (almost always as a food source, but also in religious ceremonies and perhaps just as art), and the population of those animals is especially interesting. There are common themes and subjects and there are outliers. Consider, for instance, what I take to be a hummingbird coming to a flower in a glyph from the Pony Hills site. Hummingbirds were, probably, not sources of food. Other than corn, plants were not generally depicted, and it is not clear - to me - how often two graphic images are read together in Mimbres depictions.

Hummingbird coming to a flower. Pony Hills site.

The Early Peoples website, www.earlypeople.org, has an extensive galley of glyphs from the Pony Hills and Frying Pan Canyon sites.

By heritage and training I am biased toward compartmentalization. This point was driven home to me by Christina Thompson's, *The Puzzle of Polynesia - Sea People*. Perhaps a bit afield, but it is an excellent discussion of what happens when two cultures with significantly different concepts of the world try to understand each

other. My tendency to put things in boxes clouds my understanding of the Mimbres culture. It is quite possible that art, religious depictions, depictions of trade objects, and homage to food sources was all the same thing in the Mimbres zeitgeist - or not. Graphic depictions can inform, but the perceived meaning may be different than that intended.



The inspiration for the art of the Mimbres, like that of other peoples, may have derived from many perspectives. Rabbits, like those depicted on the bowl to the right, photographed at the Maxwell Museum of Anthropology, at the University of New Mexico, were common creatures - but important creatures, creatures that ate the crops and were, in turn, eaten. Many common elements may also have represented significant cosmological thoughts. Note that the Mimbres used both black-on-white and reverse images.

Probably a Black-tailed Jackrabbit, Lepus californicus, because of markings on ear, but perhaps Desert Cottontail, Sylvilagus audubonii. And possibly - a rabbit.. On a bowl in the Luna Mimbres Museum in Deming, New Mexico. Below, Desert Cottontail east of Hillsboro.

Jacob Jerome Brody found that non-human mammals were depicted on roughly a quarter of the Mimbres Classic vessels (p. 179, *Mimbres Pottery: Ancient Art of the American Southwest*). Many were rabbits. Rabbits were often associated with the moon in prehistorical southwestern cultures. (That is the rabbit in the moon you are seeing, not a man in the moon.)

There are 29 dashes on the side of the rabbit depicted on this bowl from the McDonald Observatory in west Texas. Signage at the observatory posits that the dashes may represent the lunar synodic period (29.5 days in length, the time it takes a lunar phase to reappear - full moon to full moon, for example).

Frog (based on legs and eye placement) on a bowl in the Luna Mimbres Museum in Deming, New Mexico, (above) and at the Maxwell Museum of Anthropology at the University of New Mexico (below).

Brody (p. 179) found that just over 20% of Mimbres pottery images were of birds, like the stylized quail from the first page of this article or the swallows - or swifts - which follow.

If I may use a birding term - the jizz of these birds simply screams "swallow". A bowl at the Maxwell Museum.

Jet bird effigy from the Mattocks Site (1100-1150 CE). Appears to be an amulet. Photographed at the Maxwell Museum of Anthropology, University of New Mexico.

The inspiration for these birds may have been the Great-tailed Grackles of this general region or a species much farther away.

Macaw images are an excellent example of the multiplicity of inspiration and/or message. Many people have studied the macaw trade which existed between Mesoamerica and the southwestern portion of the United States. Two species of macaw have been found in the Mimbres archaeological record, the Scarlet Macaw (*Ara macao*) and the Military Macaw (*Ara militaris*). These species have long brightly colored tail feathers which were used in religious ceremonies by many of the early peoples of the southwest. The remains of a third large species, the Thick-billed Parrot (*Rhynochopsitta pachyrhyncha*), is also found in the area. It is not possible to determine the species of macaw from the

Macaw glyph at the Pony Hills site, southwest of Cooke's Peak.

pottery and glyph images I have seen. It is possible to eliminate the Thick-billed Parrot from consideration as a species match in many cases because that species lacks a long tail. In those cases where only the head is depicted, I am not able to select or eliminate any of the three species from consideration.

Horned Lizard based on flattened body, on a bowl in the Luna Mimbres Museum in Deming, New Mexico.

Like the frogs depicted on the previous page, horned lizards are often depicted as seen from above, which is the way you would typically see them in the field. It is not possible to determine which of the several species found in this area this graphic depicts.

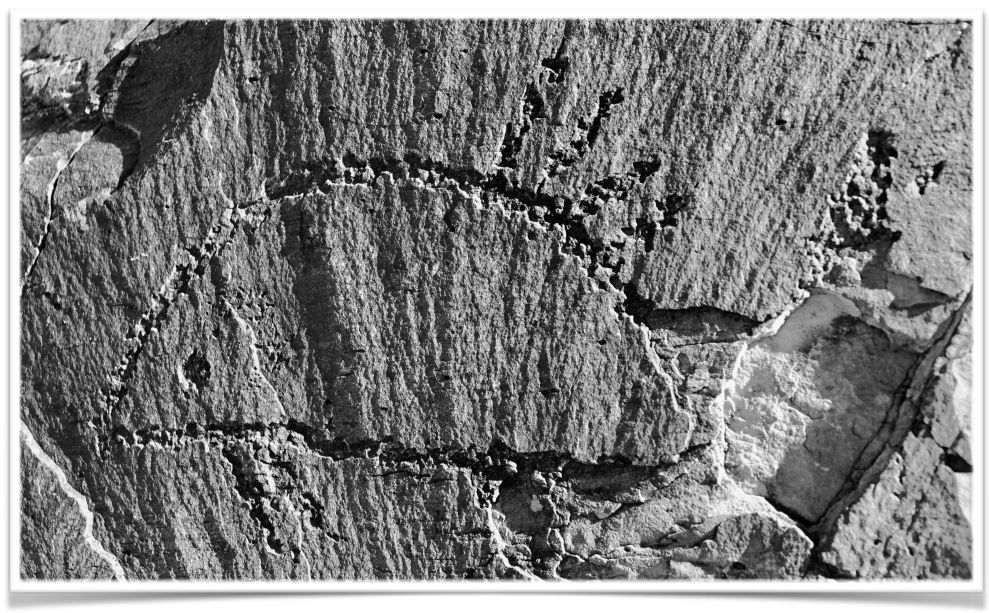
Military Macaw, Jalisco, Mexico

Although not the largest glyphs, these tracks up a rock wall are some of the most magical in the region - southwest of Cooke's Peak.

Despite the fact that there are only four toes, this is certainly a bear print, southwest of Cooke's Peak.

Footprints are often depicted in rock art and their presence is often attributed to specific purposes/roles. Human footprints are often said to be associated with the journeys of the various peoples described in the creation stories of many of the southwestern people.

Sometimes graphics are said to represent species which are not found in the Mimbres region. This is especially true of various fish images, a number of which have been identified to species by others. When depicted in rock art, fish



speciation determinations become more problematic. The best that I can do is note that in broad terms there are at least two types of fish depicted. One is flat bottomed, like the one shown above from the Jornada del Muerto area, east and south of the Caballo Mountains to our east. The other is more rounded on the bottom and is found in the southwestern part of the Black Range.

***Pronghorn**, Antilocapra americana, on a bowl in the Luna Mimbres Museum in Deming, New Mexico, and on the Nutt Grasslands at the SE edge of the Black Range.*

Bighorn sheep are often depicted in the art of the early people of the west, on their pottery, in glyphs (like the two above from the area southwest of Cooke's Peak), at apparent religious sites*, and in personal ornamentation including headdresses. The latter, especially, is often assumed to be associated with religious activities. I am not aware of glyphs in our immediate area which depict humans with bighorn sheep headdresses, but there are a number of examples farther to the east.

Desert Bighorn Sheep were extirpated from this area by the end of the 1800's.

Given the media that the Mimbres were working with, they left a remarkable record of the natural history which was all around them. It shaped their lives and, at least to some extent, was shaped by them.

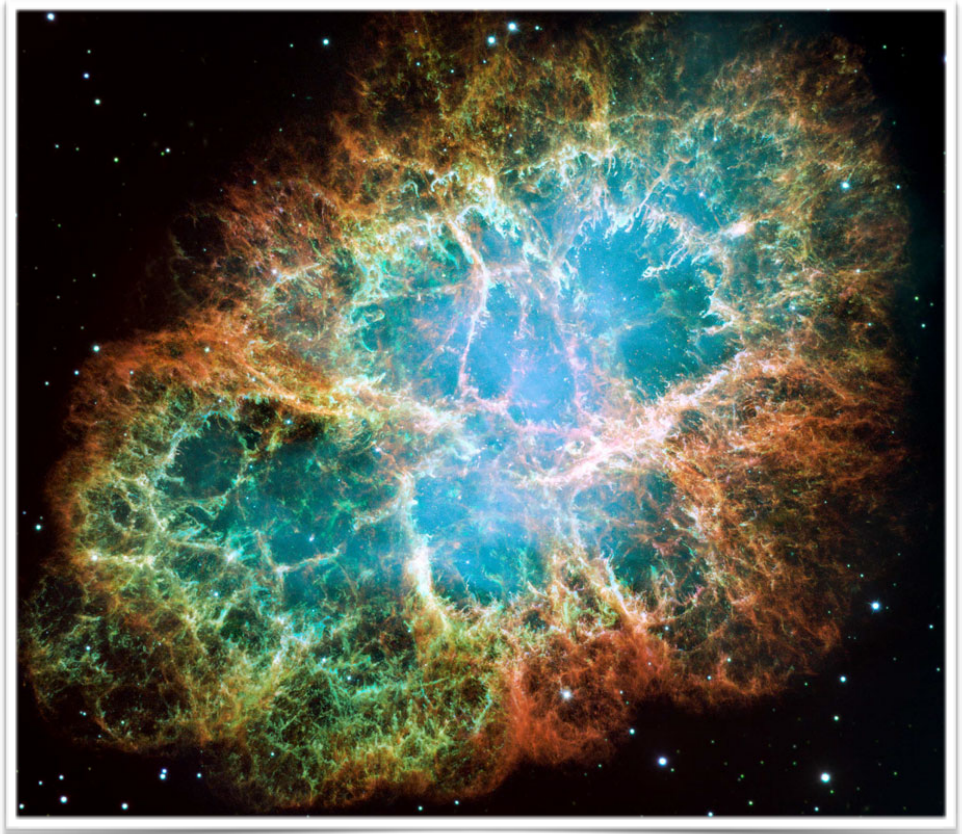
It is now assumed that ceramic pottery was first utilized by the Mogollon in about 300 CE. The use of clay to make unfired figurines dates from 5600 to 5000 BCE and unfired bowls from ca. 200 CE. It should not be assumed that these facts represent an evolution in technology in the region. It seems more likely that "fired" technologies were introduced from outside the region and that the two technologies were simultaneously used by the early peoples for a considerable time (unfired clay bowls were used [at least] as late as the 13th century CE).**

***"Great Basin Bighorn Ceremonialism - Reflections on a Possible Sheep Shrine at the Rose Spring Site, (CA-INY-372), Rose Valley, Alta California", Robert M. Yohe II and Alan P. Garfinkel. *California Archaeology*, Volume 4, Number 2, December 2012, pp. 201–224.**

**** "The First Occurrences and Early Distribution of Pottery in the North American Southwest", James M. Heidke and Judith A. Habicht-Mauche, *Revista de Arqueología Americana, No. 14, La Cerámica Más Antigua De Norte Y Mesoamérica* (enero-junio 1998), pp. 65-99.**

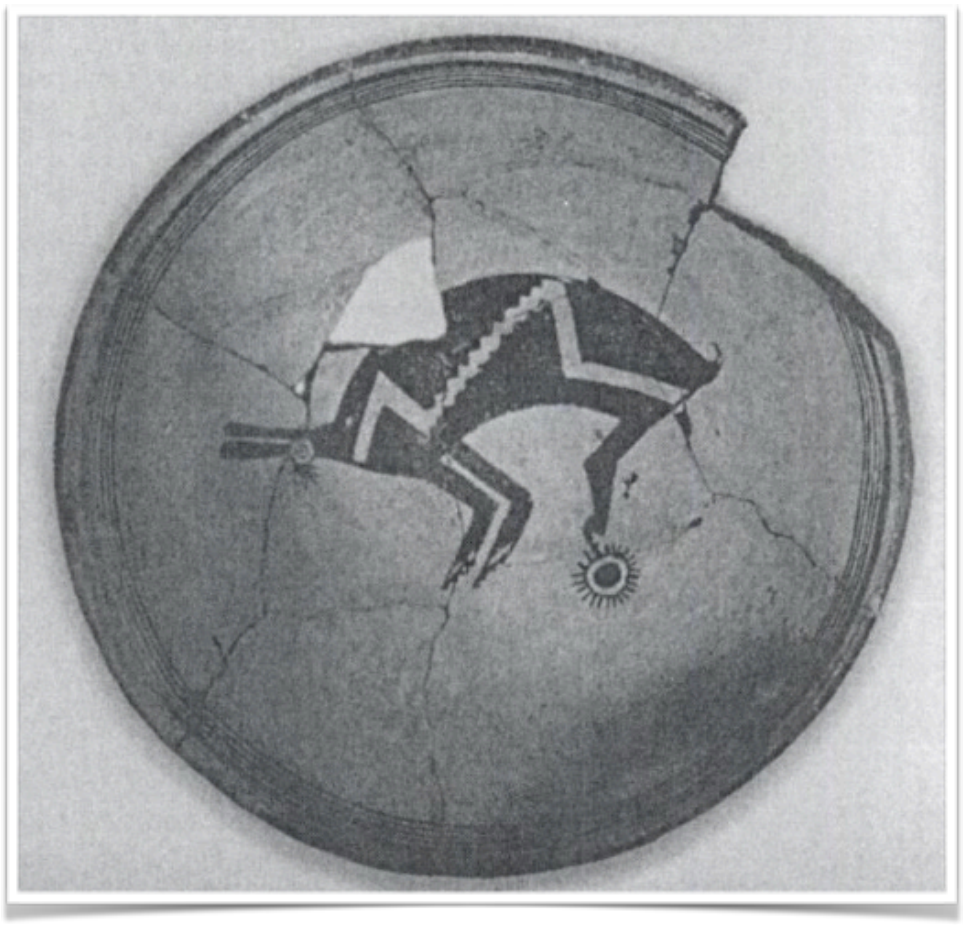
A Mimbres Controversy

A friend recently drew my attention to the work of R. Robert Robbins, an astronomer at the University of Texas at Austin. Robbins, in 1990, posited that the design on a Mimbres bowl documented the supernova of 1054 which formed the Crab Nebula. (A false color image of the Crab Nebula, from NASA, is shown below.)



NASA, ESA, J. Hester, A. Loll (ASU);
Acknowledgement: Davide De Martin (Skyfactory)

The Mimbres are known astronomers, and they documented various astronomical events and schedules in their art. They would certainly have noted the supernova. It was visible during the daylight hours for 23 days, based on Chinese records of the event, and remained visible to the naked eye for 21 months (24 months in some sources).



Did the Mimbres record the event? Some archaeologists thought not and attributed the bowl's design, which shows a rabbit and a round object with 23 rays near its foot, to other things. Others, like some claiming similar documentation from the indigenous people of Missouri and California, were prone to agree with Robbins.

Carbon-14 dating indicated that the bowl was not made prior to 1050. The site where it was found (Galaz) was abandoned in 1070.

Glyph in Chaco Canyon now believed to represent the supernova of 1054. The dot to the upper left is thought to be Venus.

The idea that the Mimbres might have recorded this event on at least one bowl and the recent findings at Chaco collided in my mind, forcing a bit of memory to happen. The image below is of a glyph in Frying Pan Canyon. It does not look like any other glyph I have seen in the area and looks suspiciously like the purported images of the supernova. If does depict the supernova, this would give us a good date for the images at Frying Pan, among other things.

A Natural and Unnatural History of Faunal Change in Southwestern New Mexico since AD 500." K.G. Schollmeyer and S.O. MacDonald. Poster presented at the 2017 Annual Meeting of the Society for American Archaeology, Vancouver, Canada, March 29-April 2.

A Natural and Unnatural History of Faunal Cha

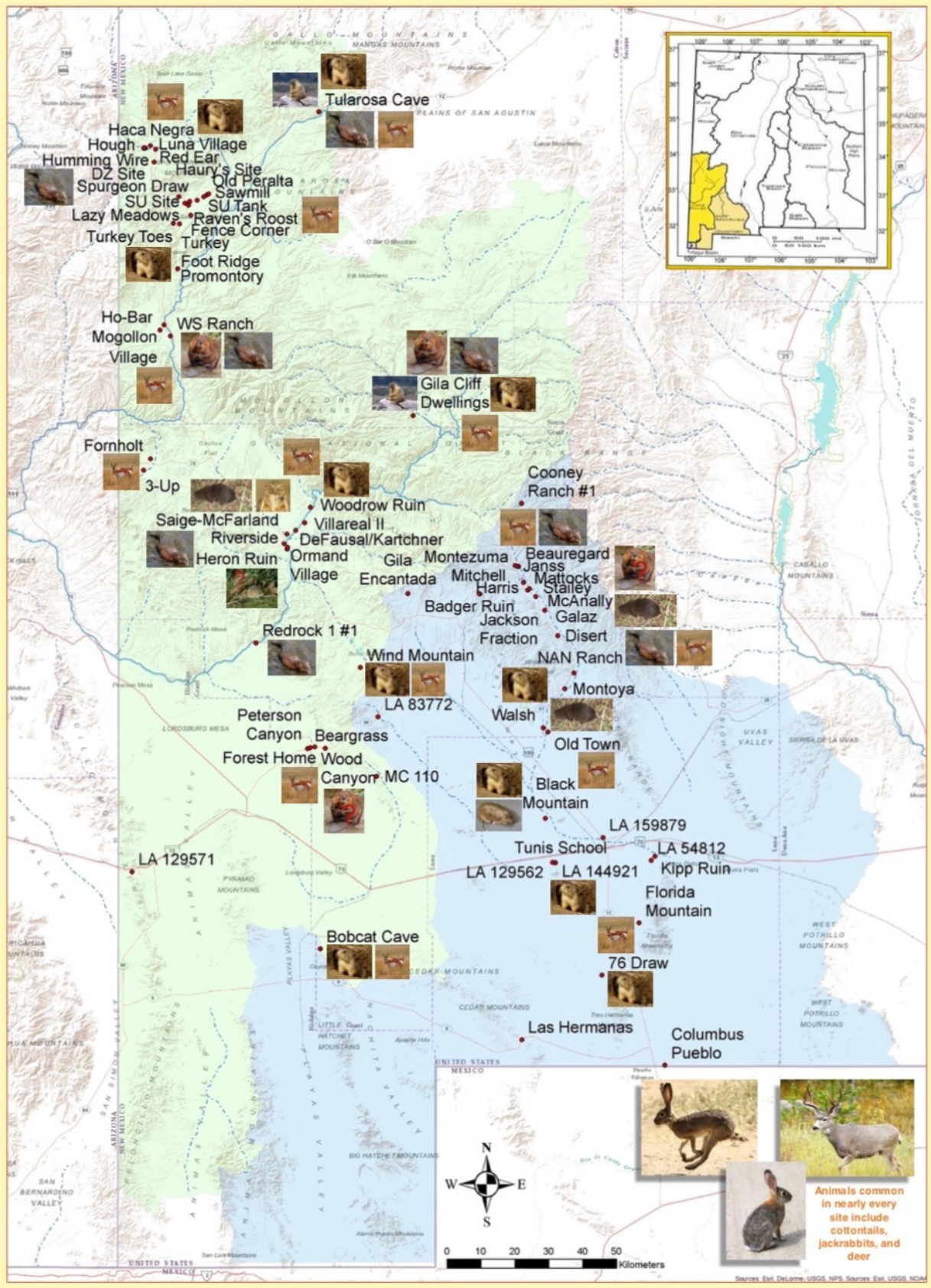
Archaeology Southwest

Karen Gust Schollmeye

[1]Archaeology Southwest [2]Museum of Sou

Project goals

- Compile faunal datasets (published and unpublished) and analyze key existing collections from as many archaeological sites as possible (currently, 96 assemblages comprising nearly 200 taxa of mollusks, fishes, amphibians, reptiles, birds and mammals from 45 sites)
- Focus on Mimbres and Upper Gila – San Francisco drainage areas in southwest New Mexico
- Examine changes in species abundance and distribution over time using archaeological and historic records
- Enhance interdisciplinary communication for archaeology and biology
- Publish results in a variety of venues



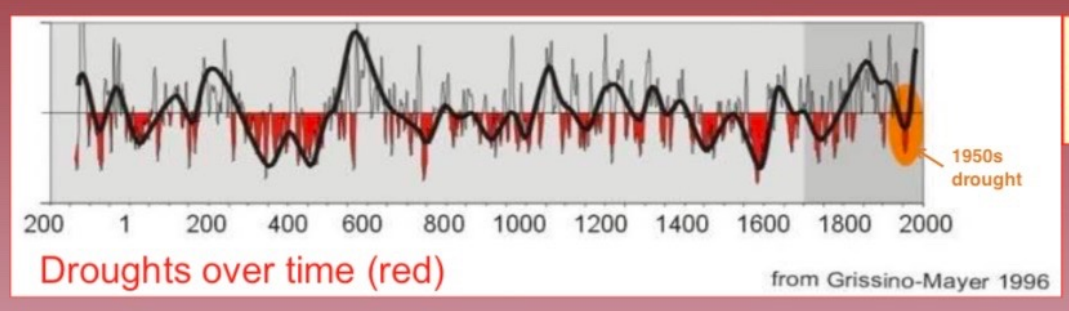
Aquatic species

Fish are uncommon in most archaeological assemblages, even in fine-screened contexts. However, a few sites (Fornholt, 3-Up, and WS Ranch in the San Francisco drainage, Saige-McFarland and Woodrow Ruin in the Cliff Valley, Janss and Montoya in the Mimbres Valley) have larger numbers, sometimes from just a few contexts.

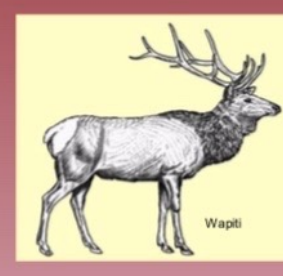
Archaeological fish remains are nearly always identified to the family level at best. Where possible, more specific identifications are highly desirable for understanding the distribution of native fishes. More than half of the region's native fish species are threatened or endangered today.

Catfish (*Ictaluridae*): listed in some archaeological reports, but the only native Southwestern species known historically (*Ictalurus pricei*) occurs only in the Rio Yaqui and Rio Casas Grandes drainages. Unclear identification criteria in published archaeological reports make assessing potential changes in distribution difficult.

California floater (*Anodonta californiensis)*: numerous archaeological worked and unworked specimens from the Gila and Mimbres valleys. This shell is unworkable after 48 hours, so transport is unlikely. May now be extirpated from its former range in Arizona, New Mexico and northern Mexico.



940-1040: long-term droughts
1210-1305: severe droughts
1917-1922: severe droughts
1949-1956: severe droughts



1000 BC-7000 BC Paleoindian Period: mobile hunter-gatherers, Clovis and Folsom points; sites with megafauna in SW generally, but the few sites known in this area consist of lithic scatters.

7000-1500 BC Early, Middle, and Late Archaic Periods: mobile hunter gatherers, low population density, small sites with short-term occupations.

1500 BC-AD 200 Late Archaic/Early Agricultural Period: agriculture begins supplementing wild resources; semi-sedentary villages in some places.

200-550 Early Pithouse Period: small clusters of houses, mix of farmed and wild resources, sedentary but likely short-term villages.

550-1000 Late Pithouse Period: villages become larger and more permanent as emphasis on farming increases; declines in large game relative to lagomorphs (hares, rabbits) visible by ca. 800.

1000-1130 Classic Mimbres Period: peak regional population, low mobility, emphasis on farming; large game relatively less common than lagomorphs; anthropogenic impacts on floodplain trees and preferred wild plant foods; "famine food" plants more common.

1130-1300 Early Postclassic Period leave the region around 1130; villages Tularosa, Black Mountain, and Animas perhaps a rebound in large game and forest and other riparian plants and a

A full-sized copy of this poster may be accessed at this link.

nge in Southwestern New Mexico since AD 500

er[1] and S.O. MacDonald[2]
hwestern Biology, University of New Mexico

Riparian species

Beaver (*Castor canadensis*): archaeological specimens in the Gila – San Francisco, uncertain in the Mimbres (two incisors in need of verification)

Muskrat (*Ondatra zibethicus*): multiple archaeological specimens in both drainages; rare today in Gila, absent from Mimbres.

Meadow voles (*Microtus sp.*): archaeological specimens in the upper Mimbres and Gila/Cliff Valley

Grassland species

Black-tailed prairie dog (*Cynomys ludovicianus*): multiple archaeological specimens in both drainages, extirpated today

Burrowing owl (*Athene cunicularia*): few archaeological specimens in the Cliff Valley, rare to absent today due to the destruction of their grassland habitat and the loss of the prairie dog colonies they associate with

Pronghorn (*Antilocapra americana*): multiple archaeological specimens in the grasslands of the region. Populations seriously depleted by the 1900s with local extinctions in the areas north of the Big Burro Mountains

Changes in species distributions

Meadow jumping mouse (*Zapus hudsonius*): possible archaeological specimens (yet to be verified) in Cliff Valley. Closest extant populations of this riparian-dependent species are in the White Mountains of Arizona, the Blue River just inside New Mexico, and southward to the middle Rio Grande.

Yellow-faced pocket gopher (*Cratogeomys castanops*): three specimens from Black Mountain site, current range is east of the Rio Grande

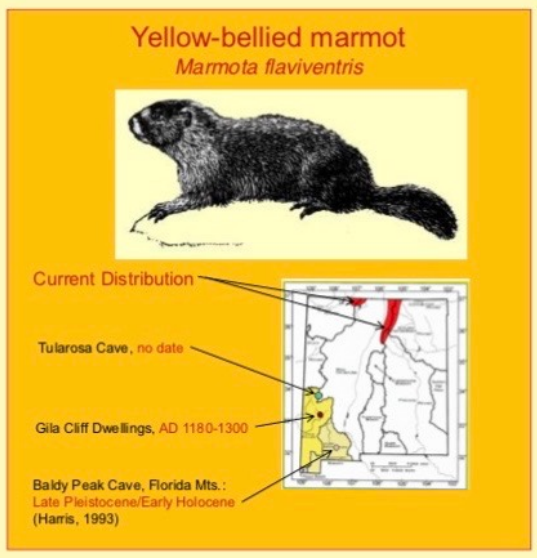
Initial results

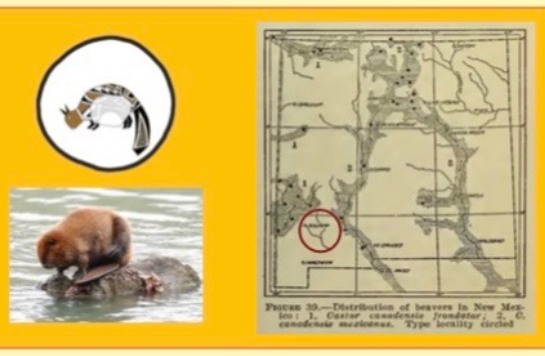
Naturogenic change

Holocene epoch warming and increasing aridification from south to north led to contraction of marmot range and apparently of several species of voles (*Microtus* sp.) as well. In contrast, the ranges of peccary and coati, for example, have recently expanded northward into the region.

Anthropogenic change

Several obligate aquatic, riparian, and grassland species found in archaeological assemblages are rare or absent today (e.g., mud turtle, muskrat, prairie dog), as the increased scale of human impacts has disproportionately affected these habitats.





Beaver range: a Mimbres conundrum

Two incisors reported as beaver have been recorded from the closed basin of the Mimbres River (Mattocks site), the only record of this species outside the watersheds of the Gila/San Francisco and Rio Grande. Were beavers once present in the Mimbres (there are no historical records-see figure from Bailey, 1931, at left), or were the incisors brought there from the Gila? Compounding the issue, recently beavers have been found active in stretches of the Mimbres. These are undoubtedly the result of unauthorized translocations.

Improving reporting in zooarchaeology

Zooarchaeologists should be more aware of when taxa occur out of their historic and modern ranges, and discuss this in reports. The use of fine screens to capture rodent teeth and other small but highly informative remains should become a more standard practice (Scarbrough and Harris, 1985).

When unusual or out-of-range taxa are found, we must discuss how they were identified and distinguished from similar taxa, with reference to anatomical markers or published discussions.

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Acknowledgments

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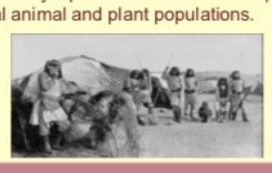
The prehispanic status of wapiti (elk) in the region is unclear. Based on the archeological record, apparently at no time were they numerous and by the turn of the last century, all were gone (Truett, 1996).

A growing body of archaeological and other evidence is revealing the natural occurrence of modern bison far "West of the Pecos" up to prehistoric/early historic times.

Apachean presence in the region by the late 1400s or early 1500s had profound consequences for land health. Their presence substantially delayed European intrusion and related land changes, and their mobile lifestyle produced few visible impacts on local animal and plant populations.



Late 1800s-early 1900s: a number of fishes, including the beautiful shiner (Mimbres), Gila topminnow (San Francisco), Palomas pupfish (Mimbres-Guzman), roundtail chub (San Francisco), and probably the razorback sucker and Colorado pikeminnow (Gila), went extinct from the region. Extirpations during this period also included bighorn sheep, pronghorn (Cliff area), a once common native reed (*Phragmites sp.*), and a freshwater clam (*Anodonta*), among others.

1935: last documented report of **grizzly bear** in the region
1941: last record of **wolf**
1950s: last **black-tailed prairie dogs** (south of White Signal)
1953: last **river otter** trapped near Cliff

1300 1400 1500 1600 1700 1800 1900 2000

ASSIC | LATE POSTCLASSIC | APACHES

HISPANIC PERIOD | AMERICAN PERIOD

many people linked to the phases; floodplain imals.

1300-1450+ Late Postclassic Period: large Cliff phase Salado and Animas phase villages; sycamores and reed grass still present in the Mimbres Valley, but absent during the American Period.

1747: first Spanish campaign into the Gila country against the Apaches and to explore the region. Todos Santos (near present-day Cliff) established to serve as a base of operations and used again in the 1756 campaign.

Mangas Valley, near Mangas Springs. Cut out in one night as result of an ordinary rain of about two hours' duration (Wooton, 1908).

Late 1800s: the exclusion of Apaches and resulting influx of ranchers and their abundant livestock, homesteaders, miners, and others into the region near the end of the 19th century quickly resulted in unprecedented destruction of land and wildlife through extensive overgrazing coupled with severe drought, widespread market hunting, and the relentless extermination of predators and other "pests." Aquatic and riparian habitats, where a large proportion of regional biodiversity resided, were especially impacted or destroyed.

Foliage Insects and Termites

by Walt Whitford

When I was a young ecologist working in a desert near Las Cruces, I read a paper by a distinguished ecologist with the title "Why the World Is Green." The premise of that article was that predators of insects that live on green plants control insect populations and that is why the world is green. That premise was not substantiated by other researchers who examined the chemistry of desert perennials. Those researchers reported a variety of feeding deterrents (chemicals) that are either toxic or disrupt the digestive systems of insects (tannins). Those chemicals include tannins, alkaloids, and terpenes. Perennial plants are "apparent", which means that perennials are always present, and with the exception of winter deciduous shrubs, are available to insects all year long. Populations of plant feeding insects are thought to be influenced by the predictability of the food resource in time and space. Long-lived perennials are examples of predictable resources and ephemeral or annual plants are unpredictable resources. Grasses are predictable and are dominated by sucking insects as are the evergreen shrubs.

Since most of the feeding deterrents are in the epidermal cells of leaves, many of the insects on shrubs have long, hollow tubes for sucking the fluids out of cells. The hollow mouth parts are inserted into the cells in the middle of the leaves where insects suck the fluids out of the cells. Sucking insects remove some but not all of the sugars in the cell fluids. This results in a droplet of "honey-dew" emerging from the anus of the sucking insect. Honey-dew attracts a number of species of ants that protect the sucking insects from predators. Honey-dew forms a glistening coat on the leaves of plants with populations of sucking insects. Sucking insects are in two orders (Homoptera and Hemiptera) with most of the species in the Homoptera.

Termites that were released from a dried cow dung pat. The termites have whitish grey bodies and yellow-tan heads. (Photo by Vic Crane)

Subterranean Termites

The most widely distributed subterranean termite in the northern Chihuahuan Desert is the Tube-forming Termite. Two other termites have been reported from arid and semi-arid regions of New Mexico. Wheeler's *Amitermes* was found in dead mesquite wood and in some dry cow dung pats but is uncommon compared to the Tube-forming Termite. A small number of *Reticulotermes* were reported from desert grasslands and is probably the most common genus of termites found in pinyon-juniper woodlands. Tube-forming Termites were named for their behavior of constructing tubes or sheeting over and around materials that they feed on. Tube-forming Termites eat virtually any carbon based material. Food items include cattle and rabbit dung, dead stems and leaves of grasses, herbaceous plants and woody shrubs, and dead cactus pads. Gallery tubes and sheeting are not produced during periods of hot-dry weather. During such periods, Tube-forming Termites are limited to feeding on large objects on the surface of the soil such as soaptree yucca logs and cattle dung pats. Termites locate these objects by temperature shadows in the soil below the item. When monsoon rains have moistened the soil, Tube-forming Termites initiate gallery construction. Galleries provide a degree of protection from predators and provide a shaded, cool environment for termite workers to carry pieces of leaves, stems, etc. back to the underground colony or to remove the softened layer of woody stems.

Termite gallery sheeting on an accumulation of dead grass and other dead plant fragments and on dead stems and leaves of a tussock grass.

Subterranean termites inhabit most habitats in the area except for places that may remain flooded for more than a week. It has been reported that the total weight of termites per unit area exceeds the total weight of cattle that are produced on that area in a year by a factor of

more than ten. Why are subterranean termites so abundant in the Chihuahuan Desert? First they can eat almost any dead plant material plus fecal materials of many animals. During dry seasons and in winter, subterranean termites feed on dead roots. Termites are able to digest cellulose, and even tougher wood fibers, because of the bacteria, yeasts, fungi, and protozoans in their gut. They can live on a diet of pure cellulose because they are able to fix atmospheric nitrogen into molecules that are needed to make proteins. Because of this ability, they produce their own essential amino acids. When termites build galleries on dead woody stems, they only graze off about half a millimeter of material that has been softened by fungi. Even this small amount of material more than balances the cost of producing a gallery around the stem. Building foraging tubes and galleries is a type of chain-gang operation. When a termite reaches the rim of the structure, it empties the wet clay from its buccal cavity (basically a throat pouch) which is deposited by the mandibles over the

A Tube-forming Termite foraging gallery built around a dead crucifixion thorn stem. (Photo by Vic Crane)

sand grain(s) left by the previous worker. The termite then sets the sand grain in its mandibles on the clay cement layer. This process is repeated many hundreds of times per hour with a structure appearing and growing during that time period.

Subterranean termites have been called the earthworms of arid and semi-arid regions. They produce galleries in the soil that allow water to travel deep into the soil by a process known as bulk flow. Those galleries replace the tunnels made by earthworms in moister conditions. Termite galleries are also enriched by feces which termites incorporate into their galleries. Plants get fertilized by the galleries.

Other Arthropods

In summer, especially during and right after the monsoon rains, there are a number of arthropods that are frequently seen and that have some interesting behaviors. Dung beetles are fascinating because they roll balls or small pieces of fecal material to suitable burial sites. Dung beetles lay an egg or eggs in the dung ball which provides the food for the developing larvae. The dung ball or dung fragment is then buried and remains so until the larvae emerge. Dung beetles are common wherever there are cattle.

There are a large number of black beetles that live in the Black Range area and the most frequently seen are many species of "stink beetles". One study reported four different species of stink beetles each of which was most abundant during a short time in a particular season. Stink beetles are so named for their habit of standing on their head when disturbed and exuding an evil smelling drop of liquid from their rear. The liquid that is exuded is sufficient to deter most predators. However, grasshopper mice are known to grab a stink beetle and shove its rear into the ground and proceed to eat the beetle like an ice cream cone. Stink beetles eat mostly dead plant material and are often seen at the margins of harvester ant nests feeding on the seed hulls and other materials rejected by the ants. Occasionally a stink beetle will walk across a harvester ant nest disk to access the chaff pile and will be attacked by the ants. Different species of stink beetles exhibit activity patterns that peak in different seasons: a spring species, an early summer species, monsoon season species, and autumn species.

Less common black beetles are predatory carabid beetles. Carabid beetles can be identified by their size (larger than stink beetles) and large mandibles or jaws. These beetles are most active after the monsoon rains have stimulated the activity of lots of arthropods. Carabids move rapidly and hunt in most habitats.

In early summer you may hear loud buzzing sounds emanating from branches of a tree in your yard or in a neighbor's yard. The sound is coming from an adult cicada. Most cicadas have membranes that vibrate rapidly when pulled by tiny muscles, and that vibration is the source of the buzzing sounds. After mating, a female cicada flies to a branch or stem and uses its scythe-like ovipositor (egg laying structure) to cut a groove into the stem into which eggs are deposited. The eggs mature in two to seven months and the larvae emerge and drop to the ground.

Townsend's cicada on a creosotebush stem. This is a common cicada of the northern Chihuahuan Desert that frequently sings and oviposits on creosotebush stems. (Photo by David Lightfoot)

Larvae tunnel into the soil and take up residence near roots of a plant. Larvae feed on the sap of roots which provides the energy and nutrients for growth of the larvae. Larvae moult a number of times before reaching adult size.

The large desert millipede (literally a thousand legs) is usually seen only after rains have moistened the soils. When disturbed, this millipede curls up into a coil and exudes an evil smelling substance from its body. Millipedes spend most of their lives underground and only come to the surface to feed and mate. The desert millipede moves very slowly and will climb into vegetation to escape hot soil or to feed on dead bark. Millipedes consume soil containing bacteria which are probably a source of nutrition. When active on the surface, desert millipedes have been observed feeding on dead plant materials that accumulate under shrubs. Gut contents of desert millipedes include lots of sand plus fragments of leaves, stems, and insect parts. In one published report, desert millipedes climbed into mormon tea plants where they fed on dead bark. In the middle of the day the larger millipedes avoided the lethal temperatures of the soil surface by clinging to branches of shrubs two to three feet above the ground. Other millipedes enter rodent burrows and holes made by other animals to avoid the high temperatures and dry conditions of the air.

Giant Desert Centipedes are mostly nocturnal and rarely seen unless forced from a refuge under a rock or log such as a yucca trunk. These predatory arthropods take a variety of prey as large as rodents, reptiles, birds, spiders, and insects. They have a venomous bite that includes a heart toxin, an enzyme that breaks down blood cells and other cells, and a nerve toxin. The bite is not fatal to humans but can be very painful and result in necrosis (death) of tissue around the bite area. Centipedes are prey for several animals such as grasshopper mice, some birds, reptiles, spiders, and other centipedes.

Sun Spider, Camel Spider, and Wind Scorpion are names that have been applied to these animals. However, there

***Orthoporus ornatus*, the Desert Millipede, immediately above and above right, photographed near Hillsboro by R. A. Barnes.**

Solifugid (sp?) - Sun Spider, Lake Valley, New Mexico, Photographed by Matilde Holzwarth

Cicadidae nymph, photographed in Hillsboro by R. A. Barnes.

are many anatomical differences between true spiders and sun spiders. Sun spiders breathe through a tracheal system with air intake and exhalation through three pairs of slits on the underside of the animal. The most distinctive feature of camel spiders is their chelicerae (jaws). The chelicerae are jointed, thus producing a powerful pincer which is capable of shearing hair or feathers from vertebrate prey. They can also cut through skin and small bones. Sun spiders are carnivores that feed on termites, darkling beetles, and other ground dwelling arthropods. They have also been reported to feed on snakes, lizards, and rodents. One study reported large numbers of sun spiders living on prairie dog colonies.

Sun Spider or Solfugid. Note the black chelicerae. (Photo by David Lightfoot)

Late summer and early autumn are the best time to see grasshoppers. There are many grasshopper species in the northern Chihuahuan Desert, and most of those are very hard to see because of their cryptic color patterns. Dr. David Lightfoot, who has studied grasshopper populations in the desert for more than thirty-five years, classified the cryptic grasshoppers into two main types: grasshoppers that spend most of their time on the ground and grasshoppers that spend most of the time in vegetation. Ground-loving grasshoppers tend to mimic stones and soil with their disruptive color patterns, and plant loving grasshoppers have body shapes and color patterns that makes seeing them very difficult when they are on grasses.

Among ground-loving grasshoppers are "lubber" grasshoppers with short fat bodies. Lubbers do not hop very far or fast and depend mainly on their cryptic color patterns to escape from predators.

Band-winged Grasshoppers are the most common ground-loving grasshoppers in the Northern Chihuahuan Desert. Band-wings' background match the color of the soil in the area in which they live. For example, Pallidwing Grasshoppers on red soil are reddish, white on white soil,

A ground dwelling Robust Toad Lubber Grasshopper on stony desert soil.

and dark brown or black on dark brown soils or on black soils. In addition to background matching, Band-wings escape predation by startling a predator or hiker by taking to the air when an intruder is near. A predator or hiker tends to focus on the brightly colored hind wings that are exposed when the grasshopper is flying. When the grasshopper drops to the ground, the banded wings present a broken pattern that blends in with the substrate and the hopper basically disappears.

Band-winged Grasshopper (photo by David Lightfoot)

Not all lubbers have cryptic (camouflage) color patterns. Horse Lubbers are distinctive with black bodies and bright yellow streaks around the head and thorax. The black and yellow colors warn potential predators that these large grasshoppers not only taste bad but can be toxic and/or lethal. If attacked by mice, Horse Lubbers emit a foul smelling spray along with a hissing sound that deters most potential predators. Most of the toxins developed by Horse Lubbers come from the grasshopper's diet. Horse Lubbers consume small amounts of leaves of many desert shrubs, but annual herbaceous plants make up most of the diet. Toxins and feeding deterrents from items Horse Lubbers eat are stored in special structures near the base of the wings and in other areas of the body. If a Horse Lubber is eaten by a mammal or bird, the toxic tissues cause vomiting and perhaps death. Plains Lubbers are commonly seen grasshoppers from late August through October. Plains or Western Lubbers share many characteristics with other ground dwelling lubber grasshoppers. Western Lubbers have a varied diet of herbaceous plants. Lubbers overwinter as eggs which hatch in the spring. They reach adult size in August.

Like Horse Lubbers, Harlequin or Rainbow Grasshoppers have aposematic (predator warning) coloration that communicates its toxicity to would be predators. Harlequin Grasshoppers sequester toxins from the plants that they eat and these chemicals make them unpalatable to most predators.

Cryptic color patterns are common among grasshoppers that live in shrubs. Some vegetation mimics are dark colored and are most cryptic on stems of shrubs like creosotebush or mesquite. Creosotebush Grasshoppers and

Harlequin or Rainbow Grasshopper (photo by David Lightfoot)

Creosotebush Katydids are among the most difficult to see among the leaves of their shrub. These insects are most visible during breeding when males stridulate (make noise) to attract females. Male Creosotebush Grasshoppers are territorial and defend their home shrub against intruders. During the late summer-early autumn breeding season, these insects may be detected because of their movement

A Creosotebush Grasshopper on a creosotebush stem (Photo by David Liahtfoot)

within a shrub. The Creosotebush Grasshopper and Creosotebush Katydid are unique in that these Orthopterans eat only leaves of creosotebush. Most species of grasshoppers and katydids feed on a large number of plants. Dietary specialization is unusual among such insects.

Not all grasshoppers that take refuge in creosotebushes are as cryptic as the Creosotebush Grasshopper. The Olive-green Grasshopper has a color pattern that provides some camouflage when the insect is in a creosotebush but not to the same degree as the Creosotebush Grasshopper.

Grasshoppers that mimic the color patterns of the grasses in which they live are among the most difficult large insects to see. These grasshoppers are characterized by thin,

elongated bodies and slant faces. They are frequently called slant-face grasshoppers.

There are many other arthropods of the Black Range region that are hidden below ground most of the time or hidden under rocks and debris. Some of the most abundant arthropods in the desert are species that hide during the day under rocks and debris. Common crickets and camel crickets are seldom seen except at night but are abundant arthropods and an important prey base for nocturnal predators.

An adult Tarantula Hawk Wasp feeding on nectar and pollen. (photo by David Lightfoot)

You may encounter holes in the soil with no tell-tale signs of the digger of the hole or its occupants. Many of these holes may be those of tarantulas or wolf spiders. Wolf spiders emerge from their burrow at night and sit near the entrance and wait for passing arthropods like crickets. They pounce on the prey and drag the prey into their burrow. Because wolf spiders only emerge from their burrows after dark they can usually only be seen with a black light. Wolf spiders are not limited by prey abundance. Wolf spiders are frequently attacked in their burrows by parasitic wasps. Wasps sting the spiders and lay an egg on the paralyzed spider. The wasp larva feeds on the paralyzed spider until it matures. The most common wasp that stings spiders is the Pepsis Tarantula Hawk Wasp. These wasps are frequently seen in the summer running on the ground while flicking their red wings. Ground searching may be the wasps' strategy for locating burrows of wolf spiders and tarantulas.

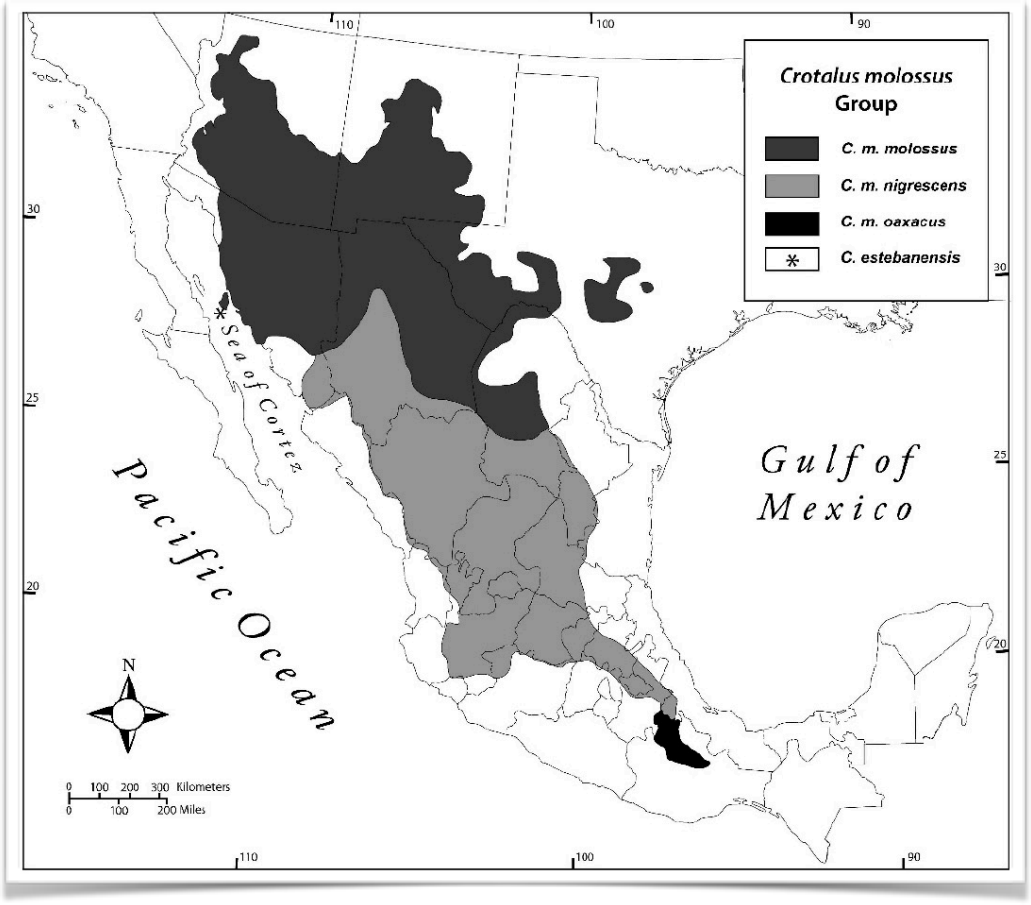
You are most likely to see a tarantula after good summer rains during the monsoon season because these large spiders are moving about in the early morning hours looking for potential mates. Although tarantulas frighten some people, they are harmless to humans because their venom is weaker than that of most bees. Tarantulas prey primarily on insects but may also take small frogs and mice. Chihuahuan Desert Tarantula produce a low web around the entrance to their burrow which probably acts as a trip wire to alert the occupant when something approaches the burrow.

Tarantulas have few natural enemies. Pepsis Tarantula Hawk Wasps are the most common wasps that keep the numbers of tarantulas in check. Tarantula hawks sting large spiders including tarantulas. The sting paralyzes the victim which the wasp pulls into an area where the wasp can bury the spider. The tarantula hawk wasp then excavates a shallow pit, lays an egg on the spiders' body, and then covers the body with soil from the pit. After the egg hatches, the tarantula wasp larva consumes the flesh of the live spider. The paralyzed spider is a unique way of keeping the food of the young wasp fresh. Pepsis Tarantula Hawks in the Chihuahuan Desert vary in size depending upon the size of the spider paralyzed by their mothers. Adult Tarantula Hawks feed on nectar and pollen, and it is in the larval stage that these wasps are parasitoids. (Parasitoids are animals that do not live on or within the host for their entire life).

Eastern Black-tailed Rattlesnake

by Bob Barnes

In our first issue, Randy Gray provided an excellent summary of the rattlesnake species found in the Black Range. In "Rattlers of the Black Range", he noted that the Black-tailed Rattlesnake, *Crotalus molossus*, had recently been redescribed as two separate species by Anderson and Greenbaum.[1] In summary, the authors of the article Randy referred to "resurrect(ed) the name *Crotalus ornatus* Hallowell, 1854 for Black-tailed Rattlesnake populations in the Chihuahuan Desert and central Texas, USA" (paper abstract).



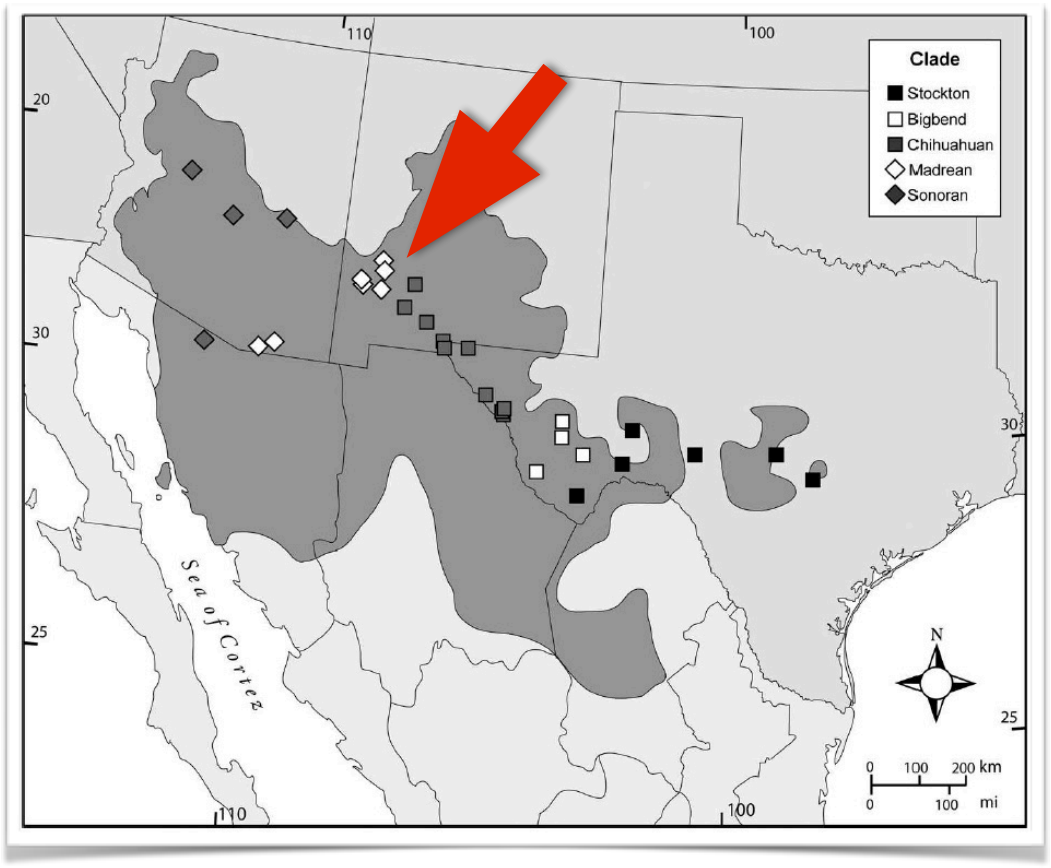
Prior to the split, the most northerly subspecies of the Black-tailed Rattlesnake (*Crotalus molossus*) group was the one we are familiar with here in the Black Range - *C. m. molossus*. The range map shown above describes the subspecies distribution prior to the paper; it is from page 20 of the cited publication and is from Campbell and Lamar (2004).[2]

Rattlesnakes are thought to have originated in central Mexico.[2, 3, 4] The divergence of these creatures into thirty-five (or 32) species is estimated to have begun between 20 and 30 million years ago.[4] This dating was determined by using a variety of techniques including Monte Carlo (Markov Chain) runs, an assessment of fossil records, and morphological investigations. The greatest diversity of rattlesnake species is found on the Mexican plateau and adjacent mountain ranges. The most likely zone of origination lies within the Sierra Madre Occidental.[4]

It is the most northerly of the subspecies which is of interest to us and the subject of the paper by Anderson and Greenbaum. The analysis performed by the authors found that divergence within *C. molossus* most likely began in the late Miocene, about 7.95 million years ago.

At page 30 of the subject article, a graphic summary (see following page) of the various clades studies indicated a geographic boundary (the Black Range) between the clades (see arrow - added). The differences between the snakes to the east (the Chihuahuan Desert and central Texas populations) and to the west were significant enough to break the clades into separate species. The Madrean and Sonoran clades to the west remained as a subspecies of *C. molossus, C. m. molossus* (the Northern Black-tailed Rattlesnake in some sources and the Western Black-tailed Rattlesnake in other sources). A total of 142 (significant) mutations have occurred between the two populations

Above: Crotalus molossus from near Portal, Arizona.
Below: Crotalus ornatus from the southeastern slopes of the Black Range.
Photographs by Randy Gray.



(east and west) since they were last in contact in the early Pliocene.

The eastern population had been described by Hallowell in 1854 as *Crotalus ornatus* - later subsumed into *C. molossus*. The authors proposed that *C. ornatus* be restored as a full species and that the English common name of Ornate Black-tailed Rattlesnake be adopted.

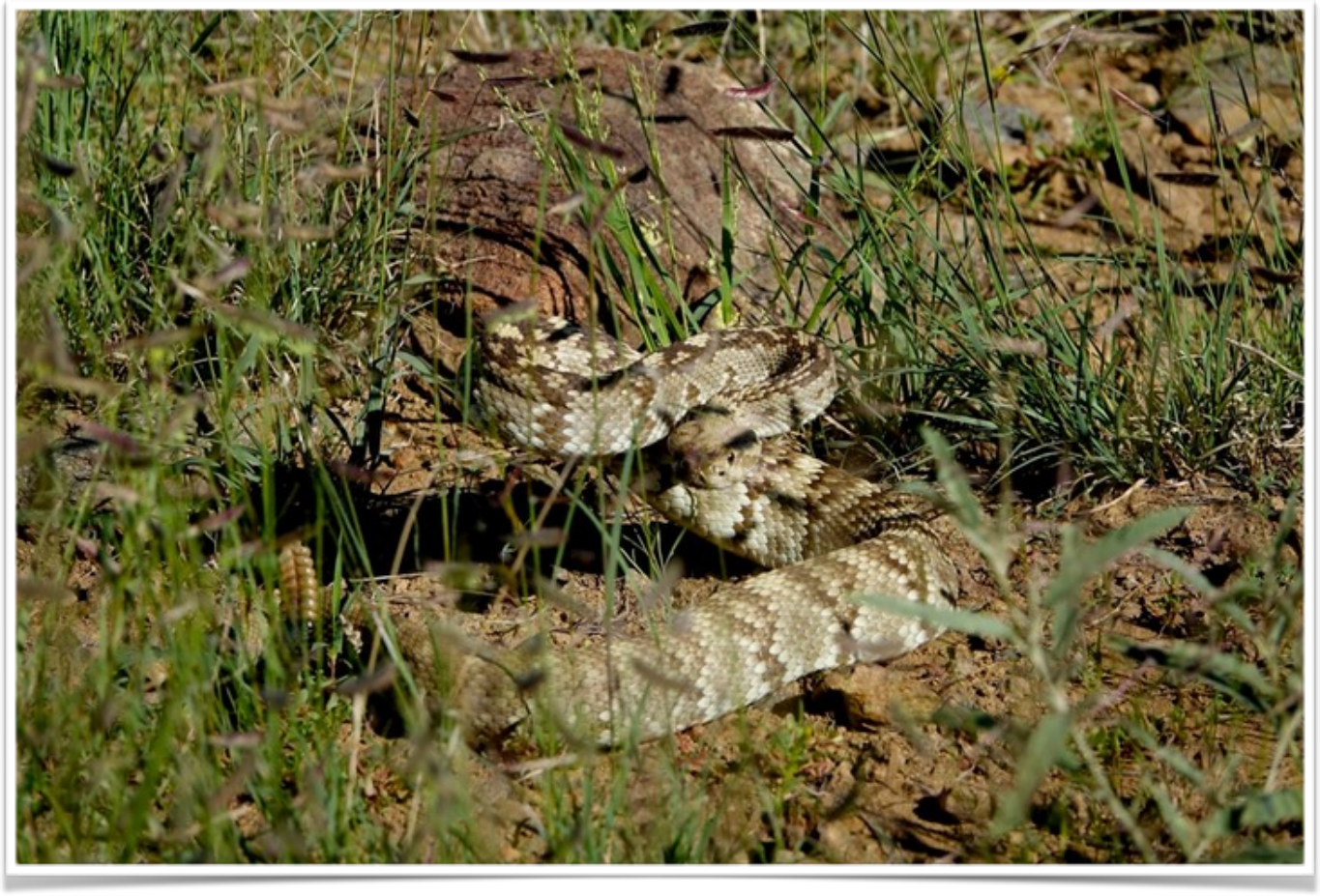
"*C. ornatus* is present in the Cook's Range, the Mimbres Mountains, and the eastern slopes of the Black Range in south-central New Mexico. *Crotalus molossus* sensu stricto is present in the Madrean Archipelago of southwestern New Mexico, the Mogollon Mountains, and the Pinos Altos Range north of the Deming Planes (sic). The wide swaths of desert grassland that currently provide corridors between Sonoran and Chihuahuan habitats likely prevent dispersal between many of the mountain ranges occupied by *C. molossus* and *C. ornatus* in this region. However, mountain ranges that define the northern border of the Deming Planes (sic) (Mogollon, Pinos Altos, Mimbres, and Black Range) seem relatively well-connected and might allow contact between lineages. In this region, the Mimbres River and western continental divide north of the Mimbres Valley seem to represent the only potential barrier that may explain the apparent lack of introgression between *C. ornatus* and *C. molossus*" (page 46 of the subject article).

The zone of separation discussed above is the Cochise Filter Barrier (generally the zone between the Sonoran and Chihuahuan desert ecosystems). This area, and the significance it has for Northern Cardinals, was discussed in Volume 2, Number 2, of this publication ("The Work of Kaiya Smith and Others"). Even in the case of Northern Cardinals, which fly, the Barrier has played a significant role in speciation. At page 46 of the Anderson/Greenbaum article there is a rather good discussion of how the Cochise Filter Barrier developed and why it has had such a significant impact on the plants and animals of this area.

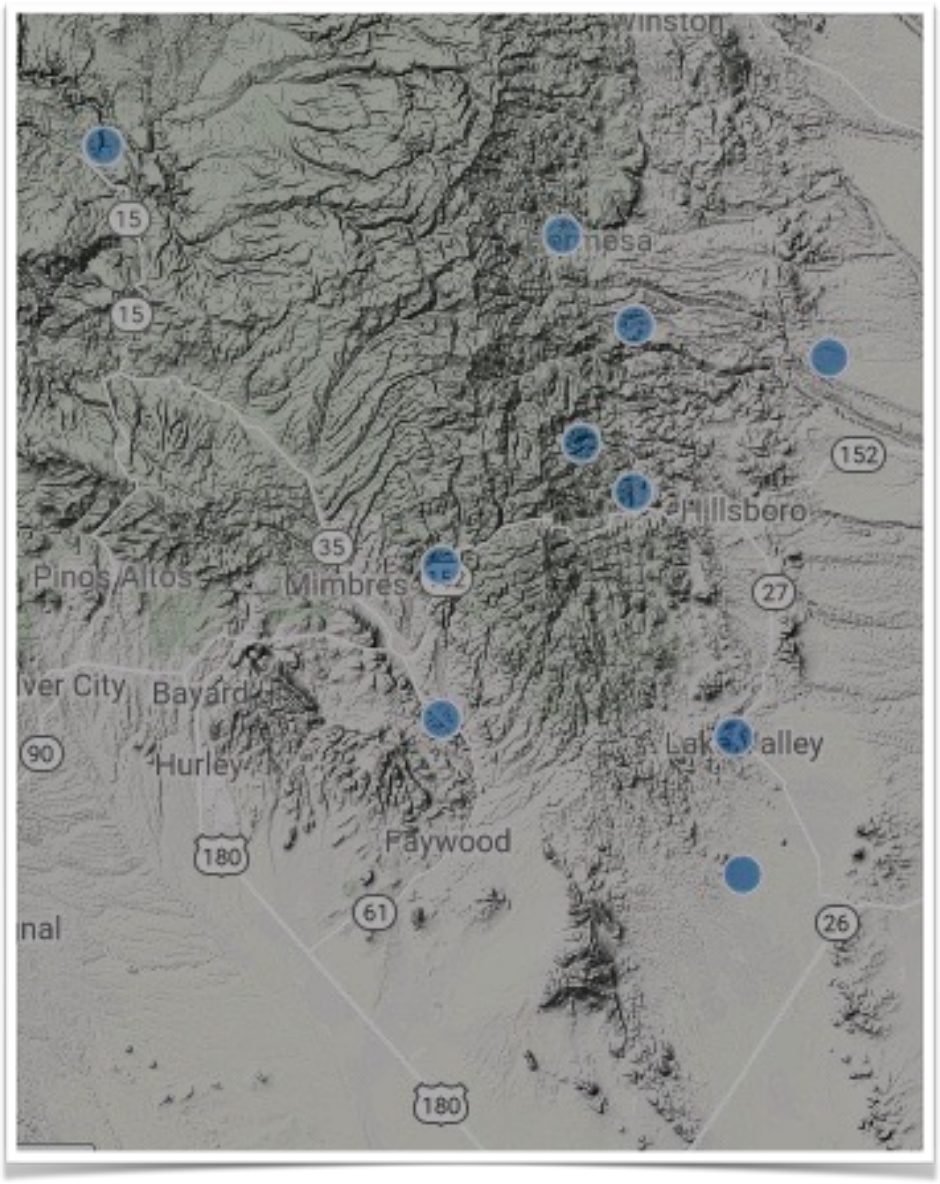
The Mimbres people depicted rattlesnakes in their art frequently, but the species depicted can not generally be determined - as in the glyph shown here from the Pony Hills petroglyph site.

The Ornate Black-tailed Rattlesnake (*C. ornatus*) is encountered periodically along the eastern slopes of the Black Range. The photo below is from near Andrews (n.e. of Hillsboro).

iNaturalist is a citizen science website which is often used in more formalized scientific studies. Recent sightings of the Ornate Black-tailed Rattlesnake (or as iNaturalist refers to it, the Eastern Black-tailed Rattlesnake) are shown on the map at the top left on the following page.

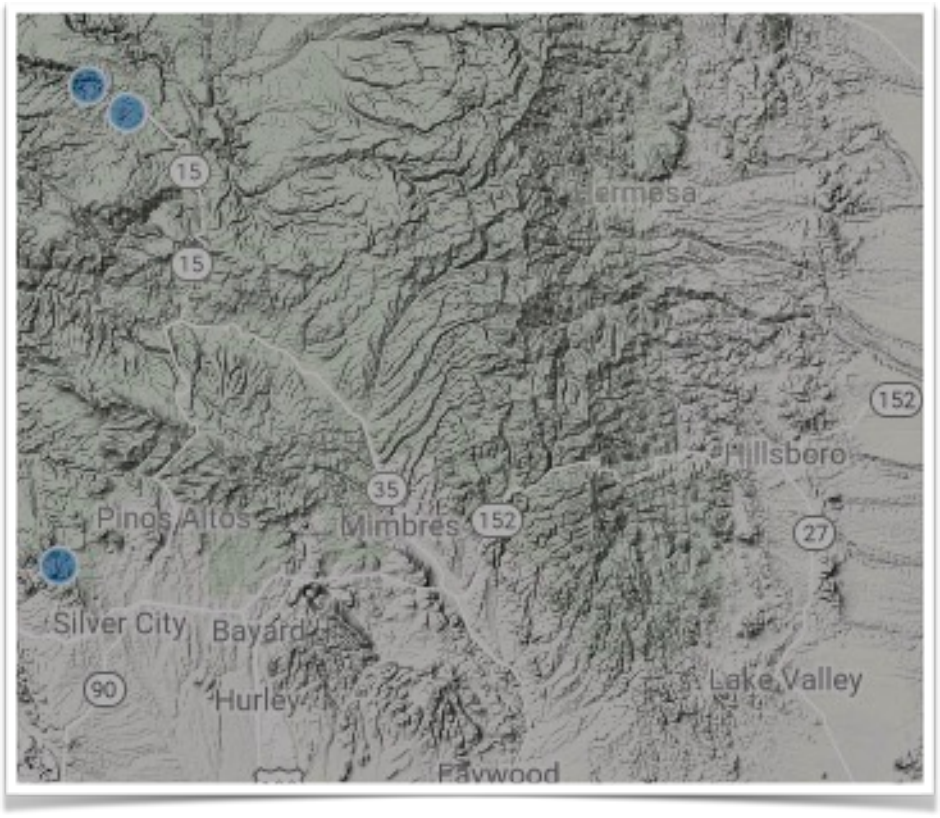


The English common name for *Crotalus molossus molossus* is also unsettled with both Northern Black-tailed Rattlesnake and Western Black-tailed Rattlesnake being used.



Crotalus ornatus sightings documented on the iNaturalist website. The sighting shown in the upper left is from the Middle Fork of the Gila River, not far from where the video of what Bob Barnes identified as a Northern Black-tailed Rattlesnake was taken.

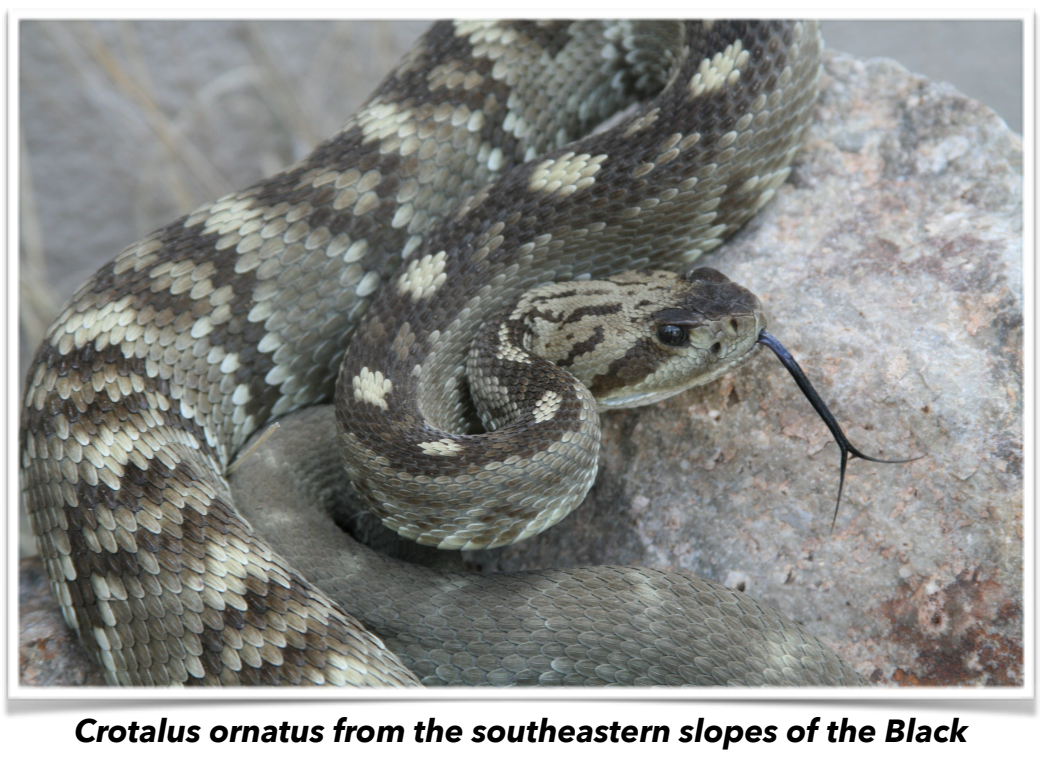
The iNaturalist map of sightings for this subspecies (the subspecies which is found near the Black Range) is shown below.



Crotalus molossus molossus sightings documented on the iNaturalist website. The righthand sighting of the two shown in the upper left is in the vicinity where the video mentioned above was recorded.

Note that sightings of both species are documented on iNaturalist for the area around the Gila Cliff Dwellings. This may represent a misidentification of the Ornate Black-tailed Rattlesnake recorded for that area, it may represent the fact that this is an area where both species are present, or it may represent the possibility of intergrades at this locale. Video of a snake recorded at the Gila Cliff dwellings is found at this link.

Middle Percha drainage (west of Kingston).



Crotalus ornatus from the southeastern slopes of the Black Range, photograph by Randy Gray. July 2019

In general, it is fairly safe to assert that a Black-tailed Rattlesnake found in the Black Range will be *C. ornatus*.

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1. "Phylogeography of Northern Populations of the Black-Tailed Rattlesnake (*Crotalus molossus* Baird and Girard, 1853), With the Revalidation of *C. ornatus* Hallowell, 1854" by Christopher G. Anderson and Eli Greenbaum, *Herpetological Monographs*, 26(1):19-57. 2012

2. Campbell, J. A., and W. W. Lamar. 2004, The Venomous Reptiles of Latin America. Cornell University Press, USA.

3. Murphy, R.W., J. Fu, A. Lathrop, J. V. Feltham, and V. Kovac. 2002. "Phylogeny of the rattlesnakes (Crotalus and Sistrurus) inferred from sequences of five mitochondrial DNA genes". Pp. 69–92 in G.W. Schuett, M. Hoggren, M.E. Douglas, and H.W. Green (Eds.), Biology of the Vipers. Eagle Mountain Publishing, USA.

4. "A Quantitative Analysis of the Ancestral Area of Rattlesnakes" by Aaron J. Place and Charles I. Abramson, Journal of Herpetology, Vol. 38, No. 1 (March 2004) pp. 152-156

Aldo Leopold - His Legacy - Part 2

By Steve Morgan

When Aldo Leopold arrived on the Carson National Forest on May 12, 1911, he found a forest much different than the Apache he had come to know so well. Where the Apache National Forest had been wild and mainly unexplored, the Carson had been heavily used for years by the sheep and cattle ranchers. Though the two forests had been established on the same day, July 1, 1908, the Carson National Forest had not been managed well. Arthur Ringland, the District 3 Forester, assigned Harry C. Hall as the new Forest Supervisor, with Aldo Leopold as his Assistant Supervisor, and the new team was put in charge of the Carson to "put the house in order."

The Carson National Forest sprawled across two mountain ranges and covered over nine thousand square miles. Supervisor Hall and Leopold felt that the Supervisor's current location in Antonito, Colorado, was too remote to operate from, so they moved the office south thirty miles to Tres Piedras.

The sleepy old railroad town of Tres Piedras takes its name from the three high hills of granite that rise from the grasslands and pine forest and stand tall over the scattering of buildings. From their new location, Supervisor Hall and Leopold went to work. These were still times when the frontier life could be rough and wild. The sheepherders were the biggest problem the new office faced, as they had pretty much done whatever they wanted and had not been called on it -- until now. Many of the meetings Leopold went to, to explain the new rules for grazing permits, found him packing his six-shooter for safety.

The massive overgrazing Leopold observed on the Carson laid the foundation for his later thinking on erosion and the effects of livestock on the arid Southwestern lands. By 1900 the Carson rangeland was supporting 220,000 head of cattle and over 1,750,000 head of sheep. It was the heartland of the sheep grazing operations.

Above: C. C. Hall, Ira Yarnall, and Aldo Leopold, Carson National Forest, New Mexico, 1911. Photo by Raymond E. Marsh. Courtesy of the Oregon State University Special Collections and Archives Research Center, Corvallis, Oregon. From the Charles Chandler Hall Photograph Album (P 301).
Below: Steve Morgan in character as Aldo Leopold.

One of the questions I am often asked when doing a performance is, "How did Leopold deal with his wife Estella's sheepherding family and his job of enforcing stricter grazing rules on public lands?" I respond by saying, "He was diplomatic and careful with his new relatives." Leopold's message to others was to strongly refuse to discuss politics and warned that "the first man who tries to spoil things for me through politics gets his block knocked off."

The reality of the time was that most of the big sheepherding families knew that changes needed to be made. The land was quickly deteriorating from the years of overgrazing. However, there were still pockets of stockmen who resisted the new rules. After one of the more heated meetings, Leopold declared, "By God, the Individual Allotment and every other reform we have promised is going to stick – if it takes a six-shooter to do it." Once the pockets of resistance were dealt with, the new Forest policies were in place and started working well.

Another aspect of Leopold's life that started in earnest during his time on the Carson National Forest was his writing. He started a newsletter for the Forest, the Carson Pine Cone, and became its chief editor, reporter and illustrator. The Pine Cone's stated purpose was to "scatter seeds of knowledge, encouragement, and enthusiasm among the forest employees and create interest in their work. May these seeds fall on fertile soil and each and every one of them germinate, grow and flourish. This is one of the most beautiful forests in the country and we should strive to make it one of the best organized and conducted forests in the country."

In March of 1912, Supervisor Hall transferred to Oregon to be nearer his home, and Forester Ringland appointed Leopold as Acting Supervisor to take Hall's place. These were busy times for Aldo with the whole forest now his to get into good working order. The policies that he and Hall had implemented were starting to show positive results. He wrote home, "This is such a delightful turmoil of a world."

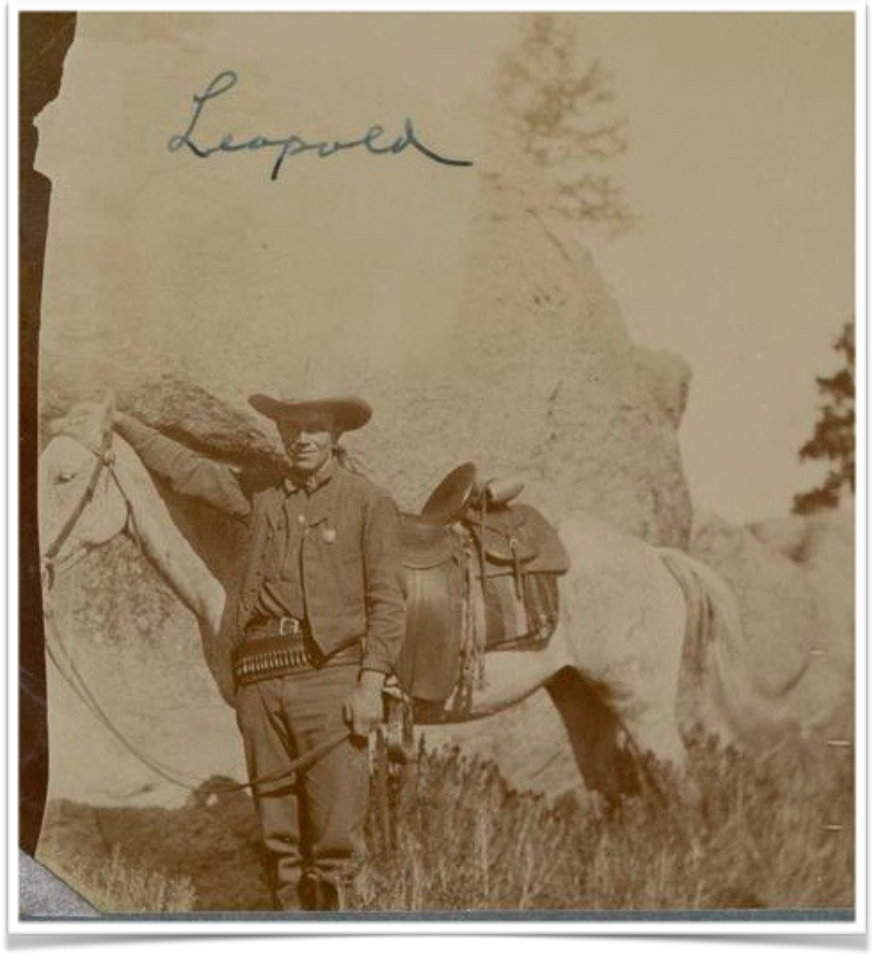
On August 10, 1912, Leopold was appointed full Supervisor of the Carson National Forest, the first in his Yale class. After the October 9, 1912, wedding of Aldo Leopold and Estella Bergere at the Cathedral of St. Francis in Santa Fe, his Supervisor duties were waiting, so they skipped their honeymoon and journeyed north by railroad to their new home in Tres Piedras. Leopold had been funded six-hundred fifty round, large silver dollars to build a new Supervisor's quarters which he had designed with Estella's help. Fondly named "Mia Casita" by Aldo and Estella, the craftsman style home nestled in the pines at the base of one of Tres Piedras weathered granite hills that towers above the surrounding landscape and still stands today looking out over the Rio Grande valley towards the mountains above Santa Fe.

Estella was a practical young woman. She was said to be unpretentious, playful, self-motivated, independent minded, and an always gracious lady. She was teaching first grade in a Santa Fe school when Aldo began courting her. Though she did not know how to cook or cut hair, she learned quickly. Those first few months of married life forged a marriage which the Leopold children later referred to "as the most loving marriage they had ever seen."

Maria Alvira Estella Bergere was born on August 24, 1890, in Las Lunas, New Mexico. Her father, Alfred M. Bergere, was born in Liverpool, England, the son of Franco-Milanese father and Venetian mother. He was a musical prodigy studying piano when he left Europe at the age of sixteen. He eventually worked his way from New York City to the Southwest where he met Don Solomon Luna, one of the most prominent and powerful sheep men in the New Mexico Territory. Two years later he married Don Luna's widowed sister, Eloisa Luna Otero.

Don Alfredo had four consuming interests in life: music, finance, politics, and his large family. There was always music in the Bergere home, and he was a key player in bringing classical music to New Mexico. As a businessman he was a realtor, sheep owner, and insurance executive. A strong Republican, he held several key positions in the state party. As to the large family, Alfred and Eloisa had nine children with Estella being the second oldest.

Eloisa's side of the family is rich in historical stories. The family name of Luna dates back to 1091 when the Spanish king bestowed the name De Luna and a coat of arms on her ancestor, a young and daring naval captain. He attacked the Moorish fleet in the light of a quarter moon and won a major battle, gaining favor with the Spanish king.



Aldo Leopold, Carson National Forest, New Mexico, 1911. Photo by Raymond E. Marsh. Courtesy of the Oregon State University Special Collections and Archives Research Center, Corvallis, Oregon. From the Charles Chandler Hall Photograph Album (P 301).

The family was deeply involved with the nobility of Aragon, Castile, and Segovia over the centuries. Eventually Eloisa's ancestor, Don Tristan de Luna y Arellano of Castile sailed to the new world with Cortez, who was married to his cousin. Don Tristan became a storied conquistador, serving as second in command under Coronado on his epic expedition through the southwest in 1540. He went on to become the governor of the Spanish Florida colony in 1559.

The Luna family became established in New Mexico in the late 1600's after acquiring a land grant of eighty-thousand acres between the Rio Grande and the Rio Puerco. This became the seat of one of the largest sheep empires in the West. Estella's grandfather, Antonio Jose Luna, drove several large flocks of sheep to the hungry miners during the gold strikes in California and made an immense fortune from that venture.

By the time Aldo started courting Estella, her family had become the largest and most powerful of the sheep ranching concerns in the west. Her uncle Don Solomon played a major role in ensuring that New Mexico became the forty-seventh state on January 6, 1912. The Leopolds and the Bergeres became even more entwined when Aldo's younger brother Carl married Estella's sister Dolores. So, when Estella quickly settled into the lifestyle of a US Forest Service family at Mia Casita, she brought with her a rich Southwestern heritage.

It was seven months later, after standing on the porch of Mia Casita basking in the glow of enjoying the best of all worlds, that Aldo left on a trip that would change his life drastically. On April 7, 1913, Aldo left Tres Piedras to settle some disputes on the Jicarilla portion of the Carson National Forest. To get to that portion of the forest required a train ride north to Antonito, Colorado, then west to Chama, and then a ferry, a stage, and finally a hired horse to finish the trip.

Leopold spent five days in cold wet weather riding the area to calm and settle the disputes, mainly over the location of the designated sheep driveways. Many of the herders were taking their own routes which weren't approved by the Forest Service. Leopold spent the nights sleeping out in the high-elevation country, and on April 16th, he was sleeping in a wet bedroll when a hailstorm hit. The storm lasted for two days of hail, rain, and snow. The arroyos were flooded, and when he finally started back to Tres Piedras on the 20th,

he decided to ride his horse across the Jicarilla Reservation, all the way to the train at Chama instead of the roundabout way he had come.

During the trip back, Leopold got lost in the dark, and ended up spending the night with an Apache Indian. His knees had swollen up so badly that he had to slit his riding boots. He was able to take a stagecoach to Chama, where he caught a train and eventually showed up the morning of April 23rd at the Supervisor's Office in Tres Piedras. Ray Marsh, Leopold's Assistant Supervisor who had been in charge of the office while Leopold was away, was stunned to see his boss and friend return with his face, hands, arms, and legs all swollen. Over Leopold's protests that there was nothing seriously wrong, Marsh put him on the next train 2 days later to Santa Fe and saved his life.

In Santa Fe the doctor diagnosed him with a case of acute nephritis, or Bright's Disease. During the trip, his kidneys had failed, and so for eight days, he worked and rode with toxins building up in his body. He was confined to his bed for six weeks, and for a man who thrived on being active outdoors and in charge of running a Forest, he "was chaffing, restless for something to do."

After one year of unpaid leave, Leopold had to be officially "separated" from the Forest Service. It was another six and a half months before his doctor would allow him to go back to work. Ray Marsh had been appointed the Forest Supervisor on the Carson. Arthur Ringland, the District 3 Forester, had been trying to find a position for Leopold since he did not want to lose him. Finally, on October 4, 1914, after packing up the rest of their belongings from Mia Casita, Aldo and Estella and their one-year old son, Starker, moved into a small house on South Ninth Street in Albuquerque.

Aldo Leopold, now 27 years old, went back to work for the Forest Service as the office manager for the Forest Service Office of Grazing. A desk job, but at least he was back to work.

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Please join us in the next edition of the Black Range Naturalist for *Aldo Leopold – His Legacy Part 3*

Much of the information included in this article was found in Curt Meine's 1988 book, *Aldo Leopold – His Life and Works*.

Low-Cost Sensor Systems

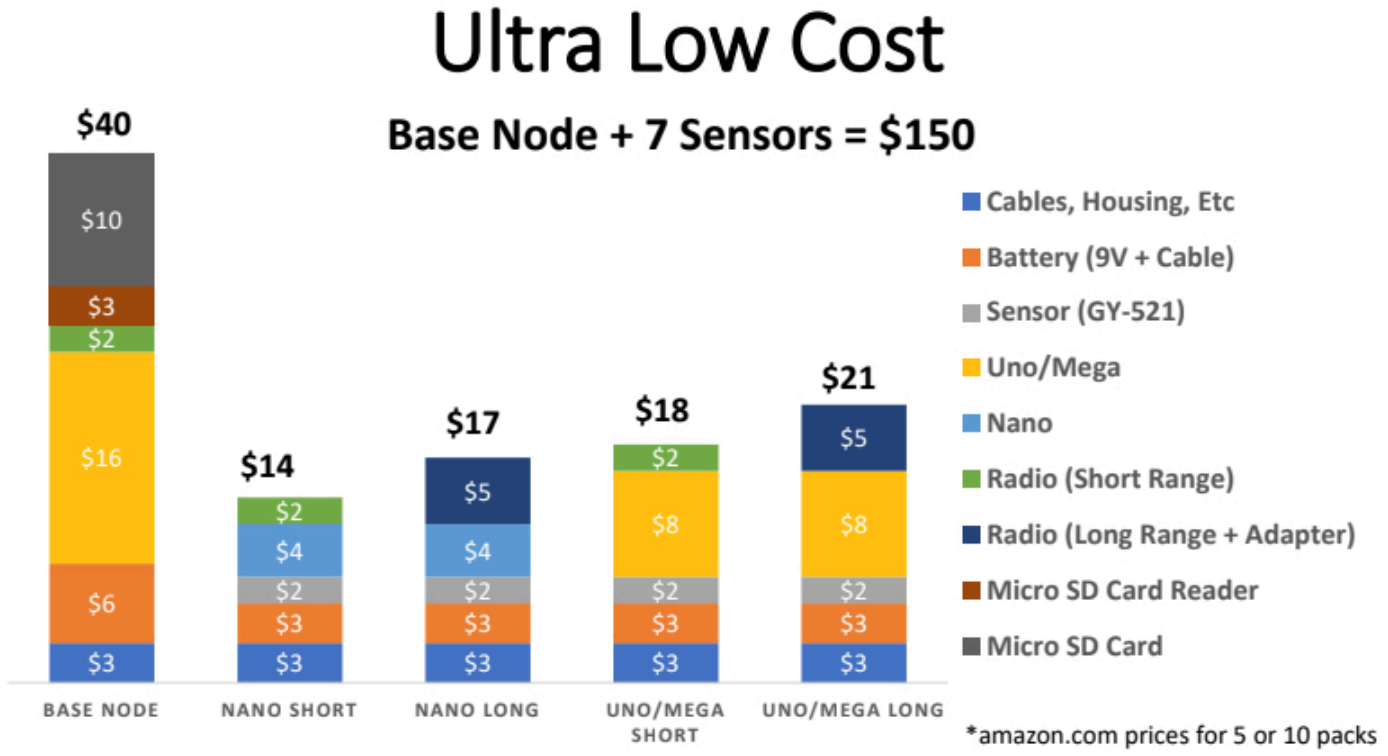
A few years ago I was able to interview Harley Shaw about his research career. For me, one aspect of that career was especially intriguing. Harley was on the ground floor of the development of radio telemetry tracking systems. I suspect that he did not thoroughly understand the complete research implications of those systems at that time, that he might not have foreseen tracking terns for tens of thousands of miles, following the migration of whales, or the exactness of GPS, for instance.

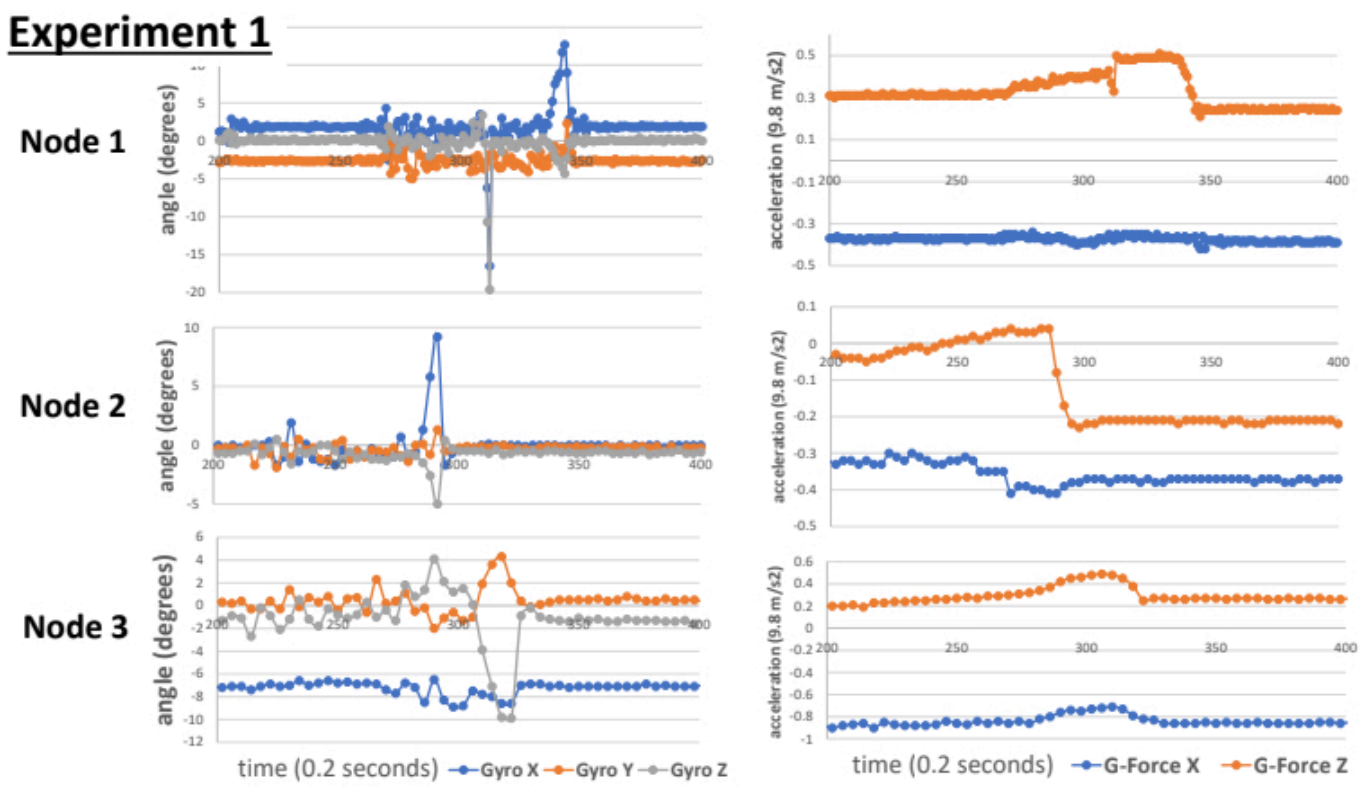
Recently I have been able to watch the development of a low-cost sensory system which may shape basic research, public safety policy, and the economics of extraction industries significantly. Or not, that is the beauty of the ground floor, you never know.

The state of current technology allows a significant amount of research in the field of geology to be conducted by remote sensors. But the full potential of that technology has never been realized, primarily because of cost.

For the last few months, Jon Barnes has been in the Black Range working out the mechanical, electronic, and data handling kinks of a sensory system which is able to use off-the-shelf components. The system is inexpensive, robust, inherently scalable, supportive of a variety of redundancy schemes, and easily manipulated and supported in the field. Such a system could change a lot of things in research (geology is his field of choice), public safety, and infrastructure economics.

To state that a system utilizes off-the-shelf components is easy, the concept is clean. But like most things which are clean and obvious they can be very difficult to accomplish. The devil, after all, is in the details, or in this case in wires, boards, and components made by different manufactures with differing capabilities and technical specifications (some of which appear to have been written by marketing departments).





The sensitivity of the array system is shown in these results from one of Barnes' field tests. The sensors were recording the same event but were affected differently based on their location. Thus, subtle differences in land movement can be identified, not only the time (left column) at which each sensor recorded movement but what the rate of slip was (right column) for each sensor. Such nuanced results create a much richer analysis.

Each of the attributes of this system comes with assorted pros/cons. Using off-the-shelf components drives the system cost down to a fraction of the cost of other sensor systems. Although it is difficult to find reasonable comparisons, the Raspberry Shake 1D, which measures the magnitude of local seismic activity, costs from $374 to $499 per sensor. The RS 1D is not a comparable unit to one of the sensors of the subject system (see left); for one thing the RS1D sensor is much more sensitive. But it is one unit, built for one purpose. In another cost comparison, sensors in soil moisture systems regularly cost $200. In general, the cost of the Earth Movement Measurement System (EMMS) which Barnes has developed is projected to be roughly a tenth of the cost of existing systems with comparable capabilities. But off-the-shelf means the components are often general-purpose rather than purpose built. Determining what units are compatible turns out to be a significant task.

Marketing claims aside, components do not always work together. It is not always apparent why that is the case. For

example, in developing the EMMS it was discovered that a communication problem between two components was created by a data bit size limitation of one of the components. Developing a different data packet system solved that problem. Once raw data are sent from the individual sensors to the base station they are stored on a local data card in the EMMS configuration. As noted below, other configurations could involve the transmission of data to alert systems or to widely distributed locations where data are stored from very large geographic areas. Regardless of where and how the raw data are stored, the data packet system developed to overcome this issue is such that the raw data can be imported directly into Microsoft Excel and analyzed.

In another case, a sensor array experienced communication issues when the radios of the individual sensor nodes were interfering with each other because they were all trying to transmit at the same time. The (rather sweet) solution was to have each radio transmit at different times (milliseconds apart) using a system based on prime numbers.

But with all that consternation in the past (future system enhancements will undoubtedly come with their own consternations) the system is low cost. Low cost, in this case, is defined as low initial cost, low maintenance cost (either repair or changeout of individual components), ease of use, and low resource requirements during use. Each of these cost parameters is important in basic research, public safety applications, and in systems which announce pending infrastructure failure - for instance. Low cost means that such systems are more likely to be deployed and deployed more aggressively (more units used as well as units placed in locations where extreme damage to the unit is likely). Such a change in deployment protocol will yield more raw data than are currently available to users, more data from a wider variety of local situations.

More raw data inputs also enable greater data integrity; cross checks and verification become possible in situations where they might not have been possible in the past.

Barnes is assessing the system's ability to determine earth movement in his field tests. The system is able to measure both the angle of movement and the speed of movement. There are numerous applications where this basic system could be utilized; land slides, land slips, subsidence, and avalanche monitoring. In our area, other uses, like automated flash flood warning systems, readily come to mind.

In every application of sensory systems, researchers, infrastructure managers, and safety officials are concerned about the reliability and redundancy of their systems. Often they are forced to choose between the two because of cost. A low-cost system tested for reliability at the first stage and which can be easily modified if a component fails in the field by simply putting a new wireless node on the ground and picking up the malfunctioning unit, addresses many reliability issues. Such maintenance capabilities help assure long term reliability.

Since the costs of these systems are low, redundancy can be achieved within a system (mesh networks, multiple sensor trees, etc.) and completely independent systems can be deployed in the same area (the ultimate in redundancy). Given the consequence of system failure for any or all users, the reliability/redundancy attributes of a low cost system are significant.

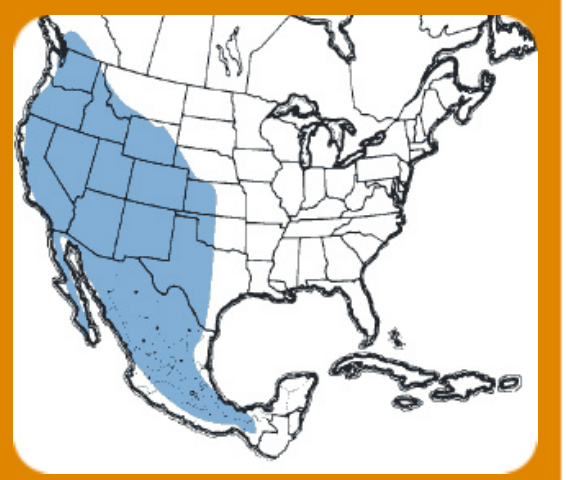
Of course, no system is perfect; reliability checks and redundancy schemes help address that basic fact. Sensor systems placed in circumstances where external forces are expected to destroy them at the moment the sensor reports the external activity can make such systems very expensive in broad applications. Forcing the cost point of each system downward is a goal worth pursuing.

Every project, every manager, every researcher has a different risk profile and an understanding of the level of risk he/she is willing to live with on an ongoing basis. The EMMS and similar systems can be tailored to the risk profile of the user's project.

And last, not least, is the fact that the system is not built around a particular type of sensor, and the sensor can be changed out. That means such a system can be used for many applications with only a minor modification.

The development of this system fills me with awe about the potentials. Automated warning systems being fed raw data from numerous dispersed sensor nodes can save lives and money, decrease grief and economic disruption, and enhance the research capabilities of many researchers. This system is begging to be enhanced, and the Black Range has been on the ground floor.

ABOUT THE BACK COVER



There are over 400 grasshopper species in the western United States. The one pictured here was photographed in Hillsboro in September and MAY be *Trimerotropis pallidipennis*, the Pallidwinged Grasshopper. If so, it has a rather large range, shown in the map from the USDA Agricultural Research Service.

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