

The Black Range Naturalist

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The Tracker and the Shadow Cat

by Stephen Siegfried

His eyes are on the ground, as is the nose of the hound. She's a sniffer, a nose hound. The man is following the track in his way. The little beagle in hers.

The tracker is wildlife biologist Harley Shaw, 86, retired from a career of hunting horseback behind hounds to tree, dart, and put radio collars on mountain lions for scientific study. The dog is Toasty, an active four-year-old beagle.

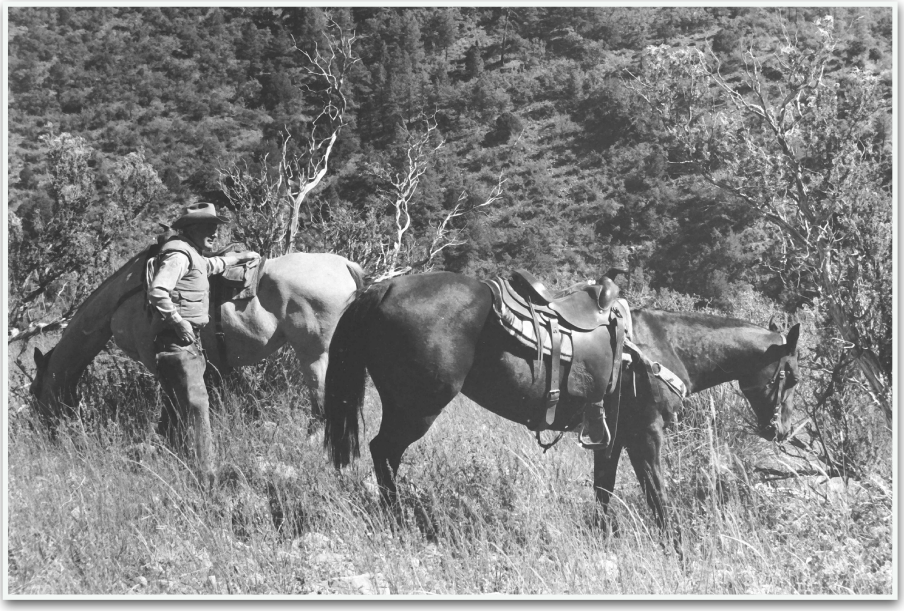
"The dog is an extension of the man," Shaw writes in *Soul Among Lions*, his book about tracking mountain lions with trail hounds during an eight-year study of the species.

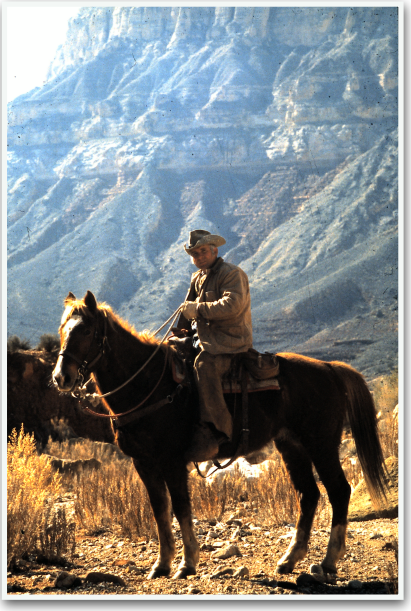
In this instance, man and his extension are out for one of their daily hikes around Hillsboro, New Mexico, where Shaw and his wife, Patty, settled in retirement. The going is slow. When the little beagle is on scent the yips start, and her tail goes into overdrive. Likely it's the scent of a cottontail or jackrabbit that has her excited. A mountain lion strike dog she's not. The tracker studies the ground.

"Telling someone how to read sign is like telling someone how to play the piano," he says. "The only way to learn is to be shown and to practice."



Harley Shaw on his horse Hambrick in 1970 (above and below right)



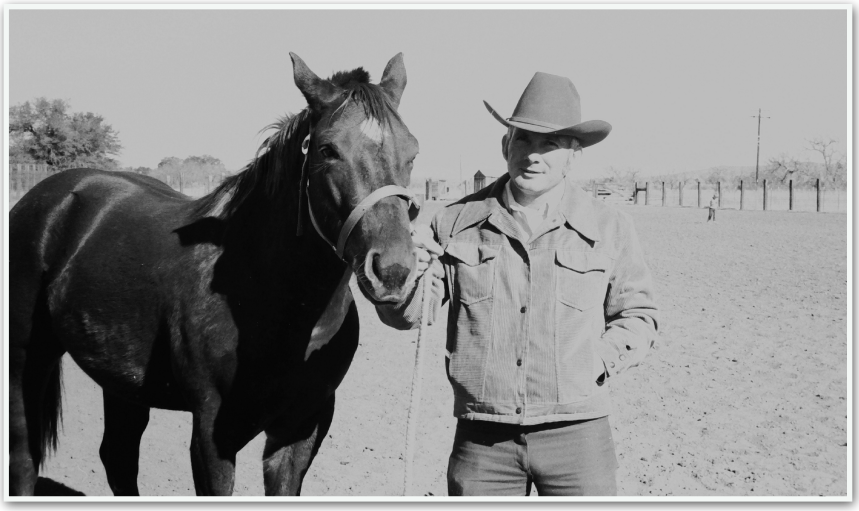


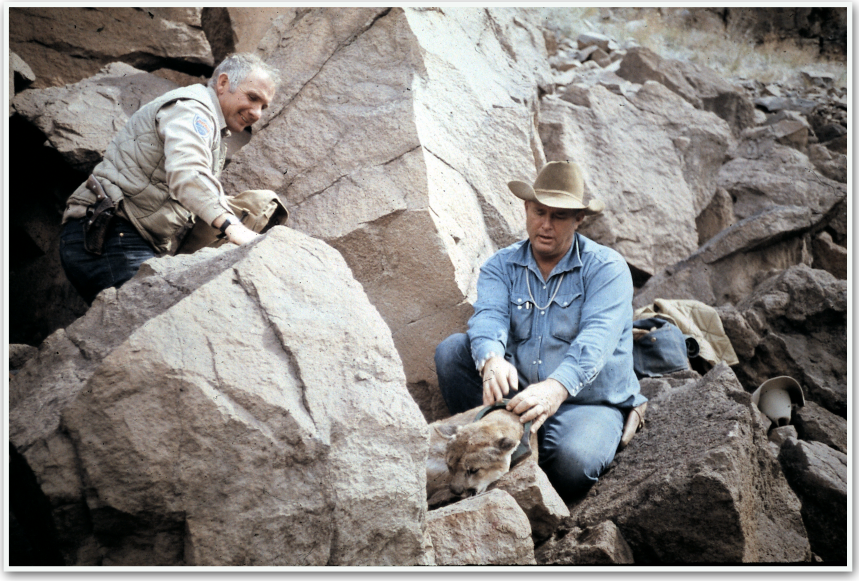
Once, after finding footprints outside a window after a break-in at the Hillsboro Community Center, Shaw noted the tread marks left by tennis shoes. Days later, he spotted the culprit on a bench outside the post office, legs crossed at the ankles to expose the soles of sneakers. The teen had been climbing through the window to use computers in the library.

Shadow cats aren't so bold.

They walk softly, on big cat feet.

If you're going to put a collar on a mountain lion, you've first got to catch one. The basis of lion hunting lies in the preternatural impulse of dogs to chase cats and for cats to flee and climb a tree for safety. Shaw knows the thrill of the chase, the hounds barking trail, baying when the cat is treed. Hunting mountain lions horseback in wild country makes *Soul Among Lions* read like an adventure wrapped in a scientific study. The author has caught and collared a lot of mountain lions. He has never shot one, except with a dart to anesthetize it.





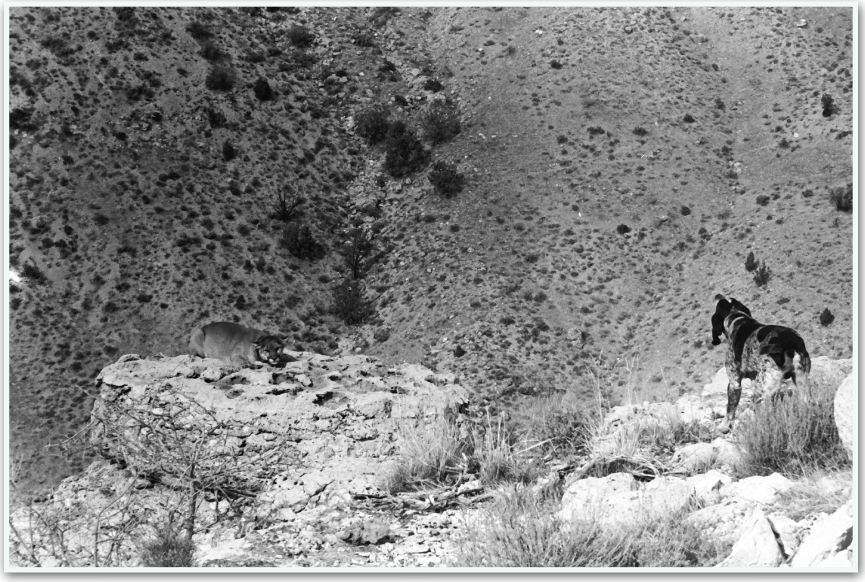
Any book about trailing mountain lions for capture has to be a book about dogs.

"One can hunt lions in several ways," Shaw writes in *Soul Among Lions*. "Only one really works: using good dogs."

The trick in training hounds, the author learns, as he assembles his pack of trail hounds, "lies in getting them to trail only the species you want to catch."

That wouldn't be Scooter, a bluetick who preferred catching porcupines to all other game, always with the same result. Scooter had to be anesthetized so many times to remove quills that Shaw worried that he had become addicted to sedatives.

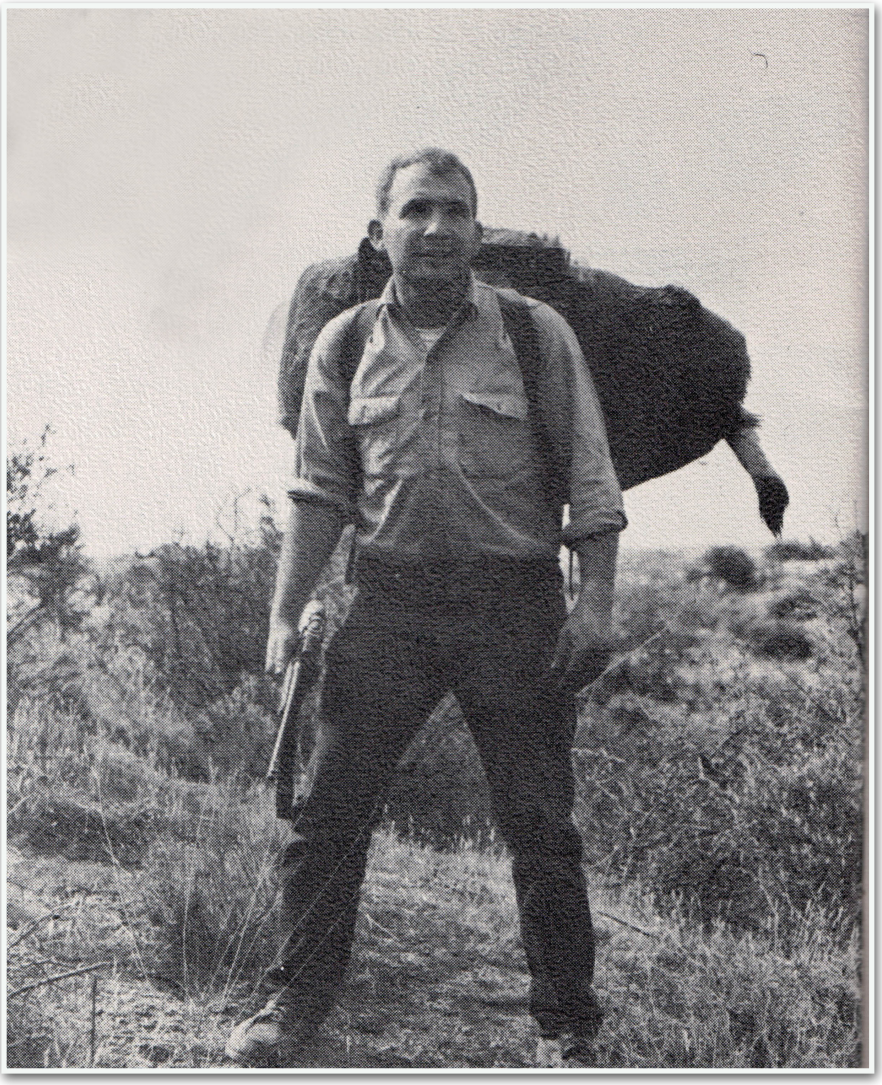
Or Joshua, a deer-chasing black-and-tan known for his booming voice, his 28-inch ear spread, "and his ability to sleep soundly under a treed lion in amidst any number of wildly baying hounds."



George Goswick was a third generation houndsman who trailed and treed lots of lions. Shaw once asked Goswick what he thought made the best lion dog, "I was hoping he'd tell me his favorite breed."









"One that will catch a lion," was all Goswick would say.

Shaw answers his own question about trail hounds in "Arizona's Dryland Lion Hunters" a chapter in David Brown's *Bringing Back the Game*. "While each dog differs, and hunter preferences vary," the "perfect" lion dog is "normally smaller and lighter than most eastern bear and coon hounds, thereby possessing greater speed and endurance over rough ground." The perfect dog "smells a track that is two days old, sometimes even colder, even on hot, bare ground."

With few exceptions, hounds will follow a track in the direction they were going when they came across it, making the odds about fifty-fifty that you're going where the animal has been, not where it's going. The tracker must then read sign to set the hounds in the proper direction.

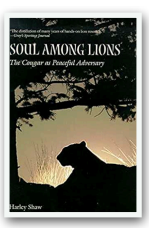
That's not necessary when the lion is wearing a collar.

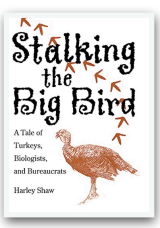
The telemetry antenna was pointing near vertical up a rocky bluff, and the hounds were trailing in the direction of the signal. After a hot, steep climb, the biologist came to a break in the cliff over a chasm about 20 feet across where the signal was lost.

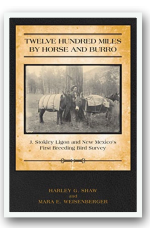
The dogs stopped at the drop-off and bawled. One old hound lay down with its head resting on its forelegs as if to say, "I've seen this vanishing act before."

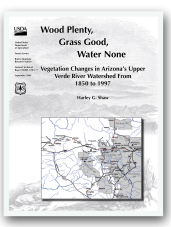
Either the puma made the jump, or the shadow cat vanished into thin air.

Few people will ever see a mountain lion in the wild. Fewer still have seen them kill. Shaw thinks the methods used "are very similar to those used by house cats, for which there is no









shortage of observations." And so it's a good guess that if Fluffy the calico launches her attack on a toy mouse with a wiggle of her hindquarters and flick of her tail, *Puma concolor* does the same with real prey in the wild.

Pumas are stalkers, not chasers, Shaw says.

"They attempt to stay invisible, either by way of ambush, or more often, stealth, until close enough to prey to attack," he writes in *Soul Among Lions*. Close enough for deer, the primary prey species for lions, he estimates, to be about fifty feet. "Lions can seldom outrun their prey, and have no stamina for long chases. They must strike quietly and quickly. And they must kill efficiently."

After the stalk and dash to the prey, belly close to the ground, the cat rises on its hind legs to plant a forepaw in the flank or shoulder of the prey. "Once the claws are hooked, the lion's jaw and teeth come into play." In deer, "the initial bite will penetrate the slender neck muscles near the back of the skull, and will contact the upper vertebrae of the neck."

After feeding, the prey is moved from the kill scene and covered, usually with brush. The lion remains in the vicinity of the kill to feed until the meat begins to spoil.

Unlike wolves and coyotes that hunt in packs, lions are solitary predators that can't afford an injury in combat with prey. They must stay fit enough to hunt, or starve to death. To survive, a puma must kill every 6 to 10 days, depending on climate and other factors. A female with cubs must kill more often.

"Kittens may stay with their mother for up to two years, and older kittens may accompany her on hunts," Shaw says. He describes one kill scene where young cougars have eaten, then played with the remains "like kittens."

The signal from the radio collar had been stationary for over a week. It was in the early days of the lion study, and Shaw suspected a slipped collar or a dead lion. Either one, he thought he had to find out.

He took another member of the study team and two dogs to the area, leaving them at the trailhead and going ahead alone. After he determined the signal was coming from a scrub oak thicket, he fired his pistol to try to move the cat. When the signal still came back from the same direction, the thought his suspicions were correct. Hearing the shot, the other biologist took it as a signal to release the dogs. When Shaw's strike dog charged into the thicket, he followed.

He didn't see the lion until he was within about ten feet of her. She hadn't slipped her collar. She was very much alive. She bluffed an attack, then retreated into the brush. When he saw the kittens on their nest, Shaw realized he had overstepped, and not because he could have been killed. After the lioness returned to the kittens, the biologists kept their distance, monitoring her movements by telemetry.

Depending on the region of the country, mountain lions are called pumas, cougars, panthers, painters, catamounts, screamers, and king cats, among other names. Shaw primarily uses "cougar," in the book, which is the main usage in the Southwest. Since publication of *Soul Among Lions,* the scientific name has been officially changed from *Felis concolor* to *Puma concolor*.

By whatever name, the lions measure between five and one-half and seven and one-half feet in length, and weigh from 75 to 190 pounds. They give birth to as many as six kittens, and breed again once the kittens go off on their own. The primary causes of mortality in the wild are humans and conflicts with other pumas. Where lions hang around areas of human density, motor vehicles are another cause of death.

Kittens raised in captivity with a steady diet have lived as long as 20 years.

We don't see them, but we see where they've been.

Besides venison, pumas have a taste for beef, veal, mutton, and horse meat. That's a problem in New Mexico, Arizona, and other western states, where ranching is basic to the economy and culture. Shaw has been to enough kill scenes to be sympathetic to the views of stockmen. He has stood on the bloody ground of pens among the uneaten and mutilated carcasses of a half dozen sheep. He understands how a man, whose livelihood can be put in jeopardy by something that kills what he has nurtured, can hate mountain lions.

In the United States, the bounty system is older than the nation. In California in the late 1500s, bounties in the form of livestock were paid by Jesuit priests for dead lions. In Connecticut, the payment for killing a "catamount" was in shillings, predating the nation's founding. As early as the 1870's, houndsmen in the Southwest were paid bounties by the government, or hired by ranchers to chase down and kill "the varmints." State bounties up to $100 were paid for lion skins in Arizona until 1969, and ranchers or private livestock organizations continued to pay private bounties for decades after that.

Shaw suspects bounties are still paid "at some level."

The most notorious of the lion hunters was Ben Lilly, who left his wife and home in Louisiana with his dogs to go hunting one day and never looked back. He hunted across Texas, reaching the Southwest in 1912 to kill bears and lions in what is now the Gila Wilderness. Lilly kept journals listing the number of lions killed, their gender, estimated age, and whether the females had kittens, or were pregnant. Born or unborn, all went into the tally, said to total more than 1,000 animals. Kittens were sometimes kept as pets and for dog training.

Shaw credits Lilly, who sent specimens to the Smithsonian - and

other hunters, like the Lees in New Mexico, and the Goswicks in Arizona - with providing researchers with "lore" to begin studying the species. In New Mexico, Frank C. Hibben was the first of the research biologists who went with houndsmen to record and document lion kills.

Traps and poisoned baits were, and still are, deployed for predator control on Southwestern ranches. Houndsmen opposed the use of poison or traps, and not only out of concern for their dogs. Dale Lee said he had too much respect for a mountain lion "to hang steel on its foot." Lee's attitude reflects that of other early houndsmen like the Goswicks, who resigned from government contracts in protest of the use of traps and poison.

Shaw thinks poisons played a larger role in eliminating lions than was generally thought. "It was believed that they would only eat what they killed, but later research indicates they will eat carrion, and are vulnerable to poisoned baits."

To this day houndsmen and sporting dog owners oppose the U. S. Department of Agriculture's Wildlife Service's use of M-44 cylinders to kill coyotes. When a coyote, fox, or your dog takes the bait, the device explodes in the animal's mouth with a lethal dose of potassium cyanide. Death is agonizingly slow. Better to be shot dead from a tree.

During the lion study Shaw addressed mixed crowds of ranchers, hunters and preservationists. All, in some way, seemed dissatisfied with the state of affairs. Ranchers complained about livestock losses; hunters wanted to talk about lion predation of the deer herd; preservationists spoke about the value of predators in nature.

Shaw presented the science the same way to each group, without speaking out of both sides of his mouth.

"I knew they would spin it the way they wanted."

As a boy growing up in rural Arizona, Harley Shaw dreamed of jumping and shooting a mountain lion. The hair and beard are white now. He's picked up a little girth since his days chasing lions on foot and horseback.

"There was this creature out there that was really something." Shaw said, seated on his patio with a glass of wine. "To a boy that hunted, a mountain lion was a real big deal. Now, I would never shoot a mountain lion. We've already eliminated the two other symbols of American wilderness in the wolf and the grizzly."

The hunter turned wildlife biologist knows that without predators, an unchecked deer herd could lay bare a hillside on its way to starvation.

"People that want lions want them because they want to keep nature complete." Shaw thinks like a mountain.

Edward Abbey, with a nod to Charles Darwin, put it this way: "Given a liberal allowance of time, it is the lion's claw, the lion's tooth and need, which has given the deer its beauty, speed and grace."

During the study, Shaw began to question how much new information was gained each time a cat was collared. What exactly is our purpose before we chase down, tree and dart a wild animal? And how might that knowledge benefit the species?

"We've gotten to the point that reason is driven by technology, like the tranquilizer gun and radio collar. In my mind, you need a clear and legitimate question before you capture and collar a wild animal."

You know a few things about cats. You know the tom grips the female's neck during copulation. You wonder how a male lion feels, when instead of the warm, soft flesh and fur of his lady love, its a vinyl composite he feels between his teeth. You think about a cartoon you once saw with Smokey and another bear in a cave. Smokey taps the sleeping bear beside him on the shoulder. We understand what he wants when she says, "Not until you take off that silly hat."

In trying to manage a solitary animal that wants to be left alone, man has the capacity to do more harm to the species than good. Too much human curiosity, Shaw believes, can kill a cat.

The tracker was first to know the lion was around. When the ground is muddy after a rain or snow, there are plenty of tracks on the unpaved streets and trails around Hillsboro. Almost everyone has at least one dog, and most get walked as part of a daily routine. But this paw print is too large for most of the local dogs, except maybe Leo, a Bernese mountain dog. But like all canids', his tracks show one large pad across the heel, and the toes are rounded. This pad has the three lobes typical of felines; the toes are teardrop shaped. No toenails are indicated.

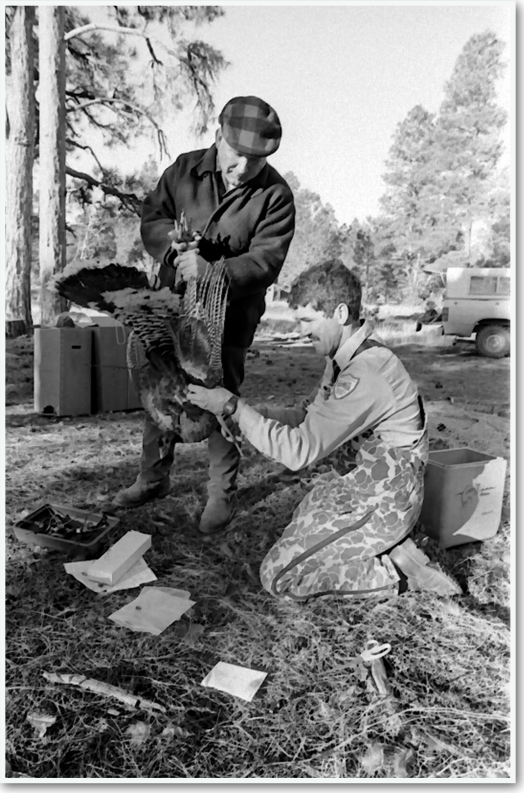
The print is much too large for a bobcat or house cat. Collared or uncollared, when a real live mountain lion starts hanging around human habitation, it's out of character for the shadow cat. Navajos put turquoise and shells in a puma track as a gift, and pray the animal will leave them alone.

After pets began disappearing from yards, and a woman saw a lion eating a cat on her porch, the New Mexico Department of Game and Fish brought in dogs. The lion was treed and euthanized. Gaunt, the cat was probably too sick or weak to hunt wild game. Not a big lion, as lions go, it was nevertheless an impressive animal. The paws were huge.

Attacks on humans are rare, and usually by lions younger than two years. A man once called Shaw to ask if it was safe to let his wife jog on the outskirts of Prescott, Arizona. "I asked him: 'Do you let her drive in town?' A lot more people die of bites from their own dogs."

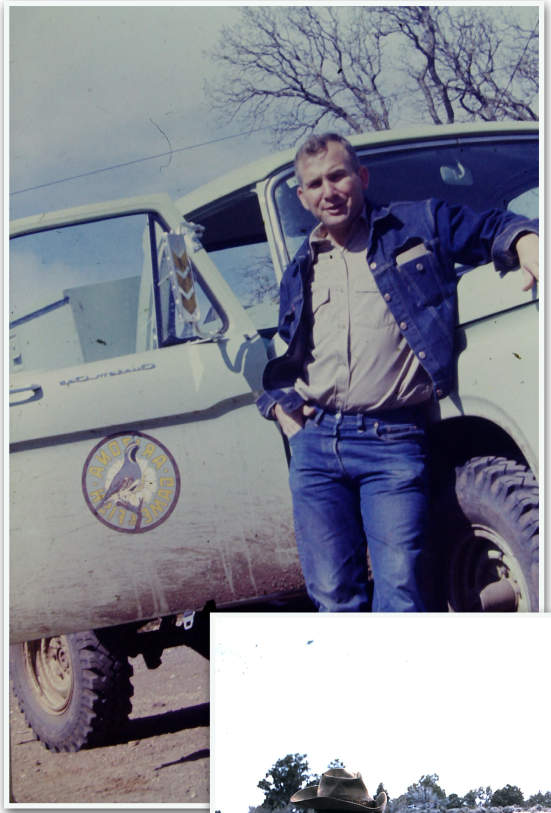
While lions are inclined to keep their distance, Shaw is convinced that lions are curious about us. "If you've done a lot of hiking in the woods, you've probably been closer than you think."





Above and to the right: Shaw conducting wild turkey research in 1983.
Center right: Sage Grouse research.
Center left: With Arizona Game and Fish
Bottom: Field research - stuck in the mud.

The Other Research of Harley Shaw







Pumas are less a threat to humans, he believes, than humans are to pumas. What mountain lions need is space, and that's becoming a rarer commodity, as trophy homes are built in wild lands and developers seek to privatize public lands. In the American Southwest, the territory for males is about 100-150 square miles, or about 12 to 13 miles on a side. Females, which wander less, require about 1/3 of that. As what Shaw calls "the human tide" encroaches into wild areas, he expects an increase of incidental human/puma encounters.

"The West is now experiencing the same phenomena that decimated the cougar in the East."



"The majority, undoubtedly, want all the automobile roads, summer hotels, graded trails, and other modern conveniences that we can give them," Aldo Leopold wrote in a 1921 Journal of Forestry article. "It is already decided, and wisely, that they shall have these things as rapidly as brains and money can provide them. But a substantial minority, I think want just the opposite. It should be decided as soon as the existence of the demand can be definitely determined, to provide what this minority wants."

Pumas have survived in the West despite hounds, guns, traps and poisons. Can they survive the "human tide?" *Soul Among Lions* and Shaw's later writings are a kind of man-to-lion apology, an indictment of humans for trespassing into the space a species needs to survive.

Harley Shaw has tried to see the world through the eyes of another species. He can't. But he has vision enough to see the consequences of man's arrogance in nature. He questions the attitudes and actions of a culture that behaves like the planet "exists to serve the human species alone."

"I begin with the notion that insofar as wildlife and wild lands are concerned, humans are a destructive force that can't be stopped," Shaw wrote in a recent article in *The Black Range Naturalist*. "Humans justify their destructiveness in economic and religious arguments. But in the end, our intelligence, if it exists, and our technological competence have brought us to be, quite simply, no damned good insofar as other creatures on the planet are concerned."

Soul among men.

A man set out to catch and collar mountain lions to learn the mysteries of a species. In the course of that study, he learned about his own. And himself. Cat catches man.

That you can't look off into open space is but one of Shaw's complaints about cities, which he avoids, along with crowds. Not far from where he lives is a canyon he likes to go to. He leaves his Willys below on the two-track and hikes to the canyon rim. He no longer rides. He had to put down his final horse four years ago.

Since retirement he has found he needs places to go where he can be alone, to look off, to ponder things. He's convinced that's what lions do. He has tried to think like a mountain lion. He can't. And he knows it. But he has studied them for too long not to believe they have thoughts. He sits among the boulders that overlook the canyon and imagines what those thoughts might be.

Wife and husband, Linda Sweanor and Ken Logan are biologists and authors of *Desert Puma*, about the couple's ten-year study of mountain lions in the San Andreas Mountains of Southern New Mexico.

Not long ago, Shaw took the couple to the canyon on a day hike. Three of the world's most prominent mountain lion biologists were discussing how little they knew about their favorite and reclusive subject, while Logan glassed the far side of the canyon with binoculars.

"You're not going to believe this," Logan said. The shadow cat was looking straight at them.

They see us.

Almost never do we see them.

Despite all his years afield, Shaw had seldom seen a mountain lion in the wild, except with hounds in pursuit, or in a tree, with the pack baying below. This was a lion in repose.

What was it thinking.

DNA Barcoding and Those White-haired Black Caterpillars

by Bob Barnes

What do you do when you are tired of the repetitive antics of humanity? Study caterpillars, of course, but at your own risk. What is the opportunity in studying caterpillars? What is the risk?

Much is yet to be learned about caterpillars and many species have not been studied extensively, even those which are clearly economically damaging. Caterpillars present an opportunity to study that which is not known, has not been studied, or about which very little has been published (and it might be all of them). That is also the risk. For starters, how is one to know what is not already known in a world where so much is known, studied, and published? Even with a vibrant internet, lit by fiber and served up by banks of memory and intelligent algorithms, it is easy to miss something. Works published in other (non-English) languages are not always extensively indexed. Articles may be authored by someone who writes poorly, published in a now defunct publication, published recently or well in the past, or report a heavily nuanced finding - making it difficult to discern its importance. It means there will be missteps, conflicting information, assumptions (informed and otherwise), and the probability of some error. Welcome to caterpillars.[1]

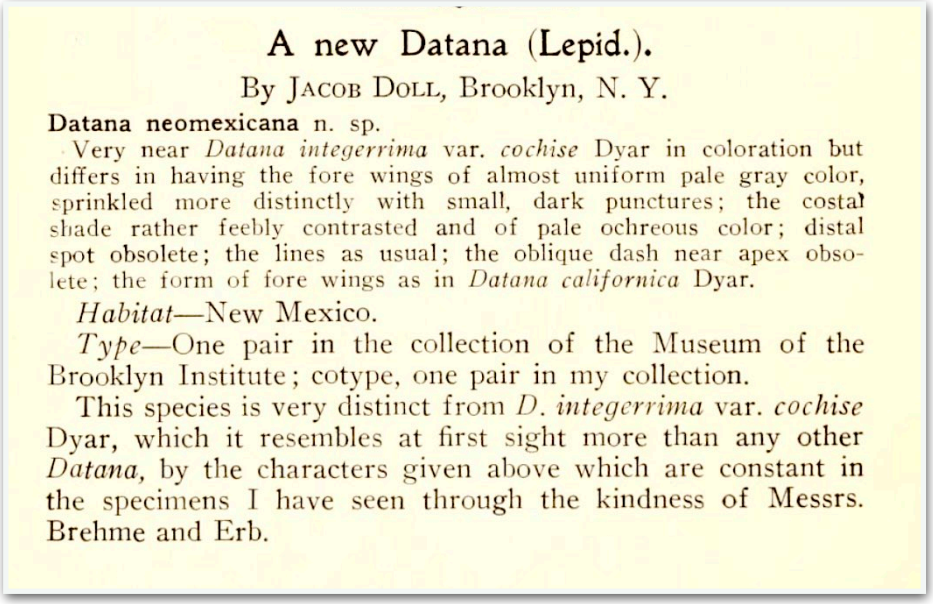
How did I get to a point where I wanted to write about DNA Barcoding (something I know little about) and those white-haired black caterpillars (which as, you will see, I know less about)?

It started innocently enough; it always does. The October 10, 2022, email from Véronique De Jaegher of Kingston included images of instars of Oslar's Oakworm Moth, White-lined Sphinx Moth, and a black caterpillar with lots of white hairs. I tried to identify the black caterpillar with a lot of white hairs for a while and decided to give it a rest for the morning.

The next day, Rebecca and I headed off on a hike up toward Emory Pass in the Black Range, from the cemetery in Kingston, looking for a plant she had seen the previous season. I ran into the Oslar's Oakworm Moth caterpillar munching on Emory Oak leaves immediately. Rebecca went on up the trail and I set about exhausting my camera battery. I quickly ran into some mistletoe in the oak, which was interesting, and then there were those black caterpillars with white hairs, lots of them.

Later in the day, after several frustrating hours of web and publication searches, I concluded that the black caterpillar with white hairs might be *Danata perfusa*, a species reported only from Arizona (per BugGuide - see later). Being at the limits of my knowledge I inquired elsewhere, sending several images, including the one below, to the community at BugGuide. The following day I received a comment that it might be an instar of *Datana neomexicana* (Hodges #7913) which has a range extending from Arizona to western Texas, to include New Mexico and parts of Colorado (thanks to the Balabans of Skokie, Illinois - part of that world wide web). The Balabans also included a link to a page on iNaturalist. BugGuide has no images of the species, either adult or instar (as of 10/13/22).





A new Datana (Lepid.).

By Jacob Doll, Brooklyn, N. Y.

Datana neomexicana n. sp.

Very near *Datana integerrima* var. *cochise* Dyar in coloration but differs in having the fore wings of almost uniform pale gray color, sprinkled more distinctly with small, dark punctures; the costal shade rather feebly contrasted and of pale ochreous color; distal spot obsolete; the lines as usual; the oblique dash near apex obsolete; the form of fore wings as in *Datana californica* Dyar.

Habitat—New Mexico.

Type—One pair in the collection of the Museum of the Brooklyn Institute; cotype, one pair in my collection.

This species is very distinct from *D. integerrima* var. *cochise* Dyar, which it resembles at first sight more than any other *Datana*, by the characters given above which are constant in the specimens I have seen through the kindness of Messrs. Brehme and Erb.

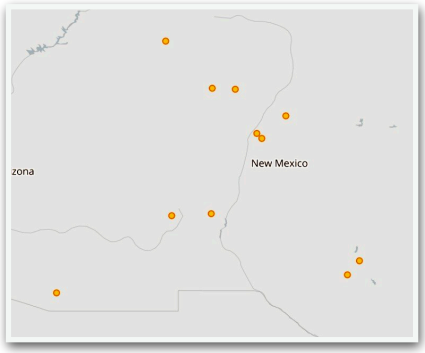
The original species description of *D. neomexicana* by Jacob Doll, published at page 300 in Vol. xxii, July 1911, *Entomological News, and Proceedings of the Entomological Section of the Academy of Natural Sciences of Philadelphia.*

Having mined the BugGuide site for all I could, I moved on to the iNaturalist instar images of *D. neomexicana*. They did not appear to match the instar photographs I had taken. (BugGuide comments that *Datana* are easy to key to genus but difficult to identify to species. I assume that caution applies to both the adults and instars.)



As a side note, an early draft of this article included an image of an adult *D. neomexicana* from the iNaturalist site under a Creative Commons license. One of the commenters on that draft noted that the image had originally been published elsewhere and was copyrighted. That commenter informed iNaturalist - which took the image down (see thumbnail above). My attitude about digital publication is that it is like raising kids, once you put it out there, it's out there, and you have no control. Still, those who wish to maintain copyright have a right to do so and their wishes must be honored. In some cases, we are talking about a person's livelihood! The image contained in the initial draft of this article was removed and a substitute found. As for the photograph I originally found on iNaturalist - I am not sure what to make of a person who posts someone else's copyrighted image on a site and makes it available to others under a Creative Commons license.

Completing my search on iNaturalist, I moved on to the Global Biodiversity Information Facility (GBIF) site. At that site I found a "sightings map" for *D. neomexicana* (below) and images of an adult, like the one shown at the top of the following page. Enter *D. perfusa* (see later) and the splitters and lumpers.



The GBIF occurrence listing for *D. perfusa* (Dyar 1923) did not prove useful. It showed a wide distribution of the species, focused primarily in the eastern United States - as well as far flung reports which are probably the result of human transport.

BugGuide describes the range of *D. perfusa* as "Arizona". Part of the discrepancy in range listed in these two sources may be that *D. perfusa* was split from a group of other moths by Dyar, including from *D. chiriquensis*, which is found farther south.

The images of instars of another species, *D. integerrima*, in the BugGuide galleries, look very much like those which I photographed on the 11th, but perhaps have significantly more white hairs. BugGuide indicates that the range of *D. integerrima* is mostly in the eastern US/Canada but notes that the Moths Photographers Group includes Arizona in its range. (See also the GBIF data base.) Following my inquiries, the map of the species found at the Moth Photographers Group at the Mississippi Entomological Museum (Mississippi State University was changed to show that the species is found in southeastern New Mexico, but not farther west. An image of an adult *D. integerrima* is shown on the following page.

Any thought that the individuals I was trying to identify were *D. integerrima* came with their own "rub"; its common name, "Walnut Caterpillar Moth" hints at its love of hickories, pecans, and walnuts. The individuals I photographed clearly liked the Emory Oaks that they were on. Later in this article some of the research on *D. integerrima* is discussed, as a way of gaining some insight into *D. neomexicana/perfusa*.

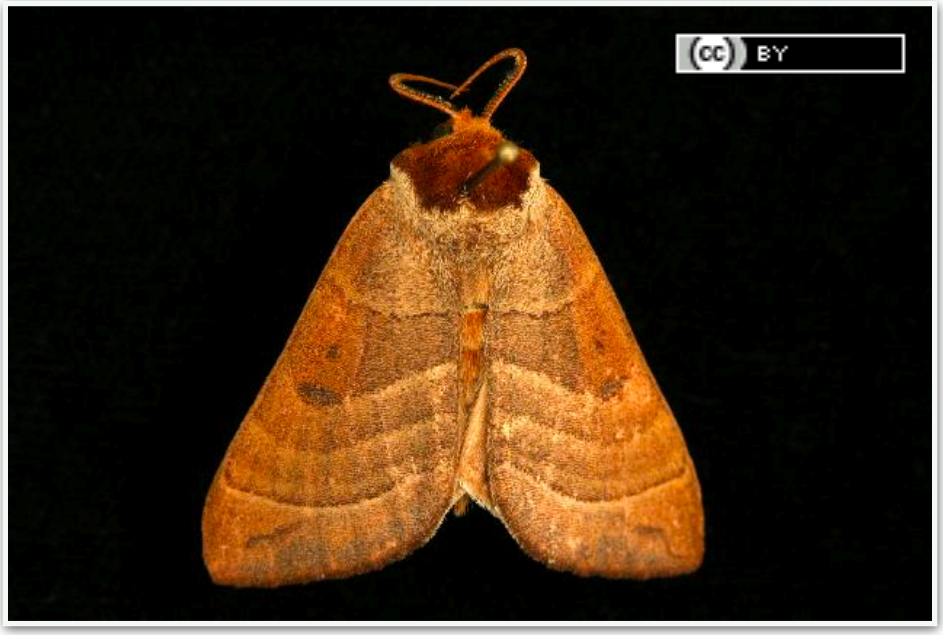
The Moth Photographers Group website notes that *D. neomexicana* can not be separated from *D. perfusa* using DNA barcoding techniques. Finally, we get to the other subject of this article.

DNA barcoding uses a standardized short section of DNA as a species identifier. DNA barcoding has been used successfully to non-invasively distinguish between life forms using DNA. DNA barcoding still faces some methodological challenges, but its successful use has been dramatic. It would appear to be a tool which could be used to solve my little mystery.

A 2017 report[2] by Zahiri et al. published in *PLOS ONE* covered the results of the DNA barcoding of 69,378 specimens from the *Noctuoidea* (Owlet Moths) superfamily which has more than 3664 described species. The survey covered all but 99 of the species, those which had not been barcoded. In this study, 255 species "shared barcodes". Barcoding could be used to identify species in 92.8% of the 69,378 samples. The survey found that individuals in the



This image of *D. neomexicana* is provided under a Creative Commons license by GBIF. The specimen was collected at Rattlesnake Spring, Carlsbad Caverns National Park, NM, on June 20, 1986. The specimen is maintained by the Colorado State University, Department of Bioagricultural Sciences and Pest Management.



This photograph of an adult *Datana integerrima*, Walnut Caterpillar Moth, is provided under a Creative Commons license from the Centre for Biodiversity Genomics (Photography Group).

***Datana* genus exhibited low barcode divergence. At page 11 of the referenced report the authors note:**

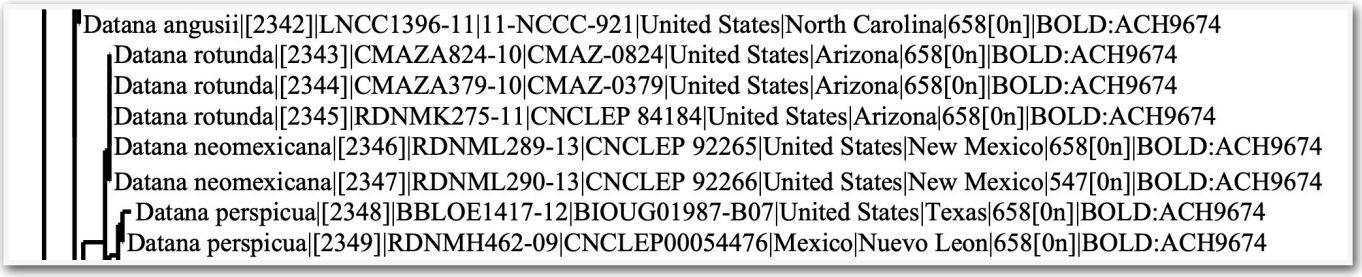
> ***First, the lack of divergence may reflect such a recent split that sister taxa lack diagnostic CO1 sequences. Second, barcode sharing can reflect introgression following hybridization between species. Finally, species sharing barcode haplotypes may actually represent only a single polymorphic species as a result of over-splitting, especially in species-rich genera, commonly referred to as "imperfect taxonomy". Distinct species with shared barcodes can also involve ancestral polymorphisms, often reflecting secondary contact between phylogeographic lineages. Other cases can arise through taxonomic and diagnostics problems such as misidentified specimens or overlooked cryptic taxa. While some instances of barcode sharing may indeed reflect invalid taxonomy, many cases of barcode sharing involve species which show differences in larval or genitalia morphology or larval and host plant use. Generally speaking, all cases of barcode sharing and deep intraspecific divergence require detailed investigation to better understand the responsible factors.***

The sample survey (69,378) included two samples of *Datana neomexicana* and 72 samples of *Datana integerrima*. It did not include any samples of *Datana perfusa* (but did include 7 samples of *Datana chiriquensis* - see earlier note on the splitting of *D. perfusa* from this species). In table 7 of the study's supplementary information, *D. perfusa* is not listed as a species without a barcode. The authors apparently did not recognize this species in this report. Steve Nanz (Editor in Chief at the Moth Photographers Group [MSU]), who commented on an earlier draft of this article, reviewed the survey and found that the *D. rotunda* specimens noted below are now treated as *D. perfusa*.[3]

In table 9 of the study's supplementary information, *D. perspicua* and *D. neomexicana* are listed as species with low barcode divergence (0.37), significantly below the 1% definitional threshold for "low barcode divergence". Supplementary information in the S1 Tree (*Notodontidae* and *Doidae*) at pages 24-25 solved part of the issue (see top of following page). Barcoding would indicate that these species are closely related. This led me to Table 8 of the supplementary material which indicated that *D. neomexicana* and *D. rotunda* are guilty of sharing a barcode. Thus, they are possibly synonyms.

The Moth Photographers Group website notes that a DNA barcode provides evidence of relatedness not proof of identification.

Taxonomic determinations in this genus appear to be in flux. *Datana perfusa* Dyar, 1923, is now considered a full species which includes *D. rotundata* (which is *D. rotunda*) Draudt, 1934, but does not include *D. chiriquensis* (which is found farther south). The genus was revised in Miller et al. (2018).[4]



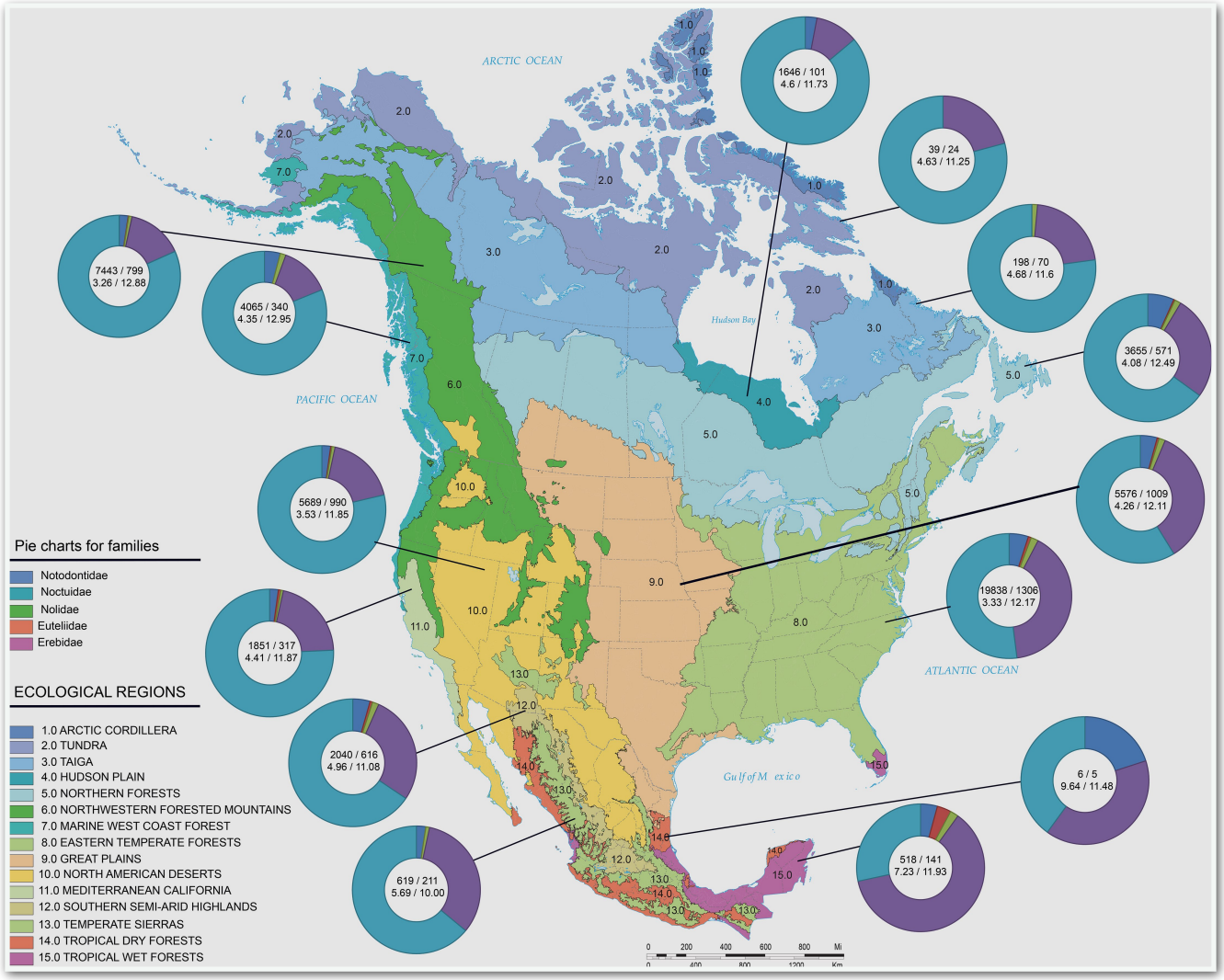
Nanz[3] noted:

The life history of neomexicana is currently unknown (or was in 2018) so yes, it is possible you have that species. The iNat larvae represent informed but unconfirmed guesses based on location by the Balabans. That neomexicana is an oak specialist is also a guess. The iNat images look like perfusa to me but I think the Balabans are likely correct. The range of perfusa is presumed by Miller et al. to extend into New Mexico near the AZ border. It feeds on Emory Oak. Per illustrations in Miller et al., larvae can **have well-defined lines like the iNat images of *neomexicana or can be obscurely lined like yours. I would not doubt that what you have is the same species as is represented as neomexicana at iNat. But since we have no description of neomexicana, I guess the jury is out until someone can rear them to adult.***

When it comes to host plants, both *D. perfusa* and *D. neomexicana* are listed as "oak specialists" by BugGuide. Based on the observations being made in the Black Range, the instars in question certainly eat oak leaves. Whether they are "specialists" or not apparently remains to be determined. Not all species in the genus Datana are host specialists, *D. ministra*, the Yellow-necked Caterpillar Moth, being one example of a species with instars which consume multiple plant species.

The referenced study included the map below which shows the distribution of families by ecological region. This map is useful and quite elegant.

Melding information from a variety of resources, which might not agree on a standardized taxonomy, and which are definitely from different time frames, can be confusing. Out of all of this it



appears, to me, that *D. perfusa* (to include *D. rotunda/rotundata*) and *D. neomexicana* are closely related - a matter of where you draw the line or what you put in the box. I suspect that their relationship may be clinal and that they are quite possibly the same species. My newly found (limited) understanding of DNA Barcoding would appear to support that premise.

Instars of caterpillar species are often variable, between stages and across range. If *D. perfusa* and *D. neomexicana* are separate species, or are a singular species exhibiting variation over distance, it is safe to assume that their instars may be variable.

Given that other species in the genus may exhibit the same behavior and life stages, I did a bit of research on instar behavior and the pupal stage of species in this genus.

As noted earlier, more research is often done on insects of economic value or which damage crops of some type. The Walnut Caterpillar Moth, *D. integerrima*, is such a creature. A study[5] of this species by Ephriam Hixson in 1941 noted that the "fifth and last instar larvae are black with white lateral stripes and conspicuous white body hairs" (p. 11). The fifth instar stage is 24-30 mm long at the beginning of its existence and from 35-43 mm at the end. "The pupa is green at first, but soon turns dark brown. It varies from 3/4 to 1 1/4 inches long and has a posterior projection" (p. 13). In the study area (Stillwater, Oklahoma) there are two generations of this moth a year.

The larval stage of this moth's life generally lasted for 19 days during the study. At about 15 days they:

> **...molt for the fourth time into the fifth instar. Following this molt they crawl up into the tree and scatter out more than they ever do in the earlier instars, usually one to the leaf. The average duration of this instar is four days, and each larva requires 5 leaves for its development. When they have all finished feeding, they crawl back down the branch to the trunk and thence to the ground, where they scatter in all directions seeking a place to go into the ground to pupate (p. 19).**

In order to determine the duration of the pupal stage and to check the time of appearance of moths in the grove, mature larvae were collected and placed in cages. The cages were examined daily and any moths that had emerged were recorded and removed . . . The cages were 10 inches deep and 20 inches square. The top was 4 inches deep and 20 inches square so as to fit on top of the lower part, and was covered with 16-mesh screen wire. The bottoms of the cages were placed in the ground to a depth of seven inches by digging a trench 20 inches square so that the soil inside of the cage was disturbed as little as possible . . . The walnut datana hibernates in the soil as a pupa at a depth of from one to three inches. The first generation moths emerge and are on the wing in May and early June. The earliest record of moth flight for Oklahoma is May 5, 1936, at Stillwater (page 15).

The mature larvae ordinarily burrow into the ground from one to three inches deep and form an oval cell in which to pupate, although many go under logs and stones to pupate when the ground is hard and dry. After the pupal cell is completed, the larva becomes shortened and thick. This stage is known as the prepupa and lasts two days. At the end of this time it molts to the pupal stage. The average duration of this stage for the first generation was 33.3 days, with the shortest period being 16 days and the longest 43 days. Hibernating pupae remain in the ground from 7 to 11 months. One moth emerged from a cage in which the larvae had been placed 11 months and 8 days before. The carryover of first generation pupae from one year to the next as happened with the spring generation of 1936, is not uncommon (pp. 19-20).

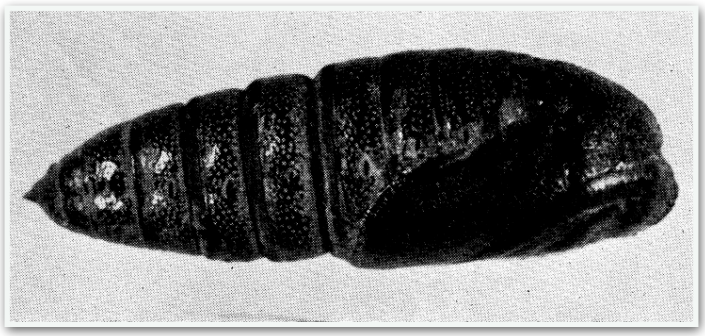
The pupa shown below is from page 20 of this report.

My initial thoughts about collecting pupae and "raising" them to the adult stage and then having a trained entomologist determine the species seems less likely to occur following this research into the pupal stage of *Datana* moths. (My commitment and resources are limited.)

During the study it was noted that "When enemies appeared, the whole colony would stop feeding, the larvae would rear their two ends in a threatening manner, and swing their heads from side to side in perfect rhythm until the disturbance passed (p. 15)." This may be the behavior captured in a photograph of a D. integerrima instar by Karen Chiasson on July 11, 2018, shown at the top left on the following page. (Used with personal permission, correspondence of October 14, 2022; all other use is covered by her copyright.)

The threat posture is said to create alarm in the minds of (potential) predators and change the shape of the target, thus making predation somewhat more difficult. Raising the body also exposes the openings of repugnatorial glands which secret a liquid which is both 'pungent and acidic'. It may be that the posture both startles a potential predator and reminds it that it's about to taste something it would rather not. This type of signaling is attributed to Monarchs and other butterfly species, via their coloration.

This is not newly described behavior: note the posture of the *Datana* in the 1880 drawing by Peale (bottom of the following page). Peale did not publish his collected work on butterflies and caterpillars. The manuscript was published in 2015 as The Butterflies of North America: Titian Peale's Lost Manuscript by Kenneth Haltman. This, just another example of the difficulties sometimes encountered in learning what is already known by others. This material was "lost" for more than a century.







***Datana*, Drawing by Titian Ramsay Peale, 1880.**

The threat behavior is also described by Hixson and in a paper by Cyrill Abbott[6]. Abbott noted that *Datana* larvae "feed in groups, and give very definite responses to various external stimuli. Air currents, sudden jars, and certain sounds cause each larva to elevate the anterior and posterior thirds of its body; contact with the substratum is maintained by means of the four middle pairs of prolegs. If the stimuli are continued, the insects may throw their heads from side to side" (p. 130).

While studying the instars of *D. ministra* and *D. perspicua,* Abbott found that their reactions were somewhat different but that both reacted to sound (F sharp above middle C and to middle C). Further experimentation involved removing the hairs from the caterpillars or "isolating" the hairs through the use of water, shellac, or procain. The experiments indicated that the caterpillars "heard" these two tones through their hairs. The author concluded: "What is the significance of this peculiar sense? The larvae give marked responses to only two notes, which, even if they were frequent under natural conditions (which they certainly are not), could hardly be considered of importance to the caterpillars. They are, therefore, not adaptive. It is probable that we are here in the presence of a "secondary" sense, developed as a result of the adaptation of certain organs to more significant stimuli" (p. 133).

On October 16, five days after Rebecca and I had initially found the caterpillars, I returned to the site to check their status and to see if their threat behavior was that described for some (all?) of the other species in the genus. The 16th was cool (mid-60s F) and overcast - quite dark, just what you would expect in southern New Mexico. That and the fact the caterpillars would be at the end of this stage and heading toward the ground did not give me reason to be optimistic.

I found several individuals of both the *D. neomexicana* (?) and Oslar's Oakworm Moth at the location where I had found them a few days before. I set about eliciting the threat posture by touching the hairs of one of the *Datanas* near its head. The response was very quick. It raised the front of its body in the manner pictured above left. The response of the caterpillar to stimulus near its rear was much more subtle and much slower. Video of this set of observations may be viewed in the gallery supporting The Black Range Naturalist on Vimeo. Photographs have also been added to the galleries of the Black Range Website at this link. One of the photographs taken on the 16th is shown at the top of the next page.

Next Steps: I will make some effort to collect pupae of the caterpillars being observed in the



Black Range. Hopefully, the pupae can be "raised" successfully and the adult sent to an authority on the taxonomic determinations of *Datana*. This effort will have to wait for the next season, giving me a chance to prepare for a successful effort.

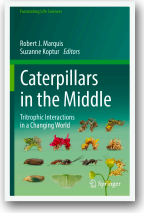
These efforts have not settled (and will not necessarily settle) the identification issue. Note that if you search Wikipedia for this genus, the results (as of October 14, 2022) do not conform to the species discussed here, other than to note the existence of *neomexicana* and *chiriquensis*.

My efforts thus far, however, leave me with more questions than I had when I started this inquiry (a good but sometimes frustrating situation).

Perhaps the repetitive antics of humanity are worthy of study. . .

Endnotes

1. **Many things in life/nature are relative, and the state of knowledge is one. While there is much still to know, there is much which is known. See for example: *Caterpillars in the Middle*, Marquis and Koptur Editors, Springer Press, 2022.**



2. **Zahiri R, Lafontaine JD, Schmidt BC, deWaard JR, Zakharov EV, Hebert PDN (2017) Probing planetary biodiversity with DNA barcodes: The Noctuoidea of North America. PLoS ONE 12 (6): e0178548. https://doi.org/10.1371/journal.pone.0178548**

3. **Personal correspondence with Steve Nanz, the Website Editor in Chief of the North American Moth Photographers Group at the Mississippi Entomological Museum at Mississippi State University, dated October 13, 2022. Steve's review of early drafts of this article (sighting October 11, draft article October 12, and additional comments on October 13) were extremely helpful.**

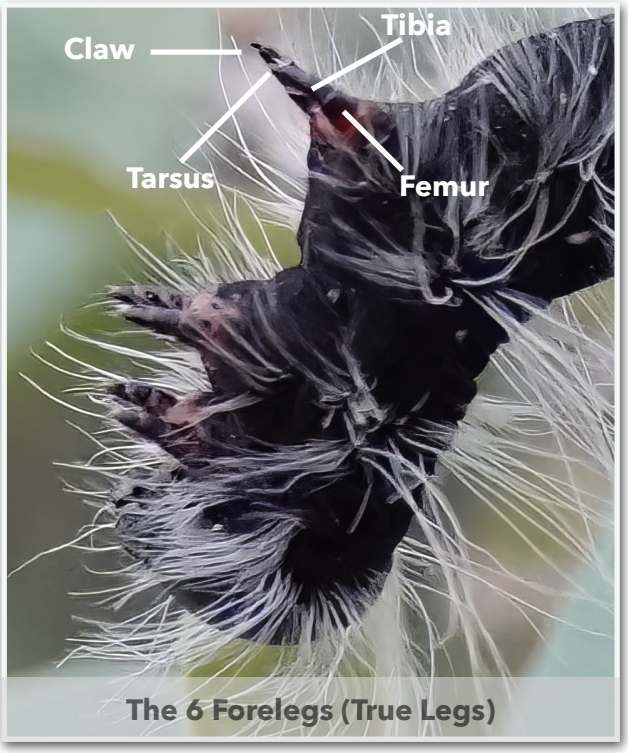
4. **Miller, J.S., D.L. Wagner, P.A. Opler & J.D. Lafontaine, 2018. *Drepanoidea, Doidae; Noctuoidea, Notodontidae (Part): Pygaerinae, Notodontinae, Cerurinae, Phalerinae, Periergosinae, Dudusinae, Hemiceratinae. The Moths of America north of Mexico,* Fascicle 22.1A: 1-339.**

5. **Hixson, Ephriam, The Walnut Datana, Agricultural Experiment Station, Oklahoma A. and M. College, Stillwater, Experiment Station Bulletin B-246, March 1941**

6. **Abbott, Cyril E., "The Reaction of Datana Larvae to Sounds", Psyche, April 1927, pp. 129-132**

A Bit of Caterpillar Anatomy





The 6 Forelegs (True Legs)

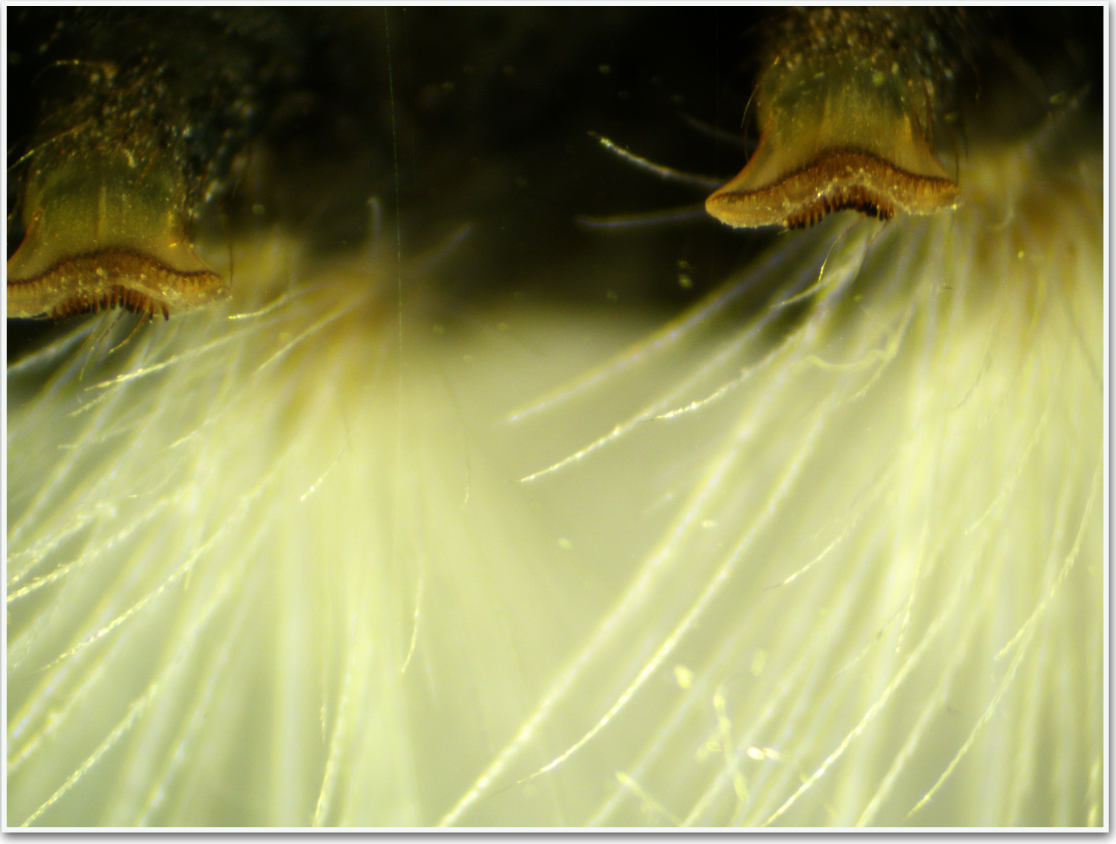


Like spiders, caterpillars extrude silk (as in "silk worms") from a spinneret. Rather than being at the rear of the animal, as in spiders, the spinneret is set amongst the mouth parts of the caterpillar.

A caterpillar has two types of legs. The first six legs, three sets of two, are behind the head and are called the thoracic legs. The caterpillar uses them to grasp and hold leaves while eating, among other things. The other legs

look something like suction cups and are known as anterior prolegs. Details of the anterior prolegs of *Hyphantria cunea* are shown on the following page. They may hold on with suction, but the small protrusions within





the "suction cup" do the heavy lifting, making numerous points of contact with which the caterpillar grasps. Photographs on this page were taken in Hillsboro on October 10, 2022, and they are of a different caterpillar species than that described in the main article.

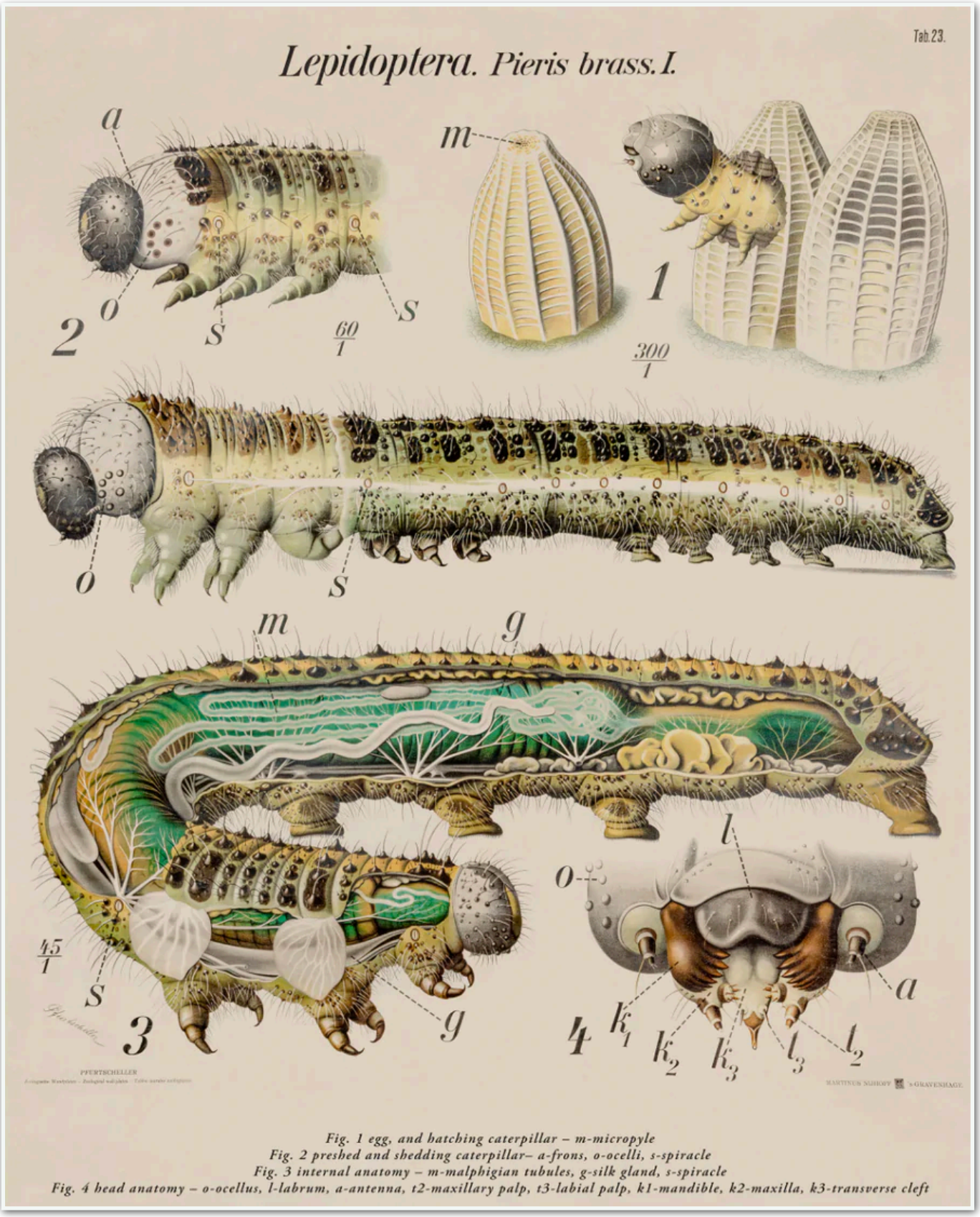


Fig. 1 egg, and hatching caterpillar – m-micropyle
Fig. 2 preshed and shedding caterpillar– a-frons, o-ocelli, s-spiracle
Fig. 3 internal anatomy – m-malphigian tubules, g-silk gland, s-spiracle
Fig. 4 head anatomy – o-ocellus, l-labrum, a-antenna, t2-maxillary palp, t3-labial palp, k1-mandible, k2-maxilla, k3-transverse cleft

This image is a copy of a Paul Pfurtscheller Zoological Wall Chart dated 1906-1908. Pfurtscheller started producing wall charts, on many topics, beginning in 1902, initially for the German market, but demand for them in other languages soon grew. He originally used the charts to illustrate his own lectures. He produced 38 charts on various zoological topics. He was working on chart 39 (a cockroach) when he died.

Black Range Observations

Bob Sivinski took the photograph to the right, of a White Angled-Sulphur, *Anteos clorinde*, at Emory Pass, Black Range, on August 8, 2011.

There are only a handful of sightings of this species in New Mexico. It generally is found in South America (as far south as Argentina), north through Central America and Mexico. It is sometimes seen as a stray in a small bit of southeastern Arizona and the lower Rio Grande valley. There are two subspecies. Based on range this is most likely *A. c. nivifera*.

The caterpillar of the Oslar's Oakworm Moth, *Anisota oslari*, pictured below, was photographed by Véronique De Jaegher in Kingston, N.M. As you can see, this instar likes to feed on oak.





Véronique De Jaegher photographed the White-lined Sphinx Moth caterpillar shown to the right in Kingston, N.M. The caterpillars of this species (*Hyles lineata*) are highly variable - as in, they don't look anything like each other. Instars vary by stage and by region! Seems like something crying out for research.



Véronique also took the photograph below, in her yard in Kingston during September 2022. This 3"+ caterpillar is an instar of Glover's Silkworm, *Hyalophora gloveri*. The slice and dice of this taxon is active. The population found here may be a separate population, associated with what is currently known as the "Mexican Variants". It was formerly considered a subspecies of *H. columbia,* a classification which some authorities still consider to be accurate.



Steve Metz has taken stunning photographs of birds around the world. In January 2023 he spent time at the Black Range Lodge in Kingston, using the Lodge as a base of operations for his photographic outings. During his visit to the southwest, he took several remarkable photographs of the Mexican Spotted Owl, *Strix occidentalis lucida,* in Grant and Sierra Counties. His photographs on the front and back covers are from the Black Range, as are his photographs on the following page. He retains copyright for all of the Spotted Owl images in this issue. (As always, contributors retain copyright of material published in The Black Range Naturalist, except for unattributed material which is by Bob Barnes and is made available under a Creative Commons, Non-Commercial License.)















Photographs on this page are by Steve Metz, who retains copyright.

Cindy Yarmal at the Animas Creek Honey and Herb Farm sent in the photos to the right and directly below of *Misumenoides formosipes*, the Whitebanded Crab Spider, photographed during November 2022 near Animas Creek on the east slope of the Black Range.

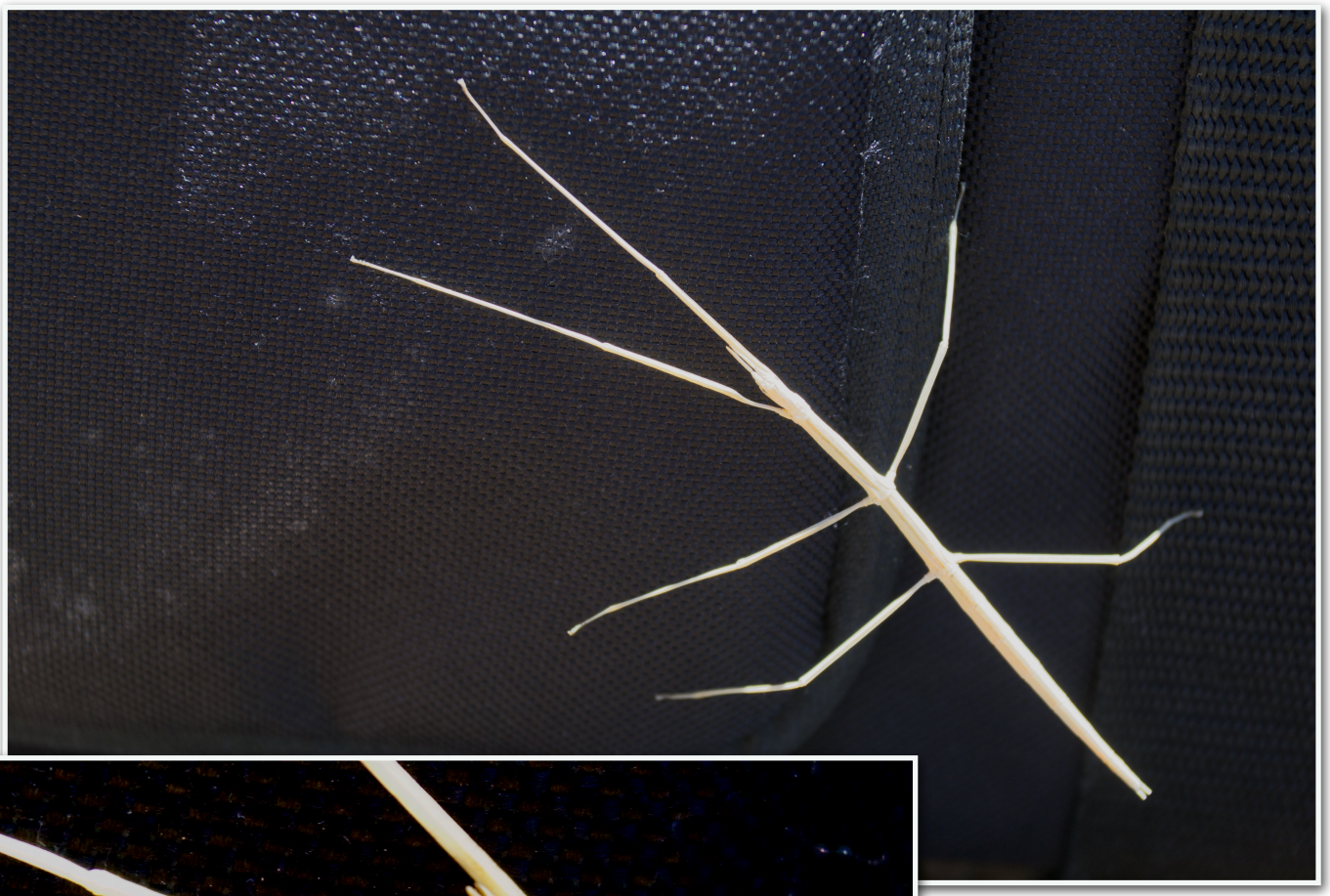








These photographs of a Walking Stick were taken by Tom Lander on the east slope of the Black Range. It is possibly in the genus *Parabacillus*.

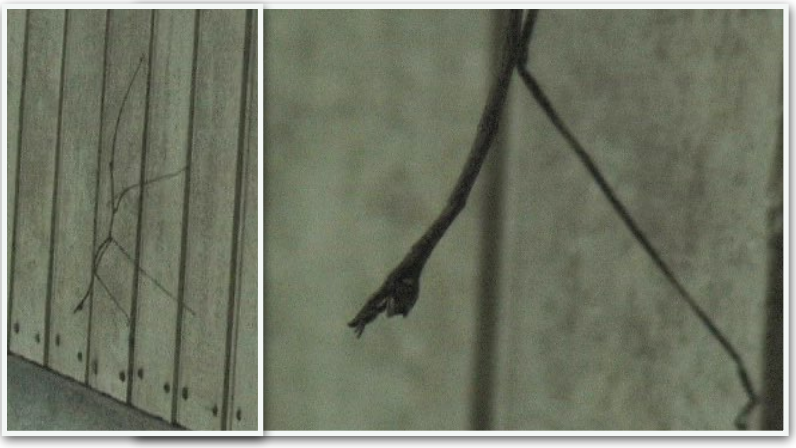




Above and left: Probably *Parabacillus hesperus,* Western Short-horn Walkingstick. These photographs were taken on April 22, 2015, near the Garfield/Butler Mining Claims, on the west slopes of Empire Peak, NE of Hillsboro, Black Range.

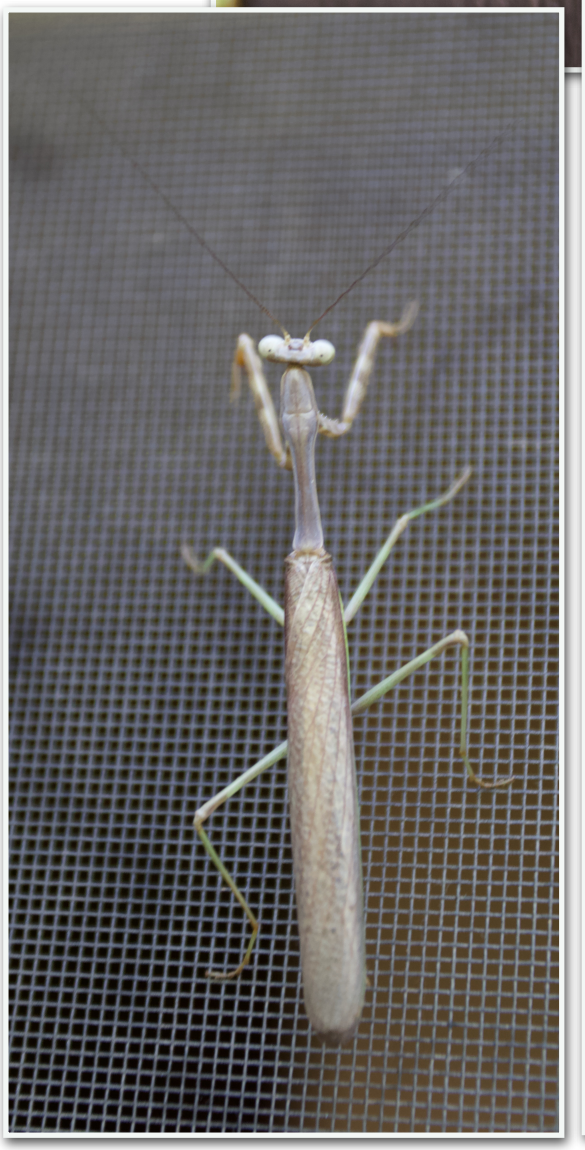
Compare the two photographs at the top with the two (center and right) from Peru, 2005 (on the side of a house) and the photograph below left from Venezuela 1997.











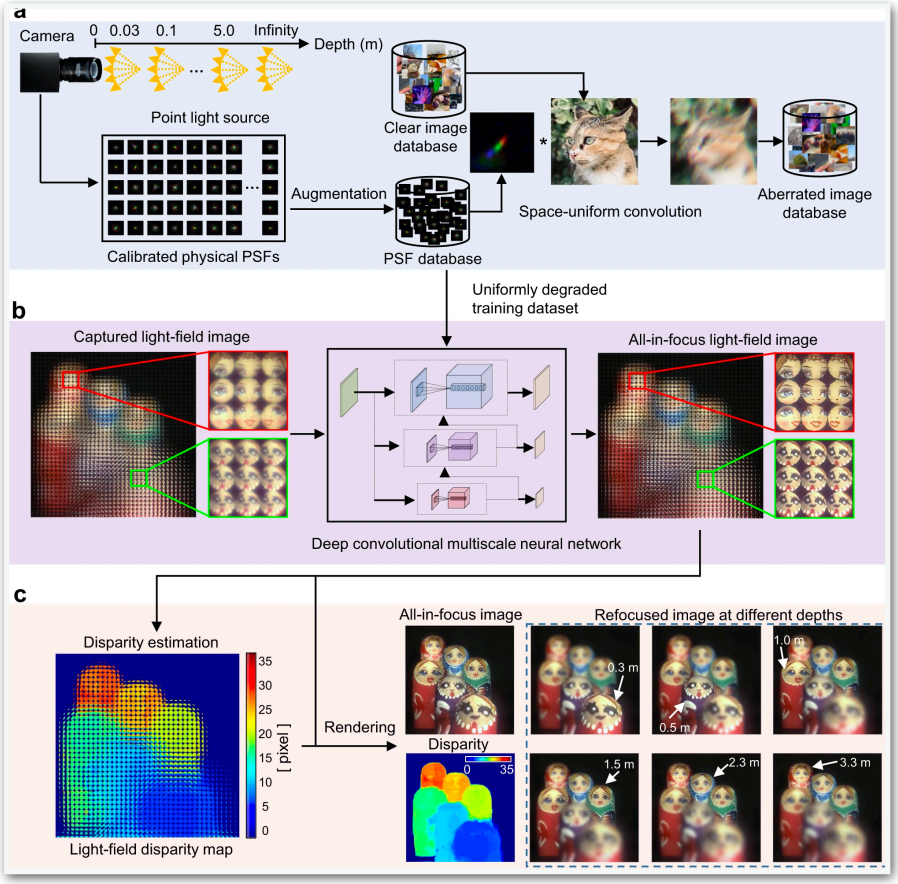


Stagmomantis limbata,
Bordered Mantis
Female (top)
Male (bottom)
Hillsboro, NM
September 2, 2014





Gray Fox photographs by Véronique De Jaegher, taken in Kingston, NM.



From: Fan, Q., Xu, W., Hu, X. et al., "Trilobite-inspired neural nanophotonic light-field camera with extreme depth-of-field", *Nature Communications* 13, 2130 (2022). https://doi.org/10.1038/s41467-022-29568-y. Used under an International Creative Commons (Attribution 4.0) License.



A species of Dalmanitina, by DanielCD.

Light Field Photography, Trilobites, Evolution, & Macro Photography

Rarely do you come across a technical article which says so much, perhaps not explicitly, but certainly usefully. The graphic shown above is from such an article.

The "evolution as progress" bias is often encountered. Usually it is implicitly embedded in the argument being presented. It is a favorite of human-centerics who think that humans are the goal of evolution. The argument breaks down with just a little prodding but is still prevalent. Other life forms have abilities which are far superior to those possessed by humans, and there are multiple examples of species who possessed those abilities going extinct or of the ability disappearing as part of the evolutionary process. One such ability was that possessed by *Dalmanitina socialis,* a long-extinct species of trilobite. It had the ability to focus on objects both near and far - at the same time. A wonderful, complex, and highly developed ability - extinct. So much for "evolution is always about becoming more complex and sophisticated."

Developers and photographers of light-field photography have been grappling with the mechanical, biological, and technical limitations of our most modern imaging systems, from animal eyes to cameras and lenses which cost well over $100,000.

The approaches used in light-field photography have been two-fold. The digital photographers of the world understand that a digital image is a data base which is processed by an algorithm, first in the capture process and then in the manipulation of the data to make an image. Here we deal with digital imaging; analog imaging is conceptually the same but technically different.

A digital image is made up of thousands of inputs, generally electrical signals created when light hits a camera sensor. There are many arguments about the importance of sensor size. The number of pixels (megapixels [MP]) is the general term of reference.

Most cameras which we encounter in the consumer market range have sensor sizes between 6.17 mm x 4. 55 mm and 53 mm x 40.2 mm (typical medium format camera). Most consumer cameras are full-frame (36 mm x 24 mm), APS-C (23.6 mm x 15.6 mm), or micro 4/3 (17 mm x 13 mm). Each sensor is made up of many micro sensors. All things being the same (and they are not always the same), the bigger the sensor the more micro sensors. A micro four-thirds sensor might have 20 MP while a full-frame camera might have 50-60 MP. An MP is one million pixels (dots) on an image. A medium format camera will take an image composed of one hundred million dots.

Passing on (and over a great many technical points having to do with how each of those pixels is utilized) to the sensor and lens interface creates another dimension to our calculus. Not all lenses and sensors are matched. Some lenses enable light to hit all areas of a sensor, some do not. That is why there is a "crop factor",

meaning that the light which passes through the lens only hits part of the sensor (fewer pixels are generated). To deviate for a moment, some photographers like using lens-camera combinations which produce a crop factor because it has the side effect of "magnifying" the image - a telephoto effect. But it is a digital telephoto effect, not an optical telephoto effect and the resolution of the image is reduced as a result.

The electronic data generated by light hitting a pixel are stored by the camera (internal, external, memory card, etc.) in a file which saves the spatial relationship of the bits of data (this bit of data was generated by this pixel and it is next to that pixel which generated that bit of data). For our purposes it is enough to understand that it is a database.

The researchers cited above (see image citation) developed a lens composed of many micro lenses. This arrangement affects the light which hits the micro-sensors on the sensor (in much the same way that the trilobites' eyes processed light). This increases the amount of data which is in the database. There is a lot left out here, but the cited article does a very good job of describing the technical details and issues, and a significant amount of supporting material is available on line.

The database can then be manipulated by an algorithm (complexity varies, more than one may be used) which is usually called "software". These algorithms are very sophisticated. That is why you can get an excellent photograph at commonly viewed sizes from a smart phone, which has a smaller lens and smaller sensor.

When most people say something like "that image is photoshopped" they imply that the image has been altered by using a software program ("photoshop") - something like older people saying "make a xerox copy". Generally, they mean that something has been deleted from the image or added to the image, affecting its basic "truthfulness". Most cameras are used to produce .jpeg images. Images produced with this software are compressed. Basically, if "pixel a" and "pixel b" which are beside each other in the image have the same attributes they are entered into the data base as "pixel ab". This reduces the size of the data file, which is the purpose of compression. The reduction In this case is almost one-half. If a photographer wishes to modify the image, by lightening the image or darkening the image, for instance, that modification is global. (Note: "modify the image" is a term which has negative connotations for many people. The modification, however, may simply be making the image look more like the original subject, such as when an "overexposed" image is darkened to make it look more natural.) Many cameras can produce a RAW file. A RAW file is not an image (nor for that matter is RAW an acronym - regardless of how it is written); it is a data base which can be manipulated with significant detail and sophistication. Once the desired modifications have been made, the data are processed into an image file, like .jpeg. There is no RAW standard. For instance, many camera manufacturers have their own method to make RAW adjustments . Not all software programs will read all RAW files.

The process utilized by the researchers can be thought of as the utilization of a RAW data base. The graphic, from the cited article, depicts the capabilities of a lens/sensor/data base set. Light-field technology enables the processing of "out-of-focus" images; it allows all of the pixels to be focused, even when in the original data base they were not, and it allows the depth of focus to be modified within one image. If we reverse engineer for a moment, most of us have seen these beautiful images where everything is sharply focused, a landscape with flowers in the foreground and a mountain glacier in the background, all sharp. Our eyes can not do that nor can any consumer camera-lens set. These images are created by layering multiple images, each shot with a different focus point (flowers in focus in this image, glacier in focus in another), on top of each other. The images (and there may be anywhere from 10 to more than a hundred) are merged - using RAW processing of each plane of focus - into one image. The process is called photo stacking (sometimes focus stacking). Some cameras can produce photo stacks, others can not. In all cases, photo stacking requires dedicated software to process the data.

The quasi-technical discussion above simply sets up the observation that trilobites may have been able to "naturally" do what humans are struggling to achieve at this moment. They did it 400+ million years ago.

The multiplicity of lenses and the amount of processing capability to make sense of all of that input require a significant amount of computing power. Does that mean that trilobites had that computing power? There may be a trap here. Implicit in this line of reasoning is the idea that trilobites were doing the same things as we expect from a full-field camera. Let us discard the color versus shades-of-gray question from the very beginning. Let us assume that they were not processing data at levels sufficient to recognize color variations. How much simpler can our reasoning become? (Lots.) Let us assume that those lenses and the processing center associated with them were not even distinguishing shades of grey. Maybe it was only processing 0s and 1s - light, no light. Still....



Trilobite from the Upper Ordovician.

"An Immense World"

Book Review by Bob Barnes

In the early part of this century I began playing with a concept I called "Realms of Density". Thought experiment after thought experiment was met with shouts of glee. Something along the lines of, '"What is Dad/Bob going to come up with next?" Not to be dissuaded, I continued the experiments from a different vantage: What does the world look like to others (human and non-human alike)?

The concept of "Realms of Density" is simple enough. Our human sensory systems allow us to understand (or so we think) the world around us. We all know, however, that there is a world out there that we are incapable of sensing. The examples are legend: What do flowers look like to bees? What do stellar formations look like....? My little experiments dealt with physical density and how we perceive it. Imagine if you will that we see the density of all objects at 100%. What would it look like at 50%? That is, what does the world look like if it is perceived as only half as dense as we currently perceive it - or any other parameter that you can imagine? Would things have the same shape, the same feel? I suspect that if you didn't tinker with any of our senses, other than how we perceive density, the world would seem quite different. Would water seem less fluid? How would that feel? How would our perception of a stream differ? Would all things simply be normative? Because everything is 50%, would the relationships that we see be the same. Crawl down that hole and the wonderland of Alice will seem stable.

Jakob Johann Freiherr von Uexküll (1864-1944) was a Baltic German whose work has greatly influenced our understanding of the world, and what we think is the understanding of the world by other creatures. He was intrigued by how other forms of life sense and/or perceive the world in which they live. He believed that all forms of life perceive the world in their own unique fashion: Each sees the world "in terms of species-specific, spatio-temporal, 'self-in-world' subjective reference frames" that he called Umwelten. Umvelt is translated as "surrounding-world", "phenomenal world", "self-world", and/or "environment" (depending on the source of translation) .

> These 'Umwelten' (plural of Umwelt) are distinctive from what Uexküll termed the 'Umgebung' which would be the living being's surroundings as seen from the likewise peculiar perspective or Umwelt of the human observer. Umwelt may thus be defined as the perceptual world in which an organism exists and acts as a subject. By studying how the senses of various organisms ... perceive and react to sensory data as signs, Uexküll argued that they were to be considered as living subjects. This argument was the basis for his biological theory in which the characteristics of biological existence ("life") could not simply be described as a sum of its non-organic parts, but had to be described as subject and a part of a sign system. (*Wikipedia*)

I will not bore you with more of the concepts of Umwelt, other than to note that apparently someone got to the core concept of realms of density before I did. Shame.

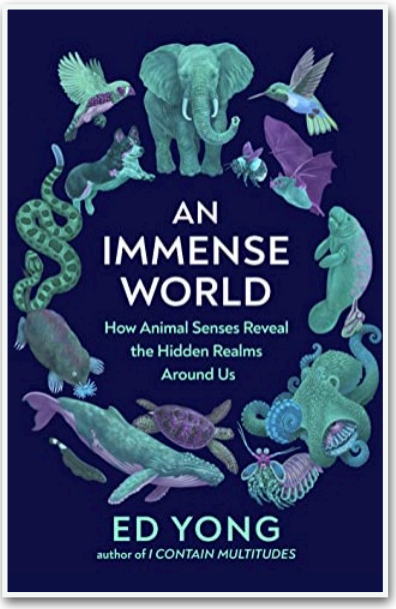
To overcome the deficiencies of the human Umwelt we use a variety of technological tricks. For example, this view of NGC 3324, in the Carina Nebula



(photo by NASA, ESA, CSA, and STScI) is wondrous. The many images which will follow from the James Webb Space Telescope (JWST) will inspire and provide sensory overload for generations. Of course, if you were able to see this part of the sky with your own eyes, at this magnification, it would not look like this at all. All that beauty is false color. Wavelengths which we can not see have been converted into wavelengths that we can see to overcome our limitations and allow us to analyze and be stupefied by its beauty. If you were able to see the wavelengths that the JWST sees with its instruments, would it look like this? Does the substitution of different wavelengths add or remove information? That is a question of Umwelt. How is it that we can expect to understand the world as others do if we sense and perceive it differently? What are we missing? There is the sense and there is the perception. How is it that our brains translate the sensory input we receive from our bodies? Other creatures have differing neural network models. How is it that they perceive the world? Given the same inputs, what is the effect of their neural models?

In "An Immense World - How Animal Senses Reveal The Hidden Realms Around Us", Ed Yong provides a survey of our current (lack of) understanding of Umvelt and the implications of that situation. Periodically readers of this magazine find references to the Umwelten of the critters of the Black Range. The terminology is different but the concepts are the same: Spiders "hear", in part, by using the hair on their legs to sense sound waves/particles; moths, butterflies, birds (and sometimes it seems - everything else in the world) is able to see ultraviolet and/or infrared radiation; rattlesnakes sense infrared, and feel your footsteps through their stomachs; etc. It is a concept that adds great beauty to the world and hopefully gives us some pause in our perception of our grandeur.

Yong does an excellent job of interlacing the fact and the personal experience. He argues that each creature senses what it needs to sense. The degree to which a species evolves the capability to sense what it needs to is a primary driver in the natural selection process.



As with many things, recognizing that something is of interest triggers increased sensitivity to its importance. Want to go on a trip to Spain? All of a sudden references to Spain will crop up everywhere - and we are not talking about the personalized marketing efforts of web browsers here. That is the case with this book. Recently, there have been several studies which have been additive to the contents of this book.



"Specializations in optic flow encoding in the pretectum of hummingbirds and zebra finches", Graham Smyth, Vikram B. Baliga, Andrea H. Gaede, Douglas R. Wylie, Douglas L. Altshuler, *Current Biology*, Volume 32, Issue 12, 2022, pp. 2772-2779 (paywall).

> Abstract: All visual animals experience optic flow - global visual motion across the retina, which is used to control posture and movement. The midbrain circuitry for optic flow is highly conserved in vertebrates and these neurons show similar response properties across tetrapods. These neurons have large receptive fields and exhibit both direction and velocity selectivity in response to large moving stimuli. Hummingbirds deviate from the typical vertebrate pattern in several respects. Their lentiformis mesencephali (LM) lacks the directional bias seen in other tetrapods and has an overall bias for faster velocities. This led Ibbotson to suggest that the hummingbird LM may be specialized for hovering close to visual structures, such as plants. In such an environment, even slight body motions will translate into high-velocity optic flow. A prediction from this hypothesis is that hummingbird LM neurons should be more responsive to large visual features. We tested this hypothesis by measuring neural responses of hummingbirds and zebra finches to sine wave gratings of varying spatial and temporal frequencies. As predicted, the hummingbird LM displayed an overall preference for fast optic flow because neurons were biased to lower spatial frequencies. These neurons were also tightly tuned in the spatiotemporal domain. We found that the zebra finch LM specializes along another domain: many neurons were initially tuned to high temporal frequencies followed by a shift in location and orientation to slower velocity tuning. Collectively, these results demonstrate that the LM has distinct and specialized tuning properties in at least two bird species.

The concepts associated with vision are dealt with, at length, in *An Immense World*. Display frame rates, refresh rates, flicker fusion thresholds (critical flicker frequency), etc., vary with species and are matched to the behavior which they support/enable. Do different species see different worlds? Yes, or at least the same world, differently.

"Hummingbird plumage color diversity exceeds the known gamut of all other birds", Venable, G.X., Gahm, K. & Prum, R.O., *Communications Biology* 5, 576 (2022).

In *Volume 5, Number 1* (January 2022) of this journal we discussed feather structure and how it created color. In the above referenced article, the authors report on their survey of the colors that 114 hummingbird species create with their feathers (and a little light). The colors assessed in this study exceed the total number of colors previously identified in the avian world. "Our results demonstrate that barbule structural color is the most evolvable plumage coloration mechanism, achieving unique, highly saturated colors with multi-reflectance peaks." (Abstract)

This study focused on the "violet cone type visual system". The differing capabilities of rods and cones, and how information from each is manipulated by centralized and non-centralized nervous systems to create a perception of "seeing" a wavelength of radiation, is discussed fairly early in *An Immense World*. As are the implications of dichromatic and trichromatic forms of vision, not to mention forms of even greater complexity - and surprisingly the notion that more does not always equate to more. You will just have to read the book to understand that statement!

Birds generally, and hummingbirds specifically, have tetra-chromatic vision, meaning that they have four types of color cones. Generally speaking, the cones are of different lengths (although other morphological differences are possible), allowing the birds to assess incoming light in the ultraviolet, red, green, and blue wavelengths. For any particular point (use "pixel" as a surrogate), inputs from all of the cones are assessed. If all the inputs are roughly equal in the amount of stimulation, the color is perceived to be gray, white, or black. If the level of input stimulation differs, it is interpreted as hue and saturation. Interestingly, the capability of hummingbirds to perceive a broad range of colors exceeds the number of colors which were identified from the hummingbird plumages.

In *Volume 5, Number 1,* we discussed the differences between pigmentation and coloration created by feather structure. This increased awareness of the number of colors exhibited by hummingbirds was due entirely to a new assessment of the "structural coloration mechanisms" (not pigmentation). The specifics of structure are discussed, in detail, in this study. The authors note that their assessment supports the notion that unoccupied avian color space (what the birds' colors are - not what they can perceive) "are unoccupied because these colors are challenging to create, rather than because they might function poorly for communication."

This study, and the book under review, go into much more detail than is articulated here.

The study of sensory ecology is intriguing, complex, and mostly unknown/unexplored. A book like *An Immense World* is incredibly valuable, and just plain fun to read. It explains much and raises so many questions. This is a book worth reading.



Black Range Weather - Rainbows

Photographs by Matilde Holzwarth



Everyone takes photographs of rainbows, everyone knows about rainbows, rainbows even show up in the Black Range - they are the source of all the gold mined here. So we thought we would talk about rainbows in this issue.

First of all, let us enjoy some images taken by Matilde Holzwarth when she lived south of Hillsboro. Although we all take photographs of rainbows, it is often the scene in which they are found that entrances us. Matilde frequently used dark sky to accent the rainbows of her photographs, and for our purposes it enhances the colors we are here to discuss.

And we all know about rainbows, ever since Newton. Famously, Issac Newton is given credit for the breakthrough science involved in splitting white light (sunlight) into a color palate using a prism. The ca. 1870 painting by J. A. Houston

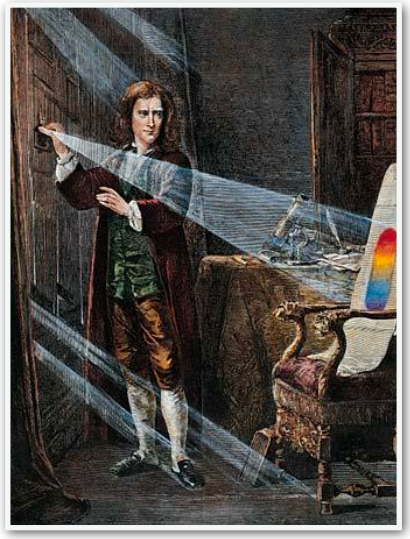








memorialized the event (see below). Here we see Newton discovering the colors of the rainbow. (As if no drunk in a Greek Cafe had ever looked at light shining through a wine bottle.) But Newton did go on to describe



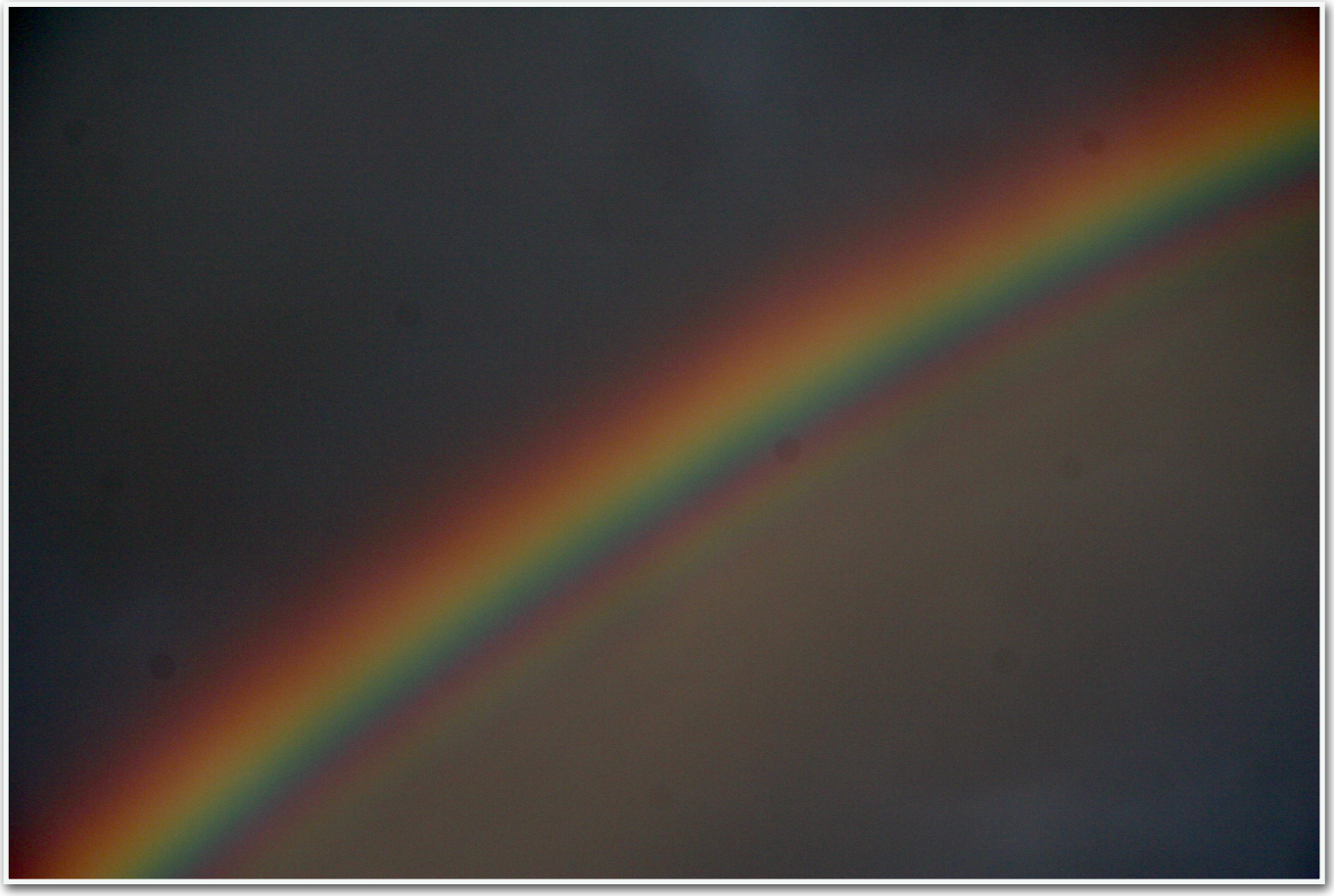
what he found in *Opticks, or A Treatise of the Reflections, Refractions, Inflexions and Colours of Light* (1704). It is for that work, explaining what he and so many others had seen in the past, that he is remembered. (He is also remembered for *Philosophiae Naturalis Principia Mathematica,* 1687, and some other works.)

The rainbow colors (the electro-magnetic spectrum visible to humans) are red, orange, yellow, green, blue, indigo, and violet (see, especially, the top of the following page). Johann Wolfgang von Goethe (*Theory of Colors*) was quick to point out that the measurement of the light spectrum was one thing but did not address how color was perceived by humans. Although Goethe did not go on to extend this question to non-humans (or to question the limitations of human sensory systems), it is those questions which have been most important to science. As early as 1722, J. C. LeBon, (*Coloritto; or the Harmony of Colouring in Painting*) described the subtractive and additive properties of color. Red, green, and blue make white; blue, red, and yellow make black; and all of those other combinations. Combinations which apparently are mixed in the brain as inputs from our visual system as well as on a painter's easel.

Human brains and their color input systems create our perception of color and determine the range of electro-magnetic radiation we can perceive.

By 1800, when William Herschel discovered infrared radiation (a color of light that humans cannot perceive), the race was on to understand the limitations of the human Umvelt and what we could (can) learn by developing equipment and processes which allow us to measure and calibrate that part of the electro-magnetic spectrum that we cannot see with our native organs. Now we can imagine myriad colors extending from the edges of the rainbow that we see with our eyes. We see many exotic stellar formations, for example, only because we are able to measure those wavelengths we ourselves cannot see, convert them into colors we can see, and experience, indirectly, what we cannot experience directly.

Rainbows are beautiful and they are interesting. They are a doorway into an augmented reality.





Bird Species by Vegetation Type

Information from a variety of sources may be used to inform decisions about plantings, plant structure, feeding, and water availability in an area that a person wants to make more attractive to bird species and generally support their viability.

The New Mexico Partners in Flight program has identified high priority migratory bird species by vegetation type. The tables which follow are based on the information from Partners in Flight as it is represented in the Draft Environmental Impact Statement (Draft EIS) for the Gila National Forest's proposed Revised Forest Plan. The formatting of the information shown here is different from that contained in the Draft EIS (Vol. 1, pp. 274- 277).

Although some of these species (e.g. Abert's Towhee) may be very rare in the Black Range, we have chosen to retain them in the listing.

The Draft EIS uses Ecological Response Units (ERUs) to describe the habitat/ ecology of specific units of land. (Although arguable, we equate ERU to "specific habitat"). In the Draft EIS the following ERUs are used:

A. Ponderosa Pine Forest
B. Ponderosa Pine - Evergreen Oak
C. Madrean Piñon - Oak Woodland
D. Piñon-Juniper Evergreen Shrub Woodland
E. Juniper Grass Woodland
F. Piñon - Juniper Woodland
G. Mountain Mahogany - Mixed Scrubland
H. Piñon - Juniper Grass Woodland
I. Montane/Subalpine Grasslands
J. Colorado Plateau/Great Basin Grasslands
K. Semi-desert Grassland
L. Spruce - Fir Forest
M. Mixed Conifer With Aspen
N. Mixed Conifer - Frequent Fire
O. Riparian

Vegetation mapping can be sophisticated and detailed, and it can recognize complex relationships. An example of vegetation mapping produced by the U. S. Geological Survey is found at this link: Chihuahuan Semi-Desert Lowland Grassland. The detail found in such assessments precludes a significant discussion of the ERUs here (a short article vs. volumes of data). Instead, the colloquial names (shown above) should be sufficient to identify the habitat involved.

The species identified by Partners in Flight are listed by "ERU preference". In addition, the Draft EIS identified Habitat Type and Special Habitat Features for each of the listed bird species. For instance, Green-tailed Towhee can be found in Montane Scrub.

For several species, we indicate specific locations where the bird species has been found. This information is listed in the second column and is entered in orange. These are not comprehensive listings, only illustrative. If the species name is a link, the link will take you to a photo gallery of the species on the Black Range Website.

There may be a tendency to assume that these bird species use the habitats described in this listing exclusively. That is not the case. And because that is not the case there is ample opportunity to attract and support bird species at locations different from the ERU descriptions (e.g. "a yard in Hillsboro"). To demonstrate the concept, we have color coded the species name box with this color if the species has been seen in "a yard in Hillsboro". Below we discuss what appeared to attract the species to that yard. In most cases, the yard included some aspect of the "habitat features" described in the table. (Of course, where your yard is, and the aspect of your yard [or other area] will determine what you can do to enhance the bird habitat.)

WATER

The availability of water in a yard may be the single most important attractor for many bird species. Although it helps to have water situated at varying heights (ground, near ground, waist high) it is seemingly more important to have still water (bird bath for drinking and bathing) and moving water (fountain, bubbler). The sound of moving water may be an attractor.

A SAMPLING OF SPECIES

Common Ground Dove: An interesting example of the need to assure that your yard has open bare ground in places and water. Many species seek to avoid tangles and dense undergrowth.

Summer Tanager: Found at medium to high sections of mature cottonwood. Attracted to feeder (suet) and water. Cottonwood crowns are fairly open; this species is often found at the edge of the crown where there are good sight lines.

MacGillivray's Warbler: Found in a Hillsboro yard in dense grasses and other vegetation of less than five feet (generally less than three). Often feeding. This species is attracted to dense undergrowth.

Scott's Oriole: During the spring in Hillsboro. Uncommon. Typically comes to nectar feeders and water.

Red-naped Sapsucker: In Cottonwoods in the spring and fall, especially, just as buds are forming or leaves are dropping. Also on yard plants like Pyracantha.

Green-tailed Towhee: Likes leaf litter, will often spend substantial amounts of time "excavating" a small area.

Virginia's Warbler: This species is generally seen in the garden, which has dense low vegetation which is shaded by taller sunflowers, near water.

Williamson's Sapsucker: Rarely in Hillsboro, seemingly brought in by availability of water, especially during colder months.

Golden Eagle/Common Black Hawk/ Peregrine Falcon: These have all been fly-overs in Hillsboro. Apparently no specific attractors in yards.

Northern Goshawk (as well as Cooper's and Sharp-shinned): Attracted to small mammal and bird activity in the yard.

A FEW OTHER SPECIES

The yard list for one yard in Hillsboro currently stands at 171 bird species, some of which are represented by more than one subspecies. Some of the birds in this listings are one-offs, some have appeared in some years and not others. Some appear only during passage, some are winter visitors, some appear only during the summer. The following species may be of interest. Our impression of what attracted them to the yard is also listed.

- ✻ Blackbirds/Cowbirds - seed, water, higher open canopy
- ✻ Hummingbirds (eight species) - nectar feeders - decide for yourself how long to leave them up when the weather starts to get cold. Whatever you do, do not simply stop feeding after birds have stayed into the cold months and are relying on your feeders. Hummingbirds typically like nearby open perches.
- ✻ Bluebirds (three species) - water, small bugs, higher open canopy
- ✻ Buntings (four species)/Dickcissel - water, seed, open areas with nearby dense scrub - Painted Bunting likes multi-level garden.
- ✻ Northern Cardinal - range is extending from the west, prefers denser stands of trees - seeds (esp. sunflower)
- ✻ Gray Catbird - colder months, attracted to water especially - spends much time in dense tangle
- ✻ Yellow-breasted Chat - spends much time in dense tangle and is attracted to water.
- ✻ Mountain Chickadee, Brown Creeper, White-breasted Nuthatch - cooler months, creeper prefers mature trunks.
- ✻ Yellow-billed Cuckoo - denser canopy of mature trees
- ✻ Doves - water and seed, open areas
- ✻ Finches (House, Cassin's, Purple) - water and seed, open areas with dense undergrowth nearby
- ✻ Flycatchers (oodles) - open canopy with dead branches
- ✻ Goldfinches (incl. Lawrence's) - niger seed and water, found at all levels
- ✻ Grosbeaks (four species) - open ground; some, like the Evening Grosbeak seem to prefer platform feeders above ground
- ✻ Kingbirds (3 species) - high open perches
- ✻ Phainopepla - leave some mistletoe around
- ✻ Orioles (four species) - nectar feeders, open perches
- ✻ Ovenbird - one year only, water, seed, dense undergrowth
- ✻ Sparrows - water and seed, open areas
- ✻ Swallows - generally swoop about; raise mosquitoes?
- ✻ Thrushes - water in particular
- ✻ Vireos - mid-level moderately dense perches
- ✻ Towhees - Water, seed in leaf litter, dense understory nearby
- ✻ Warblers - lots like multi-level vegetation

To attract and support as great a variety of species as possible, ensure that your yard habitat is as diverse as possible. Provide multiple layers of vegetation, dense tangles and open vegetation, bare ground, bare dead branches; don't obsess about a manicured environment. Provide water and multiple food types (if you are inclined).

Bird Species	Habitat Type/Special Habitat Features	Ecological Response Unit (ERU) - See Previous Page														
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Virginia's Warbler	Ponderosa Pine - Open Ponderosa Pine forests with well-developed herbaceous or woody understory. Nests on ground or low shrubs. Hillsboro	A	B				F								N	
Grace's Warbler	Ponderosa Pine - Mature Ponderosa Pine forest sometimes with a scrub oak component. Poverty Creek	A	B				F								N	
Williamson's Sapsucker	Mixed Conifer - Mid- to high-elevation coniferous forests intermixed with aspen. Aspen important nesting substrate. Hillsboro, Rabb Park	A	B				F							M	N	
Olive-sided Flycatcher	Mixed Conifer - Subalpine forest with spruce, Douglas-fir, and aspen and lots of edge habitat. Snags and trees which are higher than nearby canopy are important.	A	B				F							M	N	
Dusky Flycatcher	Mixed Conifer - Mixed conifer forest with a shrubby understory critical. Nests in low shrubs.	A	B				F							M	N	
Red-faced Warbler	Mixed Conifer - Fir and pine forests with an oak or deciduous understory. Ground nester in moist forested areas. Railroad Canyon/Lower Gallinas Campground/ Middle Percha west of Kingston	A	B				F							M		
Blue Grouse	Spruce - Fir - Mostly open areas with deciduous trees and shrubs.						F							M	N	
Peregrine Falcon	Cliff/Cave/Rock - Cliffs, ledges or rocky outcrops. Animas Creek, Fly over Hillsboro	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Bald Eagle	Cliff/Cave/Rock - Streams, lakes or other aquatic areas															O
Golden Eagle	Cliff/Cave/Rock - Snags and cliffs near open habitats. Nutt Grasslands/Foothills near Hillsboro	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O

Bird Species	Habitat Type/Special Habitat Features	Ecological Response Unit (ERU)
Prairie Falcon	Chihuahuan Desert Grassland/Cave/Cliff/Rock up to 5,500' in Elevation. Fly over Hillsboro	C D E F I J K
Long-billed Curlew	Chihuahuan Desert Grassland - Prairies and grassy meadows usually near water. Nests on ground with short grass often near a rock or other conspicuous object.	I J K
Wilson's Phalarope	Wet Meadow over 7,500' in elevation. Marshes, flooded meadows, playas. Nests in tall, dense, heterogenous vegetation within 100 meters of wetlands	O
Common Black Hawk	Southwestern Riparian Woodland (low to moderate elevation riparian) - Mature cottonwood or sycamore gallery riparian. Palomas Creek (nesting), Fly over Percha Creek and historical nesting along Mimbres River south of NM-152	O
Common Ground Dove	Southwestern Riparian Woodland (low to moderate elevation riparian) - Open country with shrubs and bushes. Open sandy areas in forest and savannah. Hillsboro	C D E F O
Elf Owl	Southwestern Riparian Woodland (low to moderate elevation riparian) - 4,000' - 7,000' in elevation. Low river bottoms and adjacent uplands, nests in cavity trees. Palomas Creek Riparian	K O
Gila Woodpecker	Southwestern Riparian Woodland (low to moderate elevation riparian) - Lowland scrub and riparian woodlands dominated by mature cottonwoods and/or sycamores along stream courses.	O
Southwestern Willow Flycatcher	Southwestern Riparian Woodland (low to moderate elevation riparian) - Riparian and wetland thickets, generally with willow, tamarisk or both with mostly native vegetation. Hillsboro - attracted to water and small caterpillars	O
Bell's Vireo	Southwestern Riparian Woodland (low to moderate elevation riparian) - Dense brush, willow thickets, and streamside thickets often near water as well as adjoining woodlands.	C D E F O
Lucy's Warbler	Southwestern Riparian Woodland (low to moderate elevation riparian) - Mature closed-canopy riparian bosque, late successional stage woodlands, less than 5,000' in elevation. Hillsboro Gardens	O
Summer Tanager	Southwestern Riparian Woodland (low to moderate elevation riparian) - 4,000 to 7,000' in elevation. Riparian woodlands dominated by tall cottonwood, willow, and sycamore. Regular in Hillsboro during summer.	O
Abert's Towhee	Southwestern Riparian Woodland (low to moderate elevation riparian) - Woodlands and thickets along rivers and streams with brushy understory of cottonwood-willow gallery forests. West slopes of the Black Range, or just in the Mogollon Gila?	O
Black Swift	High Elevation (Montane) Riparian Woodland/Cave Cliff/ Rock - Over 7,500' in elevation, canyon cliffs and walls that are shaded from the sun.	O
Hammond's Flycatcher	High Elevation (Montane), Riparian Woodland - Over 7,500' in elevation. Mature stands of primarily mixed-conifer and spruce-fir forests, often close to water with limited understory.	L M O
American Dipper	High Elevation (Montane), Riparian Woodland - Over 7,500' in elevation. Fast moving, clear, rocky streams with numerous rapids, riffles, and waterfalls.	O

Bird Species	Habitat Type/Special Habitat Features	Ecological Response Unit (ERU) - See Below													
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
MacGillivray's Warbler	High Elevation (Montane), Riparian Woodland - Over 7,500' in elevation, riparian habitats and wet thickets with dense undergrowth and moderate cover. Shrub component critical. Ground, low shrub nester. ALSO Montane Scrub with dense shrubby areas like coniferous forest undergrowth and edge, brush hillsides, and riparian thickets. Hillsboro	A	B	C	D	E	F		H							O
Painted Redstart	High Elevation (Montane), Riparian Woodland - Over 7,500' in elevation. Dense thickets and oaks in riparian woodland. Ground Nester. 1/2 - 1 mile north of campground in Railroad Canyon															O
Crissal Thrasher	Chihuahuan Desert Scrub - Less than 5,000' in elevation, shrubby habitat, especially mesquite. Lake Valley, Tierra Blanca, and Warm Springs Wash east of Hillsboro											K				
Scott's Oriole	Chihuahuan Desert Scrub - Less than 5,000' in elevation, Chihuahuan Desert with high yucca component. Lake Valley & Hillsboro											K				
Red-naped Sapsucker	High Elevation (Montane), Riparian Woodland - Over 7,500' in elevation, Mature deciduous forests, particularly aspen. Hillsboro - may follow the Percha Creek riparian corridor to lower elevations.													M		O
Green-tailed Towhee	Montane Shrub - Dense, diverse shrub habitat at high and low elevations. Nests in low shrubs. Hillsboro. Scratching in leaf litter.	A	B	C	D	E	F		H				L	M	N	
Black-chinned Sparrow	Montane Shrub - Arid Shrublands on rugged, often south slops, with moderately dense shrubs. Nests in low, dense shrubs.			C	D	E	F		H	I	J	K				
Ferruginous Hawk	Piñon - Juniper Grass Woodland - Open grasslands or agricultural fields. Nests preference is forest edge or mature, flat-topped junipers.			C	D	E	F		H	I	J	K				
Gray Flycatcher	Piñon - Juniper Grass Woodland - Open piñon-juniper with interspersed ponderosa pine. Shrub cover not too dense.	A	B	C	D	E	F		H							
Black-throated Gray Warbler	Piñon - Juniper Grass Woodland - Prefers large stands of piñon-dominated woodland. Often found in dense forests with a canopy, but likes edge habitat. Kingston (Bloodgood Spring)			C	D	E	F		H							
Gray Vireo	Piñon - Juniper Grass Woodland - Rocky hills covered with sparse bushes in shrub and immature juniper, generally ranging from 12 to 25 feet in height. Hillsboro			C	D	E	F		H							
Northern Goshawk	Ponderosa Pine & Mixed Conifer - Typically nests in mature or old-growth forests with high canopy closure and sparse ground-cover. Occasionally nests in more open stands. Hillsboro	A	B											M	N	
Mexican Spotted Owl	Ponderosa Pine - Mature or old-growth stands with complex structure, typically uneven aged and multistoried with high canopy cover.	A											L	M	N	
Flammulated Owl	Ponderosa Pine - Open Ponderosa Pine forest often associated with aspen, large shrub oaks, and clearings. Secondary cavity nester.	A	B											M	N	
Greater Pewee	Ponderosa Pine - Tall conifer forests with clearings. Snags or large trees rising above canopy.	A	B											M	N	
Olive Warbler	Ponderosa Pine - Open Ponderosa Pine/Douglas Fir forests often with an oak understory. Saddle south of Sawyer's Peak	A	B											M	N	O

Darners of the Black Range

The Darners discussed in the following article are both found in the Black Range. The Blue-eyed Darner has been verified at Bear Canyon Reservoir, at City of Rocks State Park, and a bit farther afield at Alamosa Warm Springs (Monticello Box). The Green Darner has been verified at Bear Canyon Reservoir and along the Mimbres River near City of Rocks.

Other Darners in our area include: the Arroyo Darner (*Rhionaeschna dugesi)* along Percha Creek at Hillsboro and along the Mimbres River at City of Rocks; Riffle Darner (*Oplonaeschna armata*) at Upper Gallinas Campground and at the Black Canyon Campground; Persephone's Darner (*Aeshna persephone*) near Sherwood; and the Giant Darner (*Anax walsinghami*) near City of Rocks along the Mimbres.

Representative Dragonflies of Doña Ana County, New Mexico

Photographs and article by James Von Loh

The discussions of dragonflies and damselflies, members of the taxonomic order Odonata, are prepared herein under their respective taxonomic families. Illustrative images to support each species identification and their associated observations/discussions were collected entirely from Doña Ana County, New Mexico (by the author unless otherwise credited) between 2019-2022. Habitats particularly attractive to these Odonates include the Rio Grande drainage (along the western community boundaries of Las Cruces and Mesilla) and its associated irrigation and wastewater canals, natural springs and seeps along the west-facing slopes and canyons of the Organ Mountains, and during the monsoon rain season (July-September) temporarily-filled ponds, waterfalls, and intermittently-flowing drainages.

Represented are winged juvenile (if encountered) and adult Odonates, behavior types as defined in *Dragonflies and Damselflies of the West* (Paulson, 2009), and when possible, instances of predation by these predatory insects and instances of Odonates becoming prey for other predatory insects. Because species of odonates have an aquatic larval stage which I could not photo-document and illustrate in this article, each discussion, by design, is incomplete.

Odonate morphology, anatomy, and/or behaviors that may be illustrated within these family discussions were presented and defined in Paulson (2009), as follows: Perching; Sleeping; Flight; Vision; Feeding; Predators and Predator Defense; Sexual Patrol; Courtship and Mating; Egg Laying and Hatching; Larval Life History; and Metamorphosis and Emergence.

Part I

The Darner Family - *Aeshnidae*:

Neotropical Darners - *Rhionaeschna* multicolor, Hagen, 1861 (Blue-eyed Darner); and Green Darners: *Anax junius*, Drury, 1773 (Common Green Darner).

Darners are among the largest of dragonfly species within the United States, which also makes them a challenge to bring into focus and photograph in crisp detail due to length, width, and depth elements. Besides the two species discussed herein, I have rarely viewed but never clearly photographed Giant Darners (*Anax walsinghami,* McLachlan, 1883) which fly continuously, may hover intermittently, then hang vertically when perched (Paulson 2009). My encounters with darners have been mostly while investigating riparian and wetland habitat along the Rio Grande and the associated irrigation ditches, and rarely near small livestock and detention/retention ponds which fill following monsoon rainstorms.

I would be remiss if I didn't begin this discussion by mentioning dragonfly vision, as presented in *Dragonflies and Damselflies of the West*, Dennis Paulson, Princeton University Press (2009). They possess the finest vision among insects through up to 30,000 simple eyes within their compound eyes. The very large compound eyes of darner species allow nearly 360-degree vision! So, stealthy as you think you might be, you're not fooling them and you may as well just act like any other docile, non-threatening creature, perhaps a browsing deer (I find that before approaching them it helps if I remove my own "predator" eyes [sunglasses].)

Blue-eyed Darner

Blue-eyed Darners (BeD) are widespread throughout the western and central US and generally occur from Mexico to Canada, east to Iowa, and south to Texas. They may use nearly all open water and marshy habitats of open sites; their flight season within New Mexico ranges between March and November.



The Blue-eyed Darner male perches by hanging from a southern cattail leaf (perhaps to warm in the sun, rest, hunt, and/or to display to attract a mate). Often, darners hang in shady areas within cattail stands and within the canopy of tall riparian shrubs and/or trees to sleep.

In Dona Ana County I have observed BeDs rarely to occasionally along the Rio Grande, its associated irrigation canals, and along wastewater return canals (where they may perch to sleep in the shade of sandbar willow and tamarisk tall shrubs/trees, hunt over all available habitats, and patrol/hover/hunt within southern cattail and three-square bulrush emergent wetland stands. Ovipositing occurs within southern cattail stands along the Rio Grande and its canals.



This Common Green Darner male is avoiding buffeting by wind gusts to ~40mph by perching over calm water below an embankment on a floating southern cattail stalk (perhaps also to warm in the sun, rest, and hunt). Horizontal perching is rare behavior as they typically fly incessantly or sometimes hover over the water and adjacent vegetation, preferring to hang from leaves, twigs, and branches to sleep.



Male BeD sleeping in a more shaded location in the cattail stand.

On one occasion, I was lucky to photo-document a pair of BeDs post-rendezvous (mate selection area), already mating (in copula) while hanging from the lower leaf of a southern cattail plant. In a summarized sequence from Paulson (2009): the mature male had captured the mature female with his legs and clasped her with his terminal appendages (clasped her head/"neck" on either side with two cerci, while pressing his epiproct tightly against the top of her head) creating a tandem linkage. At this stage the male transfers sperm from the genital opening under his ninth abdominal segment (S9) to store in the terminal vesicle under his second abdominal segment (S2), after which the female contorts to join him in the mating wheel (arguably heart-shaped) stage typical of many dragon and damselfly species.

In the image below, the BeD pair is in copula (in the mating wheel configuration) while hanging from a southern cattail leaf. Note the female has attached her 9th abdominal segment (S9) to the male's S2 for transfer of his sperm to her vagina, where it is available to fertilize eggs prior to their deposition into the perennial aquatic habitat (see page 41 for enlargement).

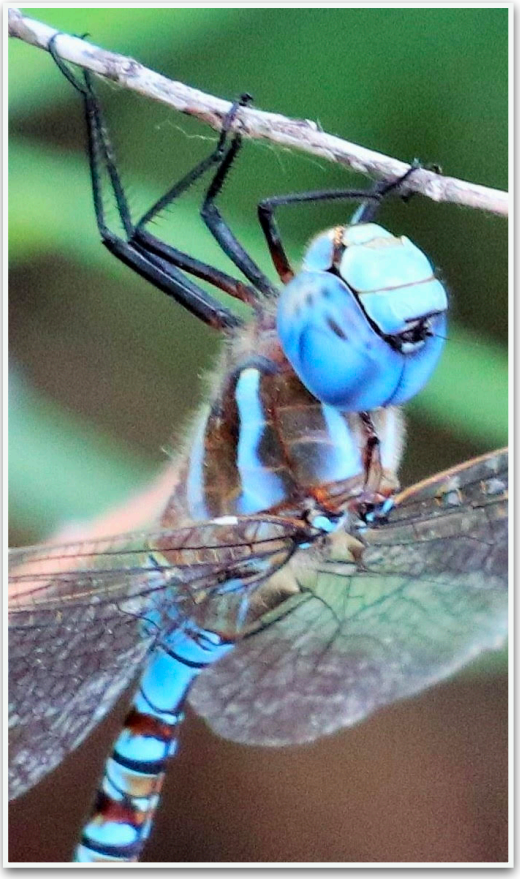




Left: Male BeD sleeping while perched on a southern cattail leaf from plants established in a small irrigation canal. He is able to hunt from this position by hawking, e.g., releasing from the perch and capturing other flying insects.



On a hot afternoon, a mature male BeD with torn and tattered wings is sleeping while hanging from a partially shaded perch under a tamarisk tree branch, adjacent to the Rio Grande.



Left: This male BeD is sleeping under a coyote willow tall shrub twig along the Rio Grande (close-up of his blue face and eyes plus the thorax/abdomen color patterns).



This male BeD was hovering, using a light wind to stay aloft while rarely moving its wings, and hunting for small flies and other prey over a field of damp grass in Wooten, NM, Otero County. This method of hunting is known as hawking, which dragonfly species known as "fliers" use to capture other flying insects (Paulson, 2009).



This male BeD is hovering, patrolling territory, and hunting by hawking among southern cattail leaves along the Las Cruces wastewater outfall near the Rio Grande.



This close-up shows the S9/S2 connection site, male epiproct location on head and cerci attachments (head/"neck"), and the color/pattern detail between the male (upper) and female (lower). Note the female's partially brown eye color, lighter color shades of the thorax, and more areas of yellow color are distinguishable.



This BeD pair is separating following copulation yet still in tandem linkage due to male epiproct contact and cerci emplacement. Copulation performed by this pair took over an hour. Now she will be lowered, by the male, to the water surface and begin egg deposition.



This post-copulation female BeD is now free from the tandem linkage, and has moved deep into the base of the cattail clump to deposit eggs at the water surface. Eggs hatch into aquatic naiads which feed on other aquatic insect larvae and freshwater shrimp, small fish, and tadpoles. Naiads swim by propulsion, ingesting and forcing water from the abdomen. The several larval instar stages require several years to mature, at which time immature BeDs emerge from the water during the night and climb onto vegetation to molt the naiad exoskeleton and expose the immature BeD form.

Common Green Darner

Common Green Darners (CGD) are widespread throughout the US. They may use nearly all open water and marshy habitats. Their flight season within NM ranges between February and December (my earliest observation is a breeding pair flying in tandem over the Rio Grande on March 31, 2022). In Dona Ana County I have observed CDGs using ponds filled during monsoon rainstorms and habitats along the Rio Grande and its associated irrigation and wastewater return canals. I have observed CGDs roosting in the shade of coyote willow tall shrubs and within stands of southern cattail, hunting over all available habitats, patrolling/hovering/hunting by hawking over open water adjacent to southern cattail and three-square bulrush emergent stands, and ovipositing on floating vegetation mats on the Rio Grande and its canals.



This close-up of a male CGD shows its basal wing and dorso-lateral head and thorax structure and color patterns.



Male CGD sleeping/hunting on/from southern cattail leaf growing within a return water canal. This is the common position taken by adults for sleeping behavior; usually southern cattail and coyote willow provide the habitat structure they seek.



This close-up of a female CGD shows its basal wing and dorso-lateral head and thorax structure and color patterns. Note: she is in tandem with the male's two cerci attached to the rear of her head/"neck".



I typically observe pairs of CGDs ovipositing adjacent to floating vegetation in shallow water of canals serving the Rio Grande. The males lead while the females deposit eggs side-to-side along floating stems and leaves.



Post-copulating CGD pair (male above, female below - in tandem with his cerci engaged behind her head/"neck"). She is preparing to oviposit on floating plant stems within this return water canal. Note that mature females (and sometimes males) develop an amber coloration on their wings.



However, this lone female CGD, exhibiting well-worn wing edges, is ovipositing in shallow water over submerged vegetation within the retention pond near Dripping Springs Visitor Center in the Organ Mountains/Desert Peaks National Monument.

Above: A pair of CGDs oviposit among a mat of floating stems, leaves, and fruits of an irrigation canal. Note the dorsal abdomen color differentiation between the male (on the left - black) and the female (on the right - brown).
Below Left: Tandem CGD pairs fly from site to site (selected by the male) to oviposit over a large area of canal, landing where floating debris and emergent plants occur. The total length, width, and depth of field of the pair create a challenge for collecting a clear and detailed photograph.
Below Right: Eggs produced by the female are deposited on both sides of, and in the water under, floating stems and other debris as the pair moves along the stem (in this example).















Top Left: A green lacewing (*Chrysoperia* sp.) appears to be foraging on freshly-deposited eggs, an identified food source for the species. Familiar bluet damselflies occasionally visited the tandem CGD pair during egg deposition, but I am unsure if they were foraging or perhaps attempting to harass the pair from the site.

Middle Left: Male bluet damselflies often approach or perch adjacent to ovipositing CGD tandem pairs. I don't know if they forage on the newly-deposited eggs or perhaps are simply interested in other odonates within their territory.

Bottom Left: Single male CGDs often approach tandem pairs and attempt to land upon them.

Top Right: Uncharacteristically, several eggs are released above the water surface from this elevated perch selected by the CGD male.

Middle Right: This tandem pair of CGD uses, in addition to floating woody plant materials, the leg and claw of a red swamp crayfish as an egg deposition substrate.



Have an interest in dragonflies? If so, the Dragonfly Society of the Americas is a valuable resource.



Above: Red swamp crayfish (RCS), *Procambarus clarkii* (Girard, 1852) are sometimes observed in flowing water of the Rio Grande, but more often following heavy, soaking rains that moisten the soil of their burrows located adjacent to the river; they emerge on the ground surface and crawl to the flowing water. Burrows are located adjacent to the confined river channel, up to ~10m distant within the overflow channel. As obligate omnivores, RSC eat plant material, animals (including insects of all life stages), detritus, and sediments.

Left: Preferred mass of floating stems in calm water for ovipositing CGDs.

Below: So now it's lift-off and a short flight to the next ovipositing site. So much better efficiency, distribution, and density than any Easter Bunny!!!





Well, the fun is over and the easy part is done. Their larvae will develop through the summer, feeding on aquatic insect larvae and small animals, and offspring will emerge during late summer, migrating in their immature colors (Paulson 2009).

Follow-ups: *Lizards, Spiders, & Penstemon lanceolatus*

The article in the January 2022 issue on *Penstemon lanceolatus* elicited this note from John Egbert:

"In my breeding bird survey of the lower Gila sometime around 1980, I saw one specimen of P. lanceolatus in the vicinity of Nichols Canyon on a bench on the south side of the river. I had previously seen this species above the limestone cut on the north side of the highway east of Silver City as I recall near the ocotillo area. I may be wrong in that association. I was a Penstemon guy so I was always on the lookout. I did quite a bit of propagation when I was living at Cliff. I did not bother that one plant during the heat of June when it was blooming, but surely would have liked a few seeds. I think what drew me up the slope was my searching for Bell's vireos and possibly Grays. I knew that both bred at Red Rock so I was on the lookout."

In our January 2023 issue we offered a survey of the lizards of the Black Range. In the issue before we surveyed some of the spiders of this area. In "Prey dangerously: black widow spider venom resistance in sympatric lizards" (Thill VL, Moniz HA, Teglas MB, Wasley MKJ, Feldman CR, 30 Sept. 2022, *R. Soc. Open Sci.* 9: 221012) Thill et al. summarize the

findings of their study of three lizard species (*Elgaria multicarinata, Sceloporus occidentalis,* and *Uta stansburiana*) and their reaction to the venom of the Western Black Widow Spider *Latrodectus hesperus*.

The Southern Alligator Lizard, *Elgaria multicarinata*, (upper right) was photographed in Washington. The Madrean Alligator Lizard (Arizona Alligator Lizard, Elgaria kingii nobilis) is the species of this genus found in our area. The Western Fence Lizard, *Sceloporus occidentalis*, shown to the middle right was photographed in Washington.

The Common (Nevada) Side-blotched Lizard, *Uta stansburiana nevadensis*, pictured below right, was photographed in northern Nevada.

All three of these lizard species prey on the Western Black Widow spider. When the Southern Alligator Lizard and the Western Fence Lizard were injected with the venom of the Black Widow Spider, their whole-animal performance (known as sprint) was not significantly decreased. That was not the case with the Common Side-blotched Lizard. In addition, the Southern Alligator Lizard "showed minimal tissue damage and immune response. That was not the case with the other two species. The physiological resistance to the toxins of the animals (or plants) that a creature preys on is not that unusual.

The venom of the Western Black Widow is very toxic and complex and has at least three different components: one which targets insects, one which targets crustaceans, and α-Latrotoxin (LTX) which targets vertebrates. When compared to the venom of the Western Diamondback Rattlesnake, less Black Widow venom is needed to kill a mouse. And Black Widows are known to meter their venom, varying the dose which they deliver.

The sprint of Southern Alligator Lizards did not diminish even when they were given an injection of five times the dose which was lethal (in





50% of the cases) to the mouse referenced above.

If you are able to observe the interaction of the Madrean Alligator Lizard and Western Black Widow, we would be very interested in hearing about your observations.

In the September 24, 2022, issue of *Ethology*, Sergi et al., reported on their study of cognition and memory in the Western Black Widow Spider. ("Western black widow spiders (Latrodectus hesperus) remember prey capture location and size, but only alter behavior for prey caught at particular sites" - Paywall). They



found that "Black widows were significantly more likely to search after experiencing prey theft, which demonstrates the spiders form memories of their prey. Black widows were also more likely to search for relatively larger prey, but this effect depended on the site of prey capture within the web (only for prey snared on the web's gumfooted lines). This indicates that black widows also form memories of the relative size of their prey and its capture location."

The wolf spider shown to the right is most likely a *Hogna carolinensis*; it has a range throughout much of the United States. It was photographed on November 9, 2022, in Ready Pay Wash, east of Hillsboro. Probably a male, since they go a-venturing for females during the daylight hours on occasion. An excellent resource on wolf spiders is The Wolf Spiders, Nurseryweb Spiders, and Lynx Spiders of Canada and Alaska. Despite its reference to our neighbors to the north, it has a wealth of information about species found in this area.

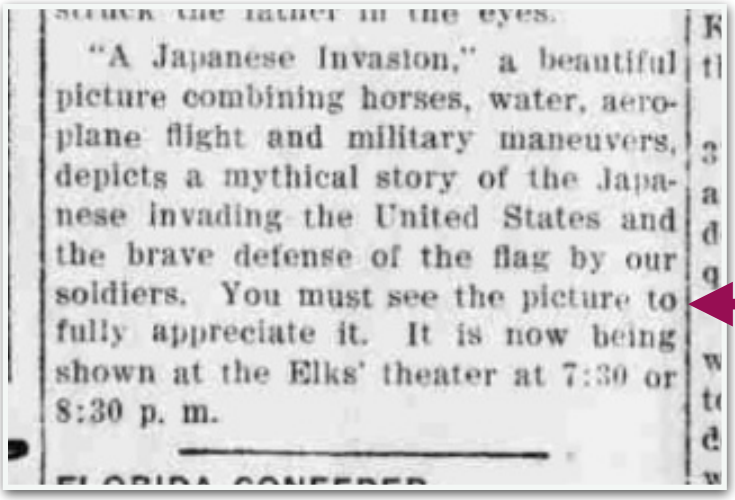


Predicting the Future - First Definitive Evidence

April 1 - The Black Range Institute of Paranormal Insight has just announced the termination of its effort to uncover additional evidence of the control of *The Santa Fe New Mexican* by aliens or super-humans at the beginning of the last century.

While researching historical evidence of Grizzly Bears in the Black Range, a separate group of researchers informed the Institute that it had uncovered the material shown at the right (from the October 21, 1909, issue of the aforementioned newspaper).

The newspaper has not been forthcoming about its management or staff from the period. Because of that the Institute has not been able to verify the obvious. Given threatened legal action by DARPA, the Institute has determined that it is appropriate to terminate the study.



struck the father in the eyes.

"A Japanese Invasion," a beautiful picture combining horses, water, aeroplane flight and military maneuvers, depicts a mythical story of the Japanese invading the United States and the brave defense of the flag by our soldiers. You must see the picture to fully appreciate it. It is now being shown at the Elks' theater at 7:30 or 8:30 p. m.



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Hang Glider

Photographs and article by James Von Loh

Serenity is an odd state of being that is rarely attained by humans. But I witnessed it yesterday, as performed by a spot-winged glider that was "hanging" effortlessly in an updraft of wind blowing against the underside of a tamarisk tree. It then exited from a small opening in the foliage where it chose to hang.

The look on the glider's face was pure serenity as it barely moved its wings while floating/hovering in the updraft. It readjusted only to move an inch or two to nab small flies, then settled back into the floating state. Below is a series of stills I collected while being a bit amazed at the sight which lasted at least a couple of minutes until a bicycler swooshed by and scared it away...

Spot-winged gliders are very cool large dragonflies that never stop flying and hovering when out to hunt and to find mates - I've only seen them stop to rest during the heat of the day and at night where they hang from willow and mesquite branches to "sleep" until mid-morning. Those images are below. Strong flyers, they occur from the tip of South America to the northern edge of North America.



...happy just hangin' in the breeze and noshin'...



...look ma - no hands...



...could life be any easier...



...don't think so...



...ooohhh breakfast...



...gotcha...



...yum...



...adjust left...



...and back (glider yoga)...



...ahhh, brunch...



...it's sushi...



...you should try it (fly-on-the-fly)...



...sleeping on a willow branch at mid-morning...



...sleeping on a honey mesquite branch on a hot afternoon...



...newly emerged from the larval exuvia, drying in the warm desert air...



...individual, newly emerged and with torn wing, pulls itself out of the pond and hangs on dry twigs...



...newly emerged individual, with folded wing, swims/floats on pond surface to find perch on which to dry...



...larval exuvia, the cast skin of emerging dragonflies...these two may have encased spot-winged gliders until their successful emergence...

I'm think the key to serenity is sleeping - a lot...

Dragonflies in the Black Range

The Dragonflies of the Black Range are poorly studied, or at least poorly reported - as indicated by a search of iNaturalist and Odonate Central. For instance, both the Blue-eyed Darner (T or C and Bear Canyon Reservoir) and Common Green Darner (Elephant Butte Dam and Mimbres) have only been seen to the west and east of the Range proper (habitat issues?). The Spot-winged Glider has not been reported from the Range (only as close as the Middle Fork of the Gila - why?)





White-collared Turkey Vulture

Photographs by Mike Abernathy



Mike Abernathy has contributed in several ways to *The Black Range Naturalist* and to the documentation of the natural history of this area. He did the aerial photography for Trailing With Toasty - a natural history video about tracking, featuring Harley Shaw and Toasty the beagle - for instance.

Recently Mike threw a big, greasy wrench into the collective knowledge set of Black Range naturalists by sharing the images shown on this and the following page.

Harley Shaw, Bob Barnes, and Mike Abernathy have been working on documenting the natural history of the Hillsboro Turkey Vultures, *Cathartes aura*, for a few years, sometimes as a group, sometimes individually. As part of his research, Mike has taken many photographs of Turkey Vultures. During the 2022 season he captured a few images of a Turkey Vulture with a white collar.

We are lucky enough to have some extraordinarily good naturalists in the Black Range, but the local vetting of the images was not satisfying, characterized mostly by puzzlement. Several people, with lots of experience with vultures in general and Turkey Vultures in particular, had not seen this plumage before. The images were then shared with a broader audience, resulting in, among other things, this article.

Later in the article, the top image on this page is referred to as "1", the other as "2", and the image on the following page as "3".



Email exchanges, reference searches, and inquiries with several other researchers who are familiar with the vultures of the Western Hemisphere narrowed the field of possible identifications (explanations) to four: *Cathartes aura ruficollis* (Turkey Vulture), *Cathartes burrovianus burrovianus* (Lesser Yellow-headed Vulture), immature Turkey Vulture, and hybrid.

In addition, the bird pictured here may be an individual color variant. Got an opinion or have additional insight about this bird? We would like to hear it. Drop a note to the editor (rabarnes@blackrange.org). We are fond of presenting knowledge as it is found; the making of sausage is as intriguing to us as the sausage patty. This kind of approach is a bit different from that found in most other journals - which like to present "facts and final findings".

Since we have only these images to go on, it is not possible to reach a definitive conclusion about the identification of this bird. Even in the best of situations, for instance, *Cathartes aura ruficollis* and *Cathartes burrovianus burrovianus* look very much alike, variations in face color being the distinguishing mark - difficult to see at long distance.

The identification points which have been offered in favor of the various identification proposals are presented below.

Resources Cited

The following resources were used and/or referenced in advancing one or more of the identification proposals.

A Guide to The Birds of Mexico and Northern Central America, Steven N. G. Howell and Sophie Webb (illustrations), 1995. If you do not have this book and think it might be a good resource, do not run out and buy it. Howell is doing a new Mexican birds book, this time with Dale Dyer. In the first edition he proposed several taxonomic changes (splits) which have become accepted over the years. In the pending book Howell proposes more splits, including the Turkey Vulture, which he believes may be three species.

"Head color and caruncles of sympatric Cathartes vultures in Guyana..." Gary Graves, *Proceedings of the Biological Society of Washington*, Vol. 129, No. 1, pp. 66 - 75.

A Revision of the American Vultures of the Genus Cathartes, Alexander Wetmore, 1964.

"Notes on the Taxonomy of Vultures", Dean Amadon, *The Condor*, Vol. 79, pp. 413-416, 1977. Although Amadon and others have had difficulties with the taxonomic determinations of Wetmore, those issues to do not appear to be pertinent to this discussion.

"Flight Feather Molt of Turkey Vultures", Chandler et al., *The Wilson Journal of Ornithology*, 122(2):354-360, 2010.

"Movement ecology of migration in turkey vultures", Mandel et al., *Proceedings of the National Academy of Science*, Vol. 105, No. 49, December 9, 2008, pp. 19102-19107.

A Field Guide to Mexican Birds, Roger Peterson and Edward Chalif, 1973, Various editions available. Referred to later as Peterson 1973.

A Field Guide to the Birds of Mexico, Ernest Edwards, 1989, self-published. Also published by the University of Texas Press.

Peterson Field Guide to Birds of Northern Central America, Jesse Fagan and Oliver Komar, 2016.

A Guide to the Birds of Costa Rica, F. Gary Stiles and Alexander Skutch, 1989.

A Guide to the Birds of Columbia, Steven Hilty and William Brown, 1986.

Birds of Columbia, Steven Hilty, published by Birdlife International and Lynx, 2021.

A Field Guide to the Birds of Mexico and Central America, L. I. Davis, 1972.

A Guide to the Birds of Panama, Robert S. Ridgely and John A. Gwynne, 1989.

Birds of Northern South America Volume 2, Restall et al., 2006.

Raptors of the World, James Ferguson-Lees and David A. Christie, 2001.

Raptors of New Mexico, Ed. by Jean-Luc E. Cartron, 2010.

The Sibley Guide to Birds, 2nd Edition, David Allen Sibley, 2014.

The Crossley ID Guide - Eastern Birds, Richard Crossley, 2011.

The Crossley ID Guide - Raptors, Richard Crossley, 2013.

The comments and opinions of the various reviewers were not always aligned. A listing of commenters is found at the end of the article. In this section they are all listed as "commenter".

Sub-species and Range

The ITIS (Integrated Taxonomic Information System) currently (10/22/22) lists four subspecies of Turkey Vulture, Wikipedia lists five, Raptors of the World lists six, other sources show that the taxonomy may not be clear. There are two recognized subspecies of the Lesser Yellow-headed Vulture.

Wetmore noted that the range of the Western Turkey Vulture, *C. a. meridionalis*, and the nominate form (found to the south), abut or overlap in this area. He noted that "the division in two races, *meridionalis* and typical *aura*, appears arbitrary, with a considerable area of overlap. . . . Division between this group (*aura*) and *meridionalis* comes near the boundary between Mexico and the United States, with the smaller southern form penetrating a short distance to the north of this line" (p. 6).

The nominate form, *C. a. aura*, of Turkey Vulture has a range which extends from Mexico south through South America. It is nearly indistinguishable from the Western Turkey Vulture except by size. It is the smallest of the Turkey Vulture subspecies.

Most sources list the range of *C. a. ruficollis*, the Tropical Turkey Vulture, as extending from Panama south to Argentina. The Cornell University eBird site shows sightings of the subspecies as far north as southern Mexico. Wetmore reported it as far north as Costa Rica. Wetmore describes *C. a. ruficollis* as "Definitely blacker above and below than the northern sub-species . . . under surface of body decidedly black; borders of wing coverts very dark brown, darker than in *aura*; in life, head and neck dull red, with several distinct transverse yellowish white or greenish white lines across the posterior surface of the crown and the nape; adult usually with an irregular area of yellowish white in the center of the crown" (p. 7). See also page 8.

The Lesser Yellow-headed Vulture ("Lesser') is a bird of Central and South America. However, the Cornell University eBird site shows sightings of the *Cathartes burrovianus burrovianus* subspecies as far north as the central part of the east coast of Mexico (Tampico). Edwards notes that the Lesser Yellow-headed Vulture (Savanna Vulture) is rare (even in southern Mexico). Wetmore (p. 13) noted that given the "known occurrence of these birds in southern Tamaulipas the possibility that they may range farther north should be kept in mind." He referenced an unconfirmed report from Brownsville, Texas.

Stiles and Skutch (Plate 13) state that the Lesser Yellow-headed and Turkey Vulture species can be safely told apart only by head color. In collected specimens the color of bare parts fades very quickly in these species.

Images (General)

The fact that a guide or reference does not show something should not be considered a definitive finding. Sometimes things are not mentioned because there are so many things to mention.

Commenter: "...all the shots seem to show the same fresh-plumaged bird with no signs of feather or other damage to it, the presence of which could otherwise suggest its possibly having previously been in captivity!"

Commenter: "I do have some experience with a bird like this one, back in the late 1970's I think. The date is uncertain (I would have to go through long-buried notes to find that), but I was in the Pajarito Mountains of southern Arizona when I saw a red-headed adult with a similar whitish ruff. I recall seeing similar birds in Costa Rica, Brazil and northern Argentina (Missiones). As to congeners, I have seen in Brazil both lesser yellow-headed vulture (several individuals) and greater yellow-headed vulture (just a single bird). The underwing pattern shown in the images eliminates the last species. . . . Regarding the imaged vulture, I note the absence of caruncles on the featherless neck/head. This would seem to eliminate lesser yellow-headed vulture from consideration. According to Wetmore's paper, by the time young lesser yellow-headed vultures become volant, they possess these protuberances. So I think that the imaged bird is a hatch year turkey vulture. . . . But I am impressed with how black the body plumage is ventrally, how different this is from the run-of-the-mill turkey vultures one sees in the American West. This is remarked on by Wetmore as a feature of South American races of turkey vulture, particularly *Cathartes aura ruficollis*. In my quick reading of Wetmore's paper, I did not see that he used the pale ruff shown by the imaged bird as a taxonomic character, though with the exception of the Arizona bird long ago I have only seen this feature in southern Middle America and South America . . . . Our small collection of vultures at UC Davis is unlikely to shed any additional light. I'll ask Carla Cicero at MVZ if she has anything that might illuminate the discussion."

Commenter: "I am pretty sure, perhaps certain, that this is a sub-adult Turkey Vulture, *Cathartes aura ruficollis*, which is typically found south of here. The face color is an age thing. The feather coloring on the legs has given me pause but this may be the result of urohydrosis, (see video at 3:06 onward for examples) they urinate on their legs to cool down in hot weather. The wing pattern is bright but typical of a TV. However, *C. a. ruficollis*, as far as I know, are not known to roam greatly. . . . For years there has been discussion about splitting *Cathartes aura* into three species, the northern one we typically have here, the nominate form found in Mexico and south), and the southern South American form. . . . "

Age

Aging a specimen is often the first step in a successful identification effort. Unfortunately the characteristics shown in the photographs lend credence to an identification of an immature Turkey Vulture or to a mature Lesser with faded color, depending on your predilection.

Abundance

The Turkey Vulture is much more abundant in Mexico and Central America than is the Lesser Yellow-headed. There does not, however, appear to be a comparison of the abundance of the two subspecies (*C. b. burrovianus* versus *C. a. ruficollis)*.

Habitat

Edwards notes that the habitat for the Lesser Yellow-headed Vulture is described as "damp grasslands, marshes, savannas, broken patches of woods near water" while that of the Turkey Vulture is simply noted as "open country".

Commenter: The habitat the subject individual was in is more in keeping with that of a Turkey Vulture but does not rule out the Lesser Yellow-headed Vulture.

Ferguson-Lees and Christie state that the Lesser "generally avoid dry cultivation" (p. 309).

Migration

Ferguson-Lees and Christie note that in North America the Turkey Vulture is "entirely migratory" (except in parts of the southeastern and southwestern areas of the United States) while in Central and northern South America it "is mostly sedentary, or somewhat nomadic" (p. 307). At page 308 it is noted that *C. a. ruficollis* is sedentary.

Ferguson-Lees and Christie note the Lesser is "often regarded as sedentary, but evidently (exhibits) at least regional or nomadic movements" within range (p. 309).

Flight

Both species of *Cathartes* discussed here hold their wings in the classic dihedral pattern. Hilty and Brown (p. 88) note that the Lessers "unlike the Turkey Vulture usually glide low over marshes and low fields, very infrequently soar high." This is also noted for Lesser in Ridgely and Gwynne (p.83). Restall (p. 69) notes the Lesser "usually flies and glides noticeably lower than Turkey Vulture."

Overall Coloration

Davis (and others) note that feather colors are black in the Lesser rather than the brownish-black color of Turkey Vultures. He notes, however, that in some cases the belly of the Lesser may be browner than that of the Turkey Vulture.

Commenter: See brownish-black feathers on the upper wings in photo 2.

White Collar

Cartron has an image, taken in Rio Arriba County, New Mexico, of an immature Turkey Vulture (p. 73) which shows a white nape like that of the subject bird. Bill color is also the same. It is not identified to subspecies. At p. 74 it is noted that it is *C. a. aura* which is found in New Mexico.

Stiles and Skutch (Plate 13) illustrates the migratory Turkey Vultures found in Costa Rica without a white collar and the resident (adult) birds with a white collar. They note that the nuchal (nape) band on the juvenile Turkey Vulture is "dull". At page 96 they note that the immature Lesser has a dusky head with whitish nape.

Hilty and Brown note (p. 87) that the immature Lesser has "head dusky, and nape white." Speaking of the Turkey Vulture, they note that the "resident *ruficollis* (e. of Andes) has whitish band across nape."

Commenter: There are many images of *C. a. ruficollis* with a white collar like the bird being discussed (e.g., Avibase and https://www.oiseaux-birds.com/card-turkey-vulture.html).

Ferguson-Lees and Christie note that *C. a. ruficollis* has "distinct bluish-white to yellowish corrugations on nape to hindneck" (p. 308).

Hilty (2021) illustrates *C. a. ruficollis* with a white nape patch (adult), duller in the juvenile. The Lesser is not illustrated with a nape patch (p. 182).

Speaking of the Turkey Vulture, Ridgely and Gwynee (p. 83) note that the "breeding race (ruficollis) has several narrow dull yellow bands across the back of neck (may appear like a pale patch at a distance." Speaking of the Lesser, they note the "immature has dusky head with whitish nape."

Restall illustrates (p. 69) the white collar on *C. a. ruficollis,* but does not illustrate a collar on the Lesser.

Ferguson-Lees and Christie (p. 86) note that *C. a. ruficollis* has "yellowish nape-bands, or crown-patch". Of the Lesser, they note the juvenile has a whitish nape.

Wetmore notes that one race of the Turkey Vulture is "lined narrowly across the back of the cranium with yellowish or greenish white" (p. 2).

Edwards; Davis; Fagan and Komar; Peterson 1973, Plate 4 and page 25, do not describe or show a white collar at the back of the head/top of the nape on the Lesser Yellow-headed Vulture or Turkey Vulture.

Crossley (Eastern Birds) at p. 233 shows an image of a juvenile Turkey Vulture (eastern subspecies?) with a faint light colored collar.

Crossley (Raptors) at pp. 12-15 shows images of Turkey Vulture with light colored and tan collars between the nape and head.

The second edition of the Sibley Guide (p. 123) illustrates an immature Turkey Vulture with a light neck patch. The first edition did not. In personal correspondence (Sibley-Barnes dated October 24, 2022) David Sibley explained the illustration as such: "I think a white collar is shown by most young Turkey Vultures (but not all). It's a patch of very short white down on the back of the head. Some juveniles (for example in this photo with wings spread - https://macaulaylibrary.org/asset/494929151 [shown below]) show dark brown down there, and I think this patch of white or brown down is either shed or worn off quite quickly, as it shows on recently fledged birds in August and September, but seems to be absent from older birds in mid-winter."

The Tim Lenz photograph and David Sibley's explanation clarify one question which we have been trying to resolve. Do the Turkey Vultures found in the United States regularly have a white collar? It appears that at least some young birds do exhibit this feather pattern, for a short period of time. We are trying to determine if this is subspecies specific or not.

The general lack of reporting of this characteristic, either from field reports or from institutional collections, is the cause of some concern, but it may simply indicate that it is an uncommon pattern or very transitory and thus not captured. It is not clear from reviewing the image in Cartron if it depicts this pattern of down in juvenile Turkey Vultures.

See *Turkey Vultures: A Photographic Guide for Aging Nestlings*.

Head

Edwards notes that in the immature Turkey Vulture the head is pale to dark gray (noted by all other authorities). He notes that the head of the immature Lesser is dark with a pale nape.

Fagan and Komar note that immature Lesser has more extensive feathering on the hind neck when compared to a Turkey Vulture.

Wetmore notes that head coloration is problematic when studying collected specimens because the color of bare parts fade quickly (p. 1).

Commenter: ". . . shots seem to show at least three tags of flesh on the bird's lateral to lower neck--which in turn could be the beginnings of the carbuncles that so far seem to characterize the two yellow-headed taxa in this group".

Underwing

Fagan and Komar note that the underwing of the Lesser shows more contrast than does that of the Turkey Vulture. The illustrations in that work support that comment for the inner wing only. The Turkey Vulture is shown with a more uniform contrast throughout the underwing (p. 153). The outer ends of underwing on the Lesser are depicted as darker than those of the Turkey Vulture.

Stiles and Skutch (Plate 13) illustrate the underwing of the Lesser as being somewhat lighter than that of the Turkey Vulture.

Hilty and Skutch (Plate 1) illustrate that the white quill pattern at the ends of the underwing of both species is the same.

Commenter: In photographs "1" and "3" I think the basic wing pattern is more like that of a TV, with a strong dark and light pattern. A Lesser would have more dark at the end of the wings and present a somewhat different pattern.

Upperwing

Edwards also notes a "pale wing-patch above near tip" for the Lesser Yellow-headed Vulture.

Howell and Webb (p. 175) note that the Turkey Vulture's "whitish shafts of outer 6 primaries form paler panel on upperwing." Speaking of the Lesser, they note that the "white shafts of



Photograph by Tim Lenz, taken at Chautauqua, New York. Tim Lenz/Macaulay Library at the Cornell Lab of Ornithology. Used here with the permission of the Macaulay Library.

outer 6 primaries form contrasting panel on upperwing, often surprisingly striking, at times suggesting Black Vulture".

Hilty and Brown note the Lesser has a "distinct pale area (due to white quills) at base of primaries from above" (p. 87).

Stiles and Skutch note that the Lesser may show "an indistinct pale brownish patch … at the base of the primaries above, but many Turkey Vultures also approach this condition - not a reliable field mark."

Ridgely and Gwynee note that the Lesser "usually has whitish patch at base of primaries" (p. 83).

Restall notes (p. 68) that the "white shafts of primaries may be seen from above" on the Lesser.

Tail

Fagan and Komar, and several others, note that the tail of the Turkey Vulture is slightly wedge shaped and that the tail of the Lesser Yellow-headed Vulture is more squared (p. 152). Photos 1-3 would appear to be more indicative of a Turkey Vulture rather than a Lesser Yellow-headed.

When perched, the folded wings of the Lesser Yellow-headed extend beyond the tail (p. 308 of Ferguson-Lees and Christie).

Howell and Webb note that when folded, the wings of the Turkey Vulture will extend somewhat beyond the tail (p. 174). They note (p. 175) that in the case of the Lesser the "wingtips project noticeably beyond tail tip" when the bird is at rest.

The Possibility of Hybridization

Commenter: "A rather conservative scenario has also been developing in my mind about how the presence of Mike's odd vulture might have come about – which is that a breeding female *Cathartes aura aura* might have been inseminated by a male *C. burrovianus* somewhere in North America (e.g., southern Mexico) and then produced and fledged one or more hybrid young between there and the Black Range! Even better would have been an errant young female *C. burrovianus* having shown up in the latter area and then been mated with by a local male *C. a. aura*. Under the latter circumstances, that particular female *C. burrovianus* and/or its hybrid offspring(s) could very well return to the Black Range next spring - so let's be on the lookout for it or them then!"

Additional Sightings

In late summer 2022, Nichole Trushell reports seeing a "turkey vulture" with a white collar. She was unable to photograph the bird or even to examine it closely. It is not known if this was the same, or a different, bird.

Some other photographs and some video recorded in the Black Range appear to show the white collar pattern. None are as definitive as those taken by Mike Abernathy, the subject of this article.

A Personal Assessment
by Bob Barnes

When I first saw Mike Abernathy's photographs I was a bit flabbergasted. I thought that I knew Turkey Vultures and I was pretty sure that was what I was looking at. However, I had never seen one with such a striking white collar, not even (to my fading memory) in Central and South America (but see later).

Preliminary research led me to the belief that the subject bird was a juvenile *Cathartes aura ruficollis,* the Tropical Turkey Vulture, which had wandered north. As far as I could tell, this was the only subspecies which consistently exhibited the white collar shown in Mike Abernathy's photographs.

Others weighed in with alternative opinions, but I was not swayed. As I did more research, however, two factors became apparent which I could not ignore. First of all, *C. a. ruficollis* is (apparently) not known to wander and its normal range extends only as far north as Costa Rica.

Secondly, a few sources (e. g., Cartron) included images with Turkey Vultures (not identified to subspecies but from the United States, in some cases, New Mexico) with white collars.

A review of the Abernathy photos, the photos by Tim Lenz (there are a series at the link provided - not just the one shown on the preceding page), and the image in Cartron caused me to conclude that we are dealing with two circumstances here.

The first is that juvenile Turkey Vultures of the North American populations have down feathering at the back edge of the head which may be white. That seems not to be in question. The lack of documentation of this plumage pattern in published material, in institutional collections, or in the field reports of numerous well-versed observers, is bothersome, but not really pertinent to our issue. (Sibley's 2nd Edition may be the first widely available documentation of this plumage.)

However, the Abernathy photographs do not appear to depict a very transitory feather pattern, the loss of baby down. The white collar appears substantial, indeed permanent. The Abernathy photographs may (I would say do, others would disagree) depict something very different.

The best field mark for distinguishing the Turkey Vulture from other species, like the Lesser Yellow-headed Vulture, is head color. Something which is not terribly useful when dealing with an immature bird, which has that uniformly gray-colored face. Other field markings are problematic. They apparently cannot be used to definitively identify vultures of this type to species, much less to subspecies.

In the end, I concluded that this was an immature Turkey Vulture, subspecies undetermined. In reviewing my photographs I came across the poor one shown on the following page, from the Percha Box, which might be a similar type of Turkey Vulture - only adult. One of the commenters mentioned seeing such a bird in southern Arizona.

Having reviewed multiple comments on Mike Abernathy's photographs, I am relatively sure that there are those

who may disagree with my assessment.

Although I find identification to subspecies both informative and important, I worry that such distinctions sometimes cloud the importance of clinal variation. I suspect that the presence or lack of a "permanent" (vs. transitory) white collar in a Turkey Vulture, is somewhat clinal, being very common by the time we reach the tropics (as exhibited by *C. a. ruficollis*) and less common, but not completely absent, in subspecies found farther north - perhaps affected by age.

Next Steps

So that is where we leave it, for now. Based on what we have seen and know at this time, five possible identifications have made it through the vetting: *Cathartes aura ruficollis* (Turkey Vulture); *Cathartes burrovianus burrovianus* (Lesser Yellow-headed Vulture); rare coloration of either *C. a. aura* or *C. a. meridionalis;* a hybrid; and a regular, but frequently unobserved, characteristic of juvenile Turkey Vultures.

Of the five, the last is probably correct but the general absence of any reference to this characteristic in the literature leaves me searching for an explanation. Hats off to Sibley, Lenz, and others who have noted this plumage.

If Mike Abernathy's photographs are best characterized by one of the other possible identifications, then the bird (or birds) may visit this area again and there is the distinct possibility that it (they) will return in the next season.

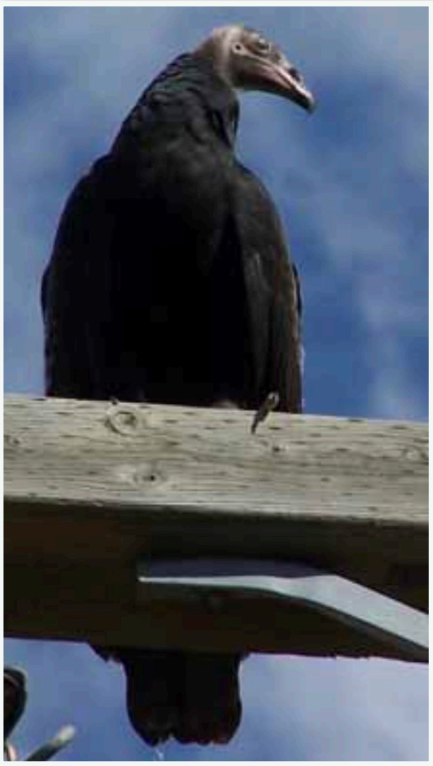
Please keep your eyes open for such birds. Photographs and other documentation will be helpful in ascertaining the significance of this set of sightings. Scoping every young vulture and documenting the findings will be helpful, and images of adult vultures with white collars would probably settle this matter.

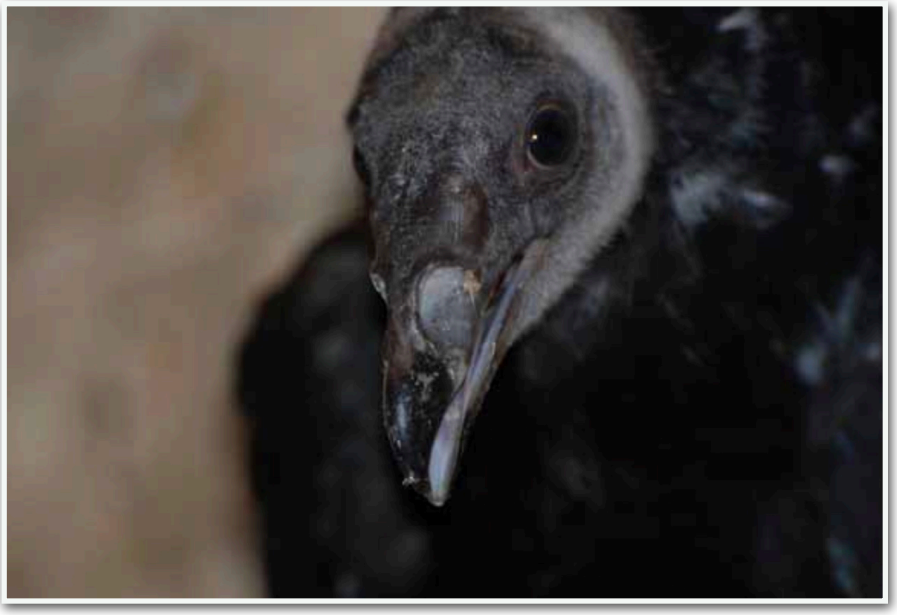
Acknowledgements

Several people have been involved in the effort described in this article. Those of particular note are Dr. John Hubbard, Dr. John Trochet, Michael Abernathy, Nichole Trushell, and Robert Barnes. Special thanks to David Sibley, Tim Lenz, and Jessie Barry at Macaulay.









Above: Nestling at 67 days
Left: Fledgling
Below: Fledgling



Turkey Vulture Natural History

In addition to the works cited earlier, the following may be of use in exploring the natural history of Turkey Vultures.

"Age Estimation and Growth of Black and Turkey Vultures", Coleman and Fraser, Journal of Field Ornithology, Vol. 60, No. 2, Spring 1989, pp. 197-208.

Turkey Vultures: A Photographic Guide for Aging Nestlings, *Alberta Species at Risk Report No. 124*, Alberta Fish and Wildlife Division, 2009. The images on this page are from the this report, as is the chart on the following page.

"Breeding Home Ranges of Migratory Turkey Vultures Near Their Northern Limit", Houston, et al., *The Wilson Journal of Ornithology*, Vol. 123, No. 3, September 2011, pp. 472-478. The identification of the home range of vultures can be a challenge because they are capable of long distance travel. For instance, this article notes that "Adults used all-night perches in varying locations up to 38 km from their nest house while traveling substantial distances to available carcasses to obtain food for their young" (p. 472). In addition, the home range of Turkey Vulture's varies widely. For instance, in a study in southeastern Minnesota individual non-breeding birds had ranges which varied from 128 to 1,227 km^2 (p. 472). This study focused on the breeding population in Saskatchewan. During the non-breeding period these birds can be found over a huge area (the southern United States to northern South America). The subspecies found in Saskatchewan is *Cathartes aura meridionalis*.

Vulture Biology and Management, Sanford R. Wilbur and Jerome A. Jackson, Univ. of Calif. Press, 1983.

In "Environmental drivers of variability in the movement ecology of turkey vultures (Cathartes aura) in North and South America", Somayeh Dodge et al.* report on a long-term study of Turkey Vulture migration, noting that "*Variation is key to the adaptability of species and their ability to survive changes to the Earth's climate and habitats. Plasticity in movement strategies allows a*

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* Dodge S, Bohrer G, Bildstein K, Davidson SC, Weinzierl R, Bechard MJ, Barber D, Kays R, Brandes D, Han J, Wikelski M.) Philosophical Transactions B, Trans R Soc Lond B Biol Sci. 2014 Apr 14;369(1643): 20130195. doi: 10.1098/rstb.2013.0195. PMID: 24733950; PMCID: PMC3983930.

APPENDIX A.

A.1 Summary of Highlights in Turkey Vulture Growth

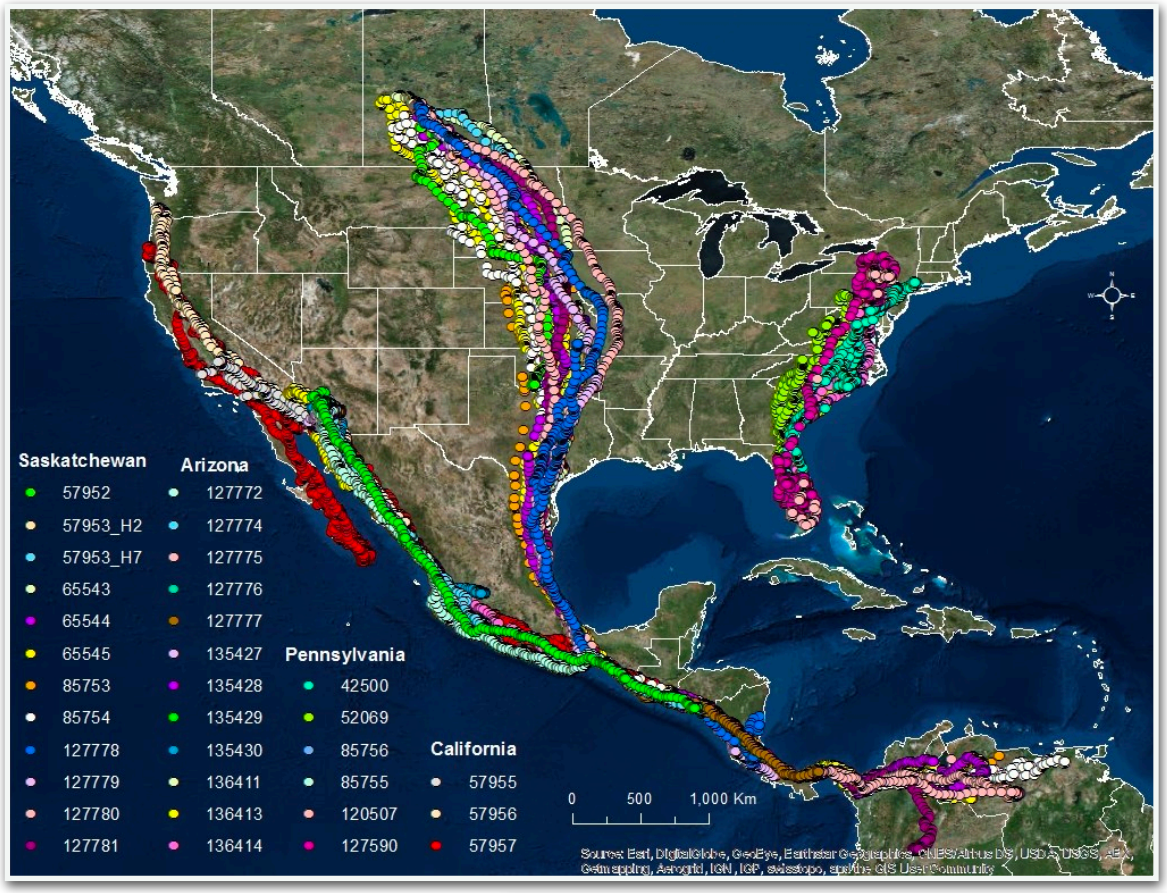
Age	Feature	Period summary
0	Down may be wet, confirming recent hatch. Eyes conspicuously bulge from sides of head. Eyes can open. Mostly sleeping, hunched up.	**0-14**. Aging is difficult because the young bird may seem "large", and there are no real benchmark events. Much of the first 3-4 days is spent sleeping. The head and beak grow rapidly, causing the bulging eyes to soon seem smaller. The rounded 'beak' becomes more pointed and a 'real' beak. Finally some real feather quills, the primaries, show on the hand.
2	Looks about, alertly, but briefly. Skin of crop may be conspicuous if food is in it. Wide circle of short down around ear opening.	
4	May threaten with hiss and wings out. The bulging eyes are almost even with sides of head.	
7	Oldest age seen with a parent brooding it in daytime.	
9	Patch on belly still is naked and pink.	
13	Tip of beak, distal to nostrils, now is separated from the face by a line.	
14	First quills, of the primary feathers, show through the down on the hand.	
15	Egg tooth is still present.	**15-53.** Dark feathers poke through the down, and slowly the young bird's coat turns from white to very dark brown. The flight feathers of the wing are first to appear, and continue growing until well after the young bird flies. Instead of shuffling about, at about 17 days the young bird stands and walks. The wing coverts and back feathers fill in, so that from the back the bird is mostly dark; but the front remains almost solidly white down. Between 36 and 43 days old, the first breast feathers poke through, and slowly start infiltrating. At and just after 50 days, the massive white downy ruff around the bird's neck starts to thin out, and some neck feathers poke through. At 53 days, the first feathers poke through below the big downy puffs on the legs. Bird is mostly dark on the back, still mostly downy white on front, with breast feathers growing in rapidly.
16	Egg tooth is gone.	
17	Nestling can stand on its feet.	
21	Quills of the alula show. A hint of the line of secondary feathers shows. Beak is shiny black, different from gray head.	
26	Wing covert feathers begin poking through. Still only a hint of feathers on the back.	
33	Much "gray" from wing coverts poking through the down above the wide and solid line of the primaries and secondaries on lower edge of the wing. Tail feathers protrude 2-3 cm beyond down.	
34	Peak of down on 'crown' is thinning. A few back feathers may show through the down.	
35	Many back feathers just showing. Wing coverts poking through most of downy upper surface of wing.	
36-43	First breast feathers poke through down, next to wings.	
44	From behind, is mostly dark because of back and wing feathers. From front, mostly white down because only a few side-breast feathers show.	
46	Still a massive white ruff of down around the neck.	
50	The neck ruff begins thinning markedly. 'Crown' of feathers just pokes through just in front of the ruff. A narrow downy band remains behind ears and eyes and over top of head until after flying.	
53	All birds have lost the huge ruff of down from the back of the neck; many feathers poke through. Breast is still mostly white, with patches of dark feathers, but no continuous dark band of feathers side-to-side yet. First leg feathers show, below the down.	
54	A few feathers show at front of the neck.	**54-flying.** By about 56 days, there are solid dark bands of feathers across the breast. When they first are able to fly, at about 61-67 days depending on the nature of their home, most young vultures retain small patches of down on the neck, breast, and legs, and many thin wisps of down trailing from dark feathers everywhere.
56	Dark feathers finally complete a band across breast.	
54-60	Appearance is very 'shaggy' or 'shabby', with diminishing amounts of down remaining on breast, neck, and legs.	
62-67	Back and underwings almost free of down except for many wisps (threads). Small patches remain on neck, breast, sides of low back, and legs. Narrow downy ruff remains behind ear and eye and over top of head. First flights usually occur.	
64	In side-view of perched bird, wing feathers reach to within a few centimetres of tip of tail.	

Turkey Vultures: A Photographic Guide for Aging Nestlings, *Alberta Species at Risk Report No. 124*, Alberta Fish and Wildlife Division, 2009. p. 6

species to better track spatial dynamics of habitat quality. We describe the mechanisms that shape the movement of a long-distance migrant bird (turkey vulture, Cathartes aura) across two continents using satellite tracking coupled with remote-sensing science . . . We conclude that the extensive variability in the movement ecology of turkey vultures, facilitated by their energetically efficient thermal soaring, suggests that this species is likely to do well across periods of modest climate change." **(Abstract)**

The study found *"little variation in the spread of migration routes within populations among individuals and years"* during their 10-year study.

"However, turkey vultures breeding in the four distinct geographical regions exhibited substantial differences in a number of migration parameters. A significant variation was found in flight speed and straightness index across seasons and among individuals, but surprisingly not between populations . . . **(and that)** ***Thermal uplift (or its residual from the***



latitudinal prediction) showed significant positive effects on movement at all seasons, but during the migration seasons its coefficients were roughly 3–30 times larger than in the non-migratory seasons. The results suggested a significant interaction between thermal uplift and population, indicating that uplift had different effects in different populations. Similarly, temperature had a significant direct effect and significant interaction with populations at all seasons".

In related efforts, the Hawk Mountain research center is conducting one of several tracking programs to define the migratory patterns of Turkey Vultures more precisely. The graphic above is from their site.

Their webpage provides links to interactive tracking maps, which illustrate the movement of various birds and their location at specific times, including a "slider" which allows the review of the birds' movement over time (see right).

If you see a Turkey Vulture with a yellow, red, or light blue tag, please use the Hawk Mountain sighting form at this site (web-based reporting). Other tag colors should be reported to the U. S. Bird Banding Lab.



Vulture - The Private Life of an Unloved Bird

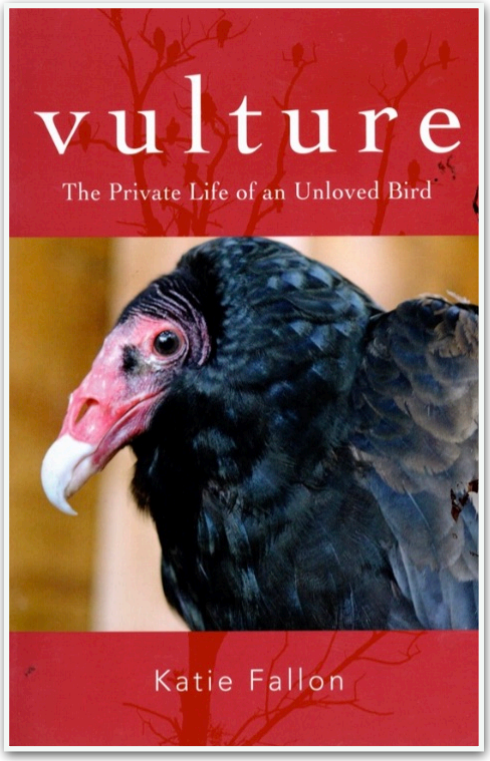
Book review by Harley Shaw

At the tail end of Volume 1, Number 1, the first issue of the Hillsboro Historical Society's newsletter, *Guajolotes, Zopilotes, y Paisanos,* published in March, 2008, I provided the following paragraph explaining the choice of name.

> And in case anyone is wondering:
>
> My suggested title for this newsletter acknowledges our town's association with Percha Creek. Percha translates to English as "perch" or "roost," purportedly deriving from turkey (guajolotes) roosts that occur along the creek. Perhaps they were historically here more than now. Of course, Hillsboro and Kingston both have their own summer turkey vulture (zopilotes) roosts. Paisanos are countrymen, a term that applies to us all who live here. . . . Paisanos is also a name that applies to roadrunners. I'm sure roadrunners roost and nest within the Percha Creek watershed.

So far, the newsletter's name has survived. So have the vulture roosts. The creek was named Percha during the reign of early Spaniards, so no one knows its true origin. No doubt some roosts of the Merriam's wild turkey exist in the forested portions of the watershed, but these aren't as conspicuous as our buzzard bedrooms. The longer I live here and watch the annual return of the vultures, the more I suspect that the creek's name was based upon presence of zopilotes, rather than guajolotes.

Whatever the case, our turkey vultures return to Hillsboro and Kingston every year. They are among the first harbingers of spring. When Patty and I moved here in 2001, the Hillsboro roost was concentrated in large cottonwoods around the town park across from the Black Range Museum. Trimming and natural decadence of some of those cottonwoods has caused the big birds to change their habits, with some birds sleeping over Route 152, right in the middle of town, others using trees



Available Here

scattered along the creek above and below both bridges, and some even sleeping on low stumps of shrubs along the mesa edge south of town. In our 21 years of residence, they've returned every year; I suspect the Hillsboro and Kingston roosts have been here longer. Long-time resident Lonnie Rubio, now 85, says the roosts were here when he was a kid. Perhaps they were here when Dugan and Stitzel found gold - but I find no written record of their early presence.

When you share your town with such conspicuous residents every summer, you can't help asking questions, many of them difficult to answer without high-tech help. The above thoughts about the longevity of the roosts might be question number one. Unless some scholar will be able to find them mentioned by an early Spanish explorer, or perhaps by co-travelers with Dugan and Stitzel, we won't know how long the vultures have spent their summer nights in Hillsboro.

But anyone watching the leisurely evening return of the vultures to their roost must wonder where they have spent their day; what they find to eat, and how far they range from our roost. Some summers, we have perhaps 200 roosting in Hillsboro alone. Where do such a body of large, warm-bodied creatures find enough carrion to feed their masses? And why, for that matter, do they only spend the summer here? When they leisurely drift southward each fall, where do they go? Without the use of modern satellite radio-tracking equipment monitored and field checked by skilled biologists, answers to such questions won't be answered; and only recently have such questions been pursued anywhere within the turkey vulture range. Fortunately, much of the available information has now been compiled by Katie Fallon in a readable book, *Vulture - The Private Life of an Unloved Bird*.

Fallon is co-founder of the Avian Conservation Center of Appalachia, a non-profit research, education, and rehabilitation center for injured birds. She is also a member of the International Association of Avian Trainers and Educators and has glove-trained a host of raptor species, including turkey vultures. She lives in West Virginia.

Most of the research she cites regarding vulture behavior was initiated in the eastern United States. But turkey vultures range over the length of North and South America.

Difficult as it may be for some of us to believe, Fallon truly loves vultures. She comments:

> When I hold a wild turkey vulture its back against my chest, wings restrained by my embrace, clawed feet in one hand and hooked head in the other—my heart races along with the bird's, as it struggles to free its great black wings, to flap, to leave me on the ground where I belong. . . . I smell the musty odor of its feathers, and perhaps the sharp smell of vomit, a turkey vulture's only true defense. . . The bird is desperate, and when I look into its stone-colored eyes, something looks back at me. In a turkey vulture's eyes I can see a mind at work, a mind that's trying to figure things out, figure me out, and determine the best way to escape. . . .

Such tolerance of odors and bodily emissions can only be likened to a mother's love.

I won't spoil the book by summarizing all of its content. Like any good scholar, Fallon quotes literature that answers some questions; in the process, she asks many more.

The work of the scientists she cites doesn't apply specifically to our Black Range visitors, but she nonetheless changes my perspective of the birds. Perhaps they aren't as repulsive as their diet might cause us to feel.

Returning to the few questions mentioned above:

1. How old are the Hillsboro and Kingston roosts? It's hard to extrapolate much regarding roost longevity from Fallon's book. Turkey vultures in the eastern U. S. are much different than our local birds. They winter at least as far north as Gettysburg. In the 1980s, some 700 black and turkey vultures roosted on Little Roundtop, and some folks speculated that the roost had been present since the massive carnage provided by the Gettysburg battle in 1863. Use of the roost has declined since the 1980s, however. Fallon comments that roosts are ephemeral and variable, so we cannot, at least, assume that vultures have summered in Hillsboro for centuries. Nor can we assume that the same birds use the roost every night. Fallon notes that vultures using particular roosts are not necessarily the same birds every night. A recent paper in the *Wilson Journal of Ornithology* (September, 2011) notes that "Adults used all-night perches in varying locations up to 38 km from their nest house while traveling substantial distances to available carcasses to obtain food for their young."

2. How far do the vultures roosting in Hillsboro or Kingston range out during their daily forays? How big is the area required to feed a roost? I was disappointed to find that the book didn't address this question. Nearly all vulture research in the U. S. has occurred in the eastern states, and I formed an impression that vulture roosts there are often located near landfills, stockyards, or other sites that accumulate carrion. Thus my local question is moot. Neither Hillsboro nor Kingston has such sites nearby; our vultures soar upward each morning and glide throughout the day over the surrounding landscape, watching and smelling for carcasses of cow, deer, rabbit, and other species scattered across the Chihuahuan desert, desert grassland, woodlands, and forest surrounding our towns. Ecologically, it seems to me, an annual estimate of range area required to feed a roost would be an important measure of the area's environmental condition. The *Wilson Journal* article cited above notes, "The home range of Turkey Vultures varies widely, for instance in a study in southeastern Minnesota individual non-breeding birds had ranges which varied from 128 to 1,227 km2." In our xeric southwestern habitats, we might expect that birds would need even larger areas to provide enough carrion to feed our large roosts.

3. Why do our vultures spend only summer months here, while many of the birds studied in the East hang around colder environs all winter? I can't answer this and didn't find an answer in the book. I have suspected, after years of casual observations, that the annual arrival of a more aggressive scavenger and predator – wintering golden eagles – nudges our peaceful vultures southward. Of late, we haven't seen many eagles, and of late, it seems the vultures might be arriving earlier, maybe staying later? I have to wonder if anyone in the Southwest is keeping track.

4. While the limited radio tracking studies haven't focused on the above local questions, they have provided surprising findings about turkey vulture migration. Some of our western birds winter thousands of miles south in Venezuela or Columbia; others may leisurely drift less than 100 miles and hang out near the border between Mexico and the U. S. More surprising to me is the finding that, although vultures are monogamous, mating for life, pairs do not necessarily migrate together. They may take their winter vacations hundreds of miles apart, but reconnect each spring to once again raise young in the nest used in previous years.

5. And reading Fallon's book brought to mind one new question for me: why do we have no black vultures in our area. Black vultures cohabit with turkey vultures throughout their eastern and southern ranges, being common in Texas and southeastern New Mexico. They occur in southwestern Arizona. What is special about our area that causes them to be excluded? How close to our towns have black vultures been recorded?

6. For such a common species as the turkey vulture, one wonders that they have not been studied more in the past. In her book, Fallon wonders the same. *Vulture* is not "everything you wanted to know" about our beloved buzzards, but it is an entertaining introduction to the bird and the people who admire and study it. Fallon provides a sizeable bibliography for those that want to read further.

In Search of the White-collared Turkey Vulture



In January 2023, I made an informal survey of Turkey Vultures along the east coast of Baja California Sur, from Loreto north to Santa Rosalia and across to the west coast at that point. No Turkey Vultures with white collars were noted in a survey of hundreds of birds, nor for that matter were any Lesser Yellow-headed Vultures sighted (not unexpected, because this area is well out of their range). It is not known if the birds surveyed were resident or migratory birds.

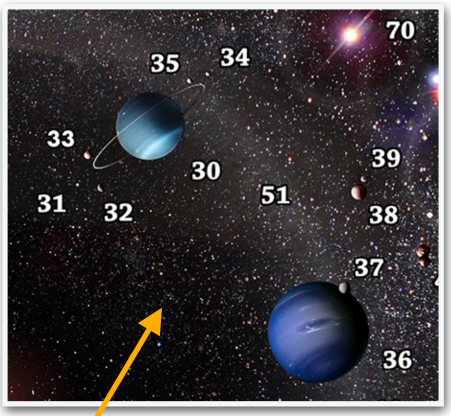
No roosts were observed. Instead, the birds generally perched on the top of Cardón, *Pachycereus pringlei*. This is a very prolific giant cactus and provides a roost of sorts. In the early morning, scores of Turkey Vultures can be seen with wings spread, greeting the morning sun and the heat which it brings. In the afternoons the birds simply perched, like the one shown above. I can not assert that the Turkey Vultures in this area do not roost en masse, only that I did not see that. Instead, they appear to roost in a dispersed mass. An interesting adaptation to the flora landscape.

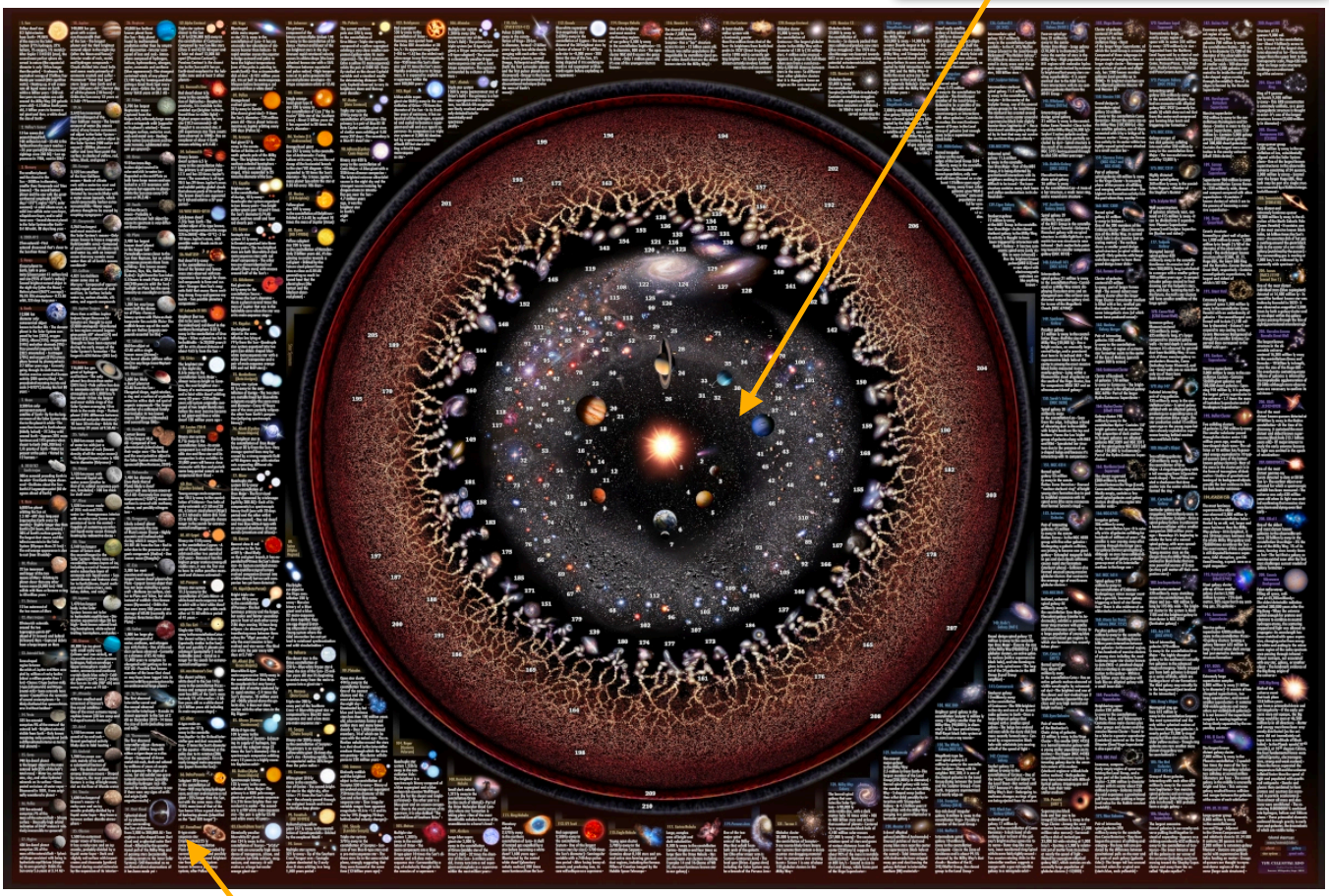
- Bob Barnes, Hillsboro

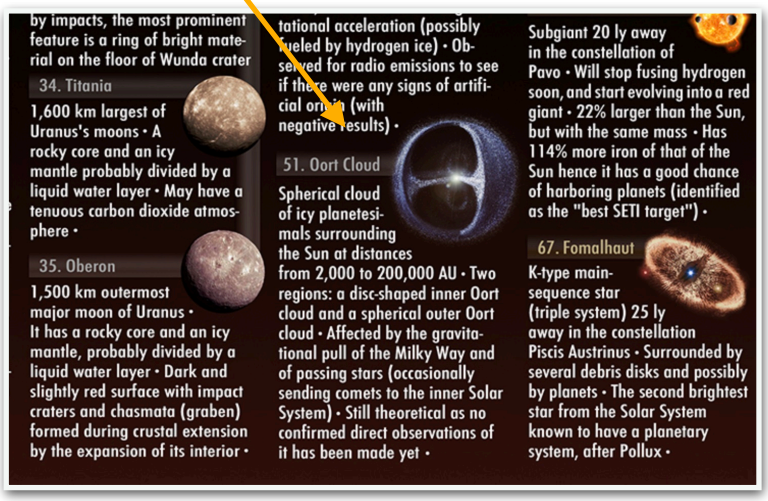
A Celestial Map of 200+ Objects in the Sky

In the October 3, 2020, issue of *The Black Range Naturalist*, Chuck Barrett described some of the objects we see in the night sky here in the Black Range. He correlated the time it took for the light of the objects he viewed to reach earth and then went on to describe what was happening on earth at the time the light left the stars in question. A unique perspective that added to our perception of time and how it is an integral part of natural history.

Pablo Carlos Budassi has published this chart and a variety of other items about the universe as we see it. His website is at the link. We have no financial relationship with him or his business. Just really interesting stuff. You can download a full size .pdf of this image at his website or view it in a "zoomable" image.







Sometimes we forget to look up, especially after the sun has set. I need to do that more often; the effect is magical. When I first saw the Milky Way here I thought I was looking at cloud cover reflecting the moonlight. Something you simply can not see in areas of light pollution.

At the 9th Natural History of the Gila Symposium, Albert Grauer described the efforts he made with Patricia Grauer and others to "certify the Cosmic Campground as the first International Dark Sky Sanctuary in the northern hemisphere". It is currently one of 14 in the world.

Most Of the World's Human Population Is At Least Bilingual - Part 1

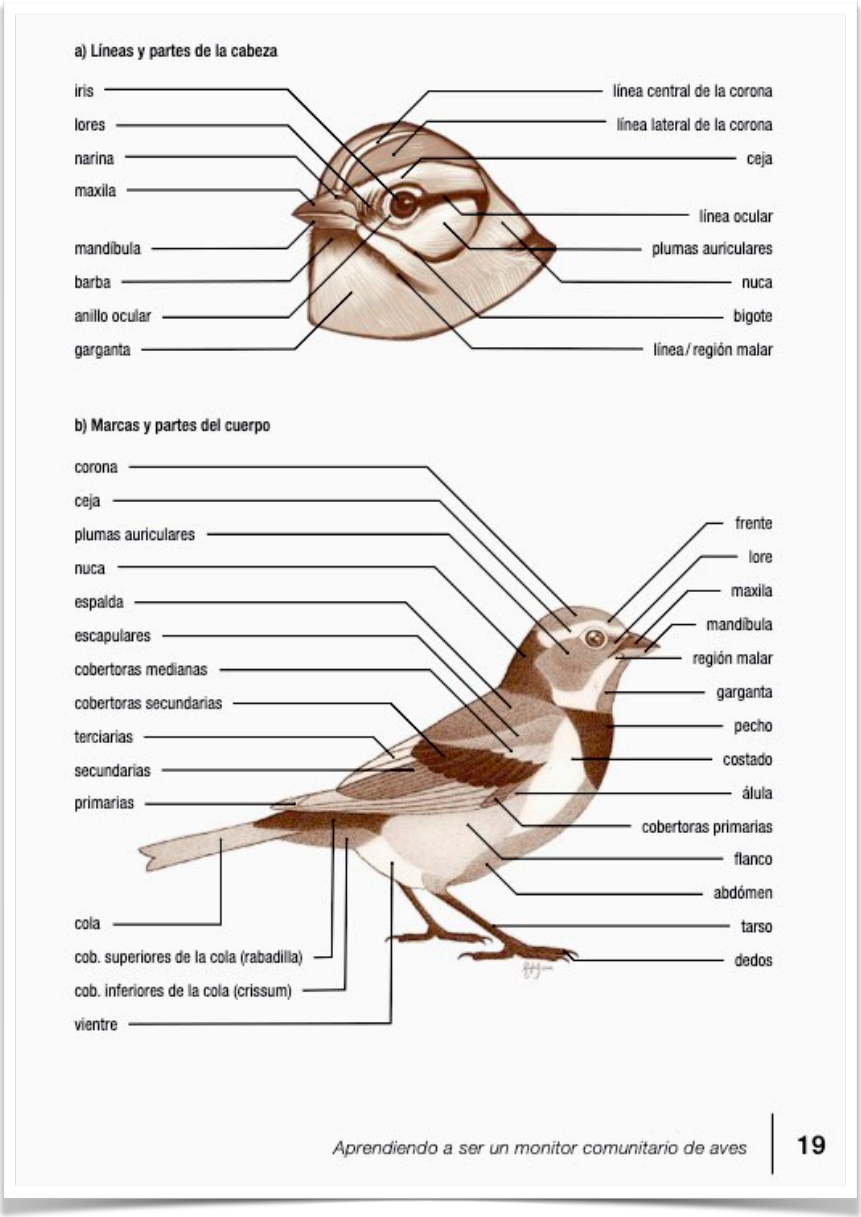
And a significant number speak three or more languages. Me, I speak one, poorly. Knowing something about the terms used by others you might encounter in your studies and avocations can be useful. Although the terms you are likely to encounter in the Black Range will be American English, that may not always be the case - especially if you are doing any type of more in-depth research.

In English-speaking North America, we have the benefit of standardized English common names with which to describe birds. The Spanish-speaking Americas do not have that benefit; standardization of common bird names has not happened. Although English speakers tout this standardization, it does not change the fact that when a person sees a Robin in Hillsboro and a person sees a Robin in England they will have seen different species.

The etymology of Spanish names provides numerous clues into how the early peoples viewed the natural history of this region because the Spanish incorporated indigenous terms into their own language. Whereas English common names tend to focus on field marks of the bird in question or honor an early naturalist, Spanish names tend to describe bird behavior. (Unless, of course, the reference being used has simply translated English into Spanish.)

In general, speciality dictionaries are needed to decipher the possible "meanings" of many of the Spanish common bird names. Many have their origins in the indigenous languages of the area, and many of those languages are not as well documented as would be useful.

English is often the lingua franca of the birding world in the Americas. Among the more serious birders, and ornithologists, the Latin binomial (scientific species name) is used. Pronunciation of English common names by non-native speakers can sometimes be different from the expected norms of native speakers and vice versa.



PROALAS, CONABIO (Cómision Nacional Para El Conocimiento Y Uso de la Biodiversidad - National Commission for the Knowledge and Use of Biodiversity)

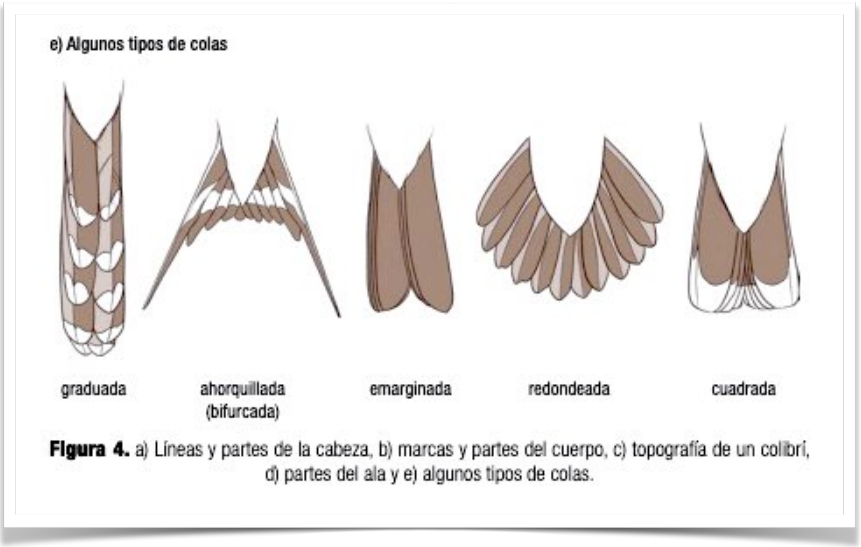
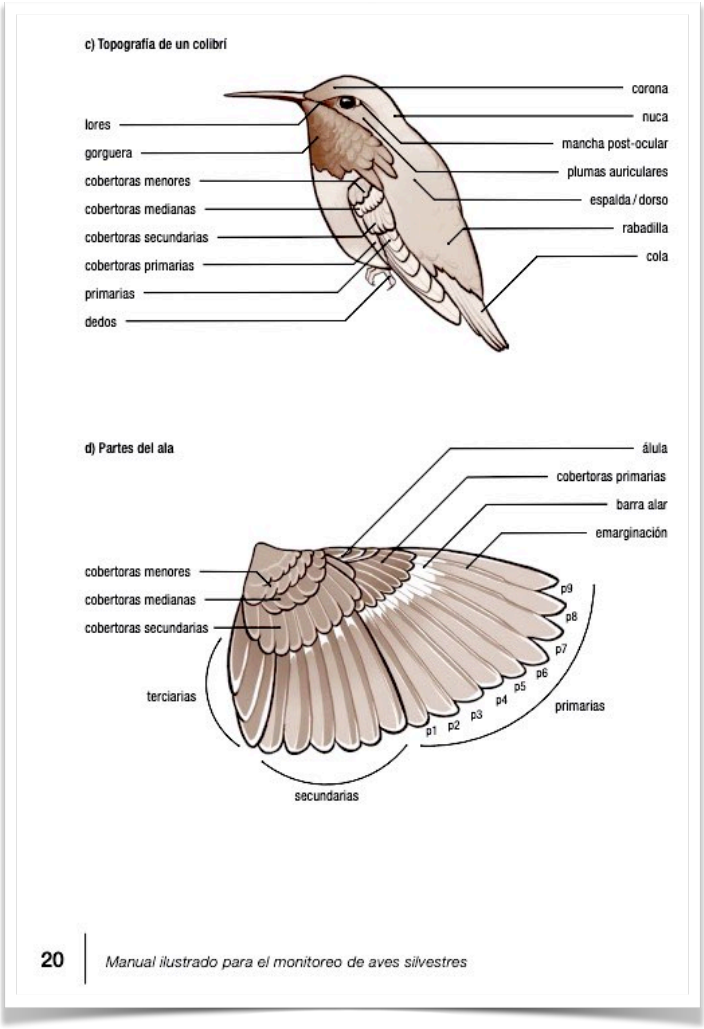


Figura 4. a) Líneas y partes de la cabeza, b) marcas y partes del cuerpo, c) topografía de un colibrí, d) partes del ala y e) algunos tipos de colas.



PROALAS, CONABIO (Cómision Nacional para el Conocimiento y Uso de la Biodiversidad - National Commission for the Knowledge and Use of Biodiversity)

Illustrations in this article are from PROALAS, a publication of CONABIO (Cómision Nacional para el Conocimiento y Uso de la Biodiversidad - National Commission for the Knowledge and Use of Biodiversity) which provides detailed instructions on how to go about performing a bird survey. Most of the terms on these charts are basically literal translations of the English terms (sometimes the same term), or English uses literal translations of the Spanish terms - I am not sure which (but I am relatively sure it is not universal).

General Terminology

In this article, and in the forthcoming Part 2, we generally use the singular term, sometimes listing the plural in a following parenthetical. For example, the general terms used in Spanish for "bird" are pájaro (pájaros) and ave (aves). Wild birds are sometimes called pájaros salvajes. Ave and pájaro are generally considered synonyms, but there are differences including usage rules for different countries.

Spanish is very different from English in the use of articles generally associated with the gender of a word. We don't go there.

The charts shown here do not use the Spanish term for the beak (bill) of a bird, which is pico. The upper part of the beak (maxila) and the lower part of the beak (mandibula) are identified.

Some other general terms which may be of use include; flock, gobble, and warble. These specific terms are included here because they demonstrate some of the issues encountered in this type of exercise.

Flock (Spanish - parva; parvón). Parva refers to a flight of birds, parvón to a large number of birds.

Gobble (Spanish - gorgorear - colloguial). May be translated as making of a birdsong as in "to gobble" or "coo". But perhaps "gurgle".

Warble (Spanish - gorgorear). May be translated as making of a birdsong as in "to warble". (Chile?)

As in English, multiple terms may be used to describe a singular concept/function/object in Spanish. Sometimes a term may be used to describe multiple concepts/functions/objects. Often usage is imprecise or a matter of context, but it can also flow from the etymological history of the word.

Some Sources Included, or linked to in Parts 1 and 2

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ChatGPT

Of late there has been much furor about ChatGPT and its ability to write like a human, sometimes very poorly indeed. Many people, however, have not knowingly encountered a ChatGPT product and are reacting to news-worthy stories about its misuse.

And misuse there has been and will be. It is a commentary on our time, a time of deepfakes and entertainment-news. "Artificial Intelligence" (AI) technology has already proven itself to be efficient and effective in several fields. We are flooded with reports about how effective AI systems are in the medical fields - spotting tumors, for instance, that humans miss. AI has been used to identify new proteins, parse how they form, and assess how they might be used. Software engineers have been fired for asserting that the AIs that they work with are sentient. Lots of news about a phenomenon which will affect all of us. The latest furor, however, seems to have centered on writing academic papers. Apparently, ChatGPT can write very convincing papers; it can even grade them.

Everyone reading this grew up in the modeling era. Models have been used by humans for eons. They are very useful tools to ferret out complex issues and answer complex questions. During the last century, modeling took a major step forward by using machines to parse larger amounts of data and more complex problems. With the development of the transistor and modern computing, very complex digital models were developed.

Computer modeling is a useful tool for both science and business. For all of its utility, however, it has always been looked at with a certain amount of trepidation. Trepidation flowing from the "black box", a term of endearment which describes many a model. Just what is in the black box? A question many a researcher has asked when reviewing someone else's work. The black box was built by a human: Did they know what they were doing? Did they make a coding error? Does the thing do what it says it's doing? Is the program right? In many cases, these questions can not be answered efficiently or effectively.

Toward the end of the last century and continually since then, the models have become more and more sophisticated. Ever wonder what a black box actually looks like? - It looks like this: 0010 1100 0000 0100 etc. (etc. meaning billions of lines of yes/no). Sometimes the computer programs were developed to predict what an outcome is likely to be and that is not always based on a formulaic random-based numbering sequence. These programs have evolved further to enable them to modify how they themselves work. How do you know what is in a black box when it is not even what some programmer coded anymore?

The question of authority doing harm has been a major concern for humanity for a very long time - probably one of our core concerns. "First, do no harm" is a concept written into the dictates of many a professional code. Isaac Asimov wrote an extended moral code into his stories about robotics during the middle of the last century. His scientific work in these matters is often overlooked, but he was struggling with the same issues we face with ChatGPT when he described robots (black boxes that move) and postulated concepts like the need to audit (often self-audit) the degree to which robots comply with the moral code. Humans look at moral codes in the same manner as they look at statutes and regulations; they are nothing more than something to work around in our greed.

Why this rant? Because most models have nothing which approaches a moral code, and probably do not need one. They may have verification loops to assure accuracy but that is a mathematical function.

What does that mean for ChatGPT and similar programs? It means that when prompted the program will generate material, the material will not always be accurate, and the program does not care. ChatGPT has been used to write scientific papers which are not only inaccurate but in some cases patently false - paper citations have been made up, for instance. If you can't trust that the work cited exists, even if you were never going to read it....

All of this negativism must have a yin to the yang.

Jon Barnes, one of the authors - the other being ChatGPT - agreed to generate an article using the program so we could assess its potential. And, it has some real, positive potential. I mean, could those instructional manuals get any worse? For authenticity, the following article has not been subjected to any type of copy editing.

Geocaching in the Black Range Mountains

by Jon Barnes and ChatGPT

"The Black Range Mountains in New Mexico offer an exciting opportunity for adventure seekers, offering a lesser-known activity known as geocaching. This modern treasure hunt combines technology with the great outdoors.

Geocaching involves using a GPS device or smartphone to find hidden treasures, referred to as caches, placed in various locations around the world. These caches can vary in size, from small film canisters to large ammo cans, and often contain a logbook and trinkets or toys.

The Black Range Mountains are home to a wide variety of geocaching sites, each with its unique history and challenges. Caches in the Black Range Mountains are often located in remote areas, requiring a hike to reach them. This makes the Black Range Mountains an ideal destination for those looking for a challenging geocaching adventure that combines physical activity with a sense of accomplishment."

By now you may have noticed something a little different about this article; it is written by me (a human) and ChatGPT (a computer program). I will use italics when it's me the human. When I am quoting the computer I will just use quotation marks, as I did for the first three paragraphs of this article.

"ChatGPT is an advanced AI program that can understand and communicate in human language. It can provide information on various topics, compose stories, answer questions and even generate poetry. It can be integrated into different applications such as chatbots and virtual assistants. In the context of geocaching in the Black Range Mountains of New Mexico, ChatGPT can offer insight on the activity, including its basic principles, how it works and the features of popular geocaching apps."







OK, now back to the main article about geocaching in the Black Range.

"To start geocaching in the Black Range Mountains, all you need is a GPS device or smartphone with geocaching apps such as "geocaching.com" or "c:geo" and you can also join a geocaching group or club for more information about the best caches in the area, as well as tips and advice.

The Black Range Mountains in New Mexico offer a wide variety of opportunities for geocaching, with its rugged wilderness and scenic locations. Here are some good spots to put a geocache in the Black Range:

1. **Hiking trails: The Black Range Mountains are home to a variety of hiking trails, which offer a great opportunity to hide a cache for hikers to find. These caches can be hidden along the trail or at the trailhead.**

2. **Scenic overlooks: The Black Range Mountains offer several scenic overlooks that provide great views of the surrounding landscape. These locations can make great spots to hide a cache, as they are often visited by tourists and outdoor enthusiasts.**

3. **Historical sites: The Black Range Mountains are home to several historical sites, such as mining ruins and old homesteads. These sites can be great places to hide a cache, as they can provide an opportunity to learn about the history of the area.**

4. **Campsites: The Black Range Mountains offer several campsites for people to spend the night. These campsites can be a good spot to hide a cache, as they are often visited by campers and outdoor enthusiasts.**

It's important to note that when hiding a geocache, it's important to get permission from the landowner if it's on private property, and to make sure that it's legal to place a cache in that area. Also, make sure that the location of the cache is safe, and won't cause any damage to the environment.

Finding a geocache can be a fun and exciting adventure, but it can also be challenging. Here are some strategies that can help you to find a geocache:

1. **Read the cache description: Before you set out to find a cache, make sure you read the cache description carefully. It will give you important information about the cache's location, size, and difficulty level, as well as any hints or clues that have been provided to help you find it.**

2. **Check the map: Use the map feature on your GPS device or geocaching app to locate the cache. The map will show you the**

cache's coordinates and its proximity to your current location.

3. Look for the obvious: Sometimes, caches are hidden in plain sight. Look for things like rocks, logs, or tree stumps that may be slightly out of place.

4. Search for the not-so-obvious: Caches are often hidden in clever ways, so be prepared to think outside the box. Look for things like hollowed-out trees, fake rocks, or hidden compartments.

5. Use your intuition: Sometimes, the best way to find a cache is to trust your instincts. If something feels off, or if something catches your eye, it's worth investigating further.

6. Check the hints: If you are having trouble finding a cache, check the hints provided by the cache owner. These hints can give you additional information to help you find the cache.

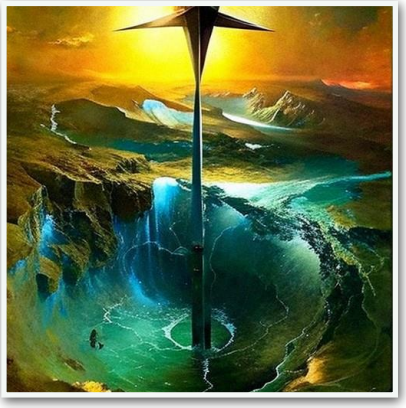
7. Collaborate with other geocachers: Joining a geocaching group or club, and working together with other geocachers can be a great way to find a cache. Sharing information and working together can increase your chances of finding a cache.

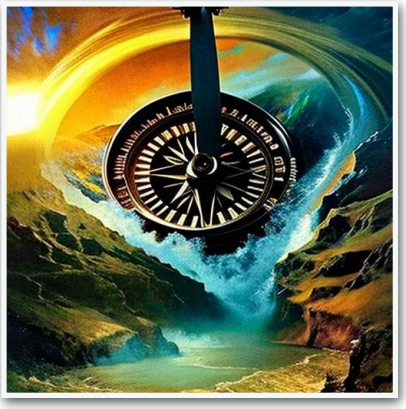
8. Be persistent: Finding a cache can be a challenge, so be prepared to put in some effort. Don't give up too easily, and be prepared to search multiple times if necessary.

Remember that the most important thing is to have fun and enjoy the adventure of searching for the cache, so don't put too much pressure on yourself and enjoy the journey.

Using a smartphone app when geocaching can make the experience more efficient and convenient. With the app, you can access detailed information about caches, including location, size, difficulty level, and hints provided by the cache owner. You can also log your finds, track your progress, and connect with other geocachers. Additionally, the app can provide turn-by-turn directions to caches, making it easier to navigate to them. Some apps also allow you to









import and export cache information in GPX, LOC, and KML formats, which can be shared with other geocachers and used with other geocaching apps and devices. Smartphone apps can also have features like "Live", which allows you to see the real-time location of other geocachers using the app, making it easier to plan a geocaching event with friends or family."

Two popular geocaching apps are C:geo and Geocaching.com.

"C:geo is a free and open-source geocaching app for Android devices, that provides an easy and efficient way to access geocaching information and navigate to caches in the Black Range Mountains in New Mexico. This app is an excellent choice for geocachers looking for an alternative to the proprietary app offered by Geocaching.com.

The app is user-friendly and easy to navigate, and it provides detailed information about each cache, including its location, size, difficulty level, and hints for finding it. It also allows users to log their finds, track their progress, and connect with other geocachers.

To start using c:geo, you first need to download and install the app from the Google Play Store. Once the app is installed, you need to create a free account on Geocaching.com, since c:geo uses the data from Geocaching.com. Then you can sign in with your Geocaching.com account and import your data.

The app's main menu provides options such as "Find a Cache," "My Profile," and "My Finds." The "Find a Cache" option allows you to search for caches in your area, and you can filter your search results by location, size, difficulty level, and other criteria. The "My Profile" option allows you to view your personal statistics and your geocaching journey. The "My Finds" option allows you to view the caches that you have found.

C:geo also includes a "Map" feature, which allows you to view the location of caches on a map and navigate to them. You can also use the map to search for caches by location, and the app will provide turn-by-turn directions. This feature is very useful for hikers, bikers, and off- road vehicle enthusiasts who want to explore the Black Range Mountains.

One of the main advantages of c:geo is that it provides the ability to add

and edit new caches, this is an option that's not available on the official app. This feature is useful for those who want to create their own caches, or for those who want to add new information to existing caches.

C:geo also allows you to save your favorite caches, this feature is useful for those who want to revisit a cache or plan a geocaching trip."

The second app is Geocaching.com.

"Geocaching.com is an online platform that allows geocachers to search for caches, log their finds, and share information with other geocachers. The Geocaching.com app is a mobile application that allows geocachers to access the platform on their smartphones or tablets.

The Geocaching.com app offers many features to make geocaching easier and more efficient. The app allows you to search for caches near your current location, or you can search for



caches in a specific area by entering the coordinates or address. The app also provides detailed information about each cache, including the size, difficulty level, and hints provided by the cache owner.

The app also allows you to log your finds, both online and offline. This means that even if you don't have an internet connection, you can still log your finds and the app will sync them to your account once you have a connection. Additionally, you can also take and upload pictures of your finds to your account, and share them with other geocachers.

The Geocaching.com app also offers a feature called "Live" which allows you to see the real time location of other geocachers who are also using the app and also allows you to share your location with other geocachers. This feature is especially useful when geocaching in a group or when planning a geocaching event.
One of the best feature that Geocaching.com app offers is the ability to import and export cache information in GPX, LOC, and KML formats, this allows you to share cache information with other geocachers, and also allows you to use other geocaching apps and devices."

Using ChatGPT and Stable Diffusion
by Jon Barnes

The article on geocaching was written and illustrated by a computer. ChatGPT wrote the article, and Stable Diffusion created the images. This article discusses the use of these tools.

Writing the Geocache Article

Both ChatGPT (https://chat.openai.com/chat) and Stable diffusion were used to write the geocaching article. I used ChatGPT to create a list of activities to do while in the Black Range, places to see, and common plants and animals of the Black Range. I decided to make an article about the activities that people could undertake. Geocaching came up on a list of the suggested activities I used. I then had ChatGPT write an outline. I was able to get ChatGPT to write short 400 word replies to my prompts based on the outline. I copied each section back into the prompt box and asked the program to write a few paragraphs about that topic. Finally, I copied the ChatGPT replies into a Microsoft Word document to make the disjointed replies into one cohesive article. This method let me get around the word count limit which exists in the program.

The pictures in the article were created using artificial intelligence. To make those pictures I used a website called https://neural.love/.

That website uses a program called Stable Diffusion to make pictures based on text prompts. This is very similar to ChatGPT; however, instead of a text response, you obtain four pictures. The "Free AI Art Generator" section uses text prompts to make free images. You can type in anything, for example "A grizzly bear using a compass." To the left of the text box, there is a prompt for style selection, in which you can choose what style you want your art to be in, from fantasy to pictures to paintings.

Prompts

Prompts are important for obtaining the desired output. There is even a newly created job of Prompt Engineers, who sell high quality prompts. A key feature of Neural Love is that it adds both positive and negative keywords to the prompt to improve its appearance.

Neural.Love adds extra words to your prompt to make it look better, which allows new users to create impressive art without having to research the exact keywords to put in. You can see what extra words Neural Love used by clicking on the "for prompt engineering" section on the images you already made.

For example if I typed in "chessboard on a table." Neural Love might add keywords as shown below.

Positive Prompt

"a professional photo of a (chessboard on a table:1.2), 8k, 4k, 85 mm, f2.2, photography awards and 85 mm f1.8, 50 mm photo, soft light, masterpiece, sharp focus, pretty, (hasselblad:0.8)."

Neural Love also added in some negative prompts.

Negative Prompt

"blender, cropped, lowres, double, blurred, deformed, repetitive, black and white, poor quality resolution, low quality, blender, cropped, lowres, double, blurred, deformed, repetitive, black and white, poor quality resolution, low quality"

Those prompts generated the image at the top of the following page.

Some other "text to image" websites are: Leonardo.ai, MidJourney, Stable Diffusion on Hugging Face, and Dall-e2.

What are neural networks?

ChatGPT and Stable Diffusion are transformer-based neural networks pretrained with supervised learning. ChatGPT is a generative-pre-trained transformer. A transformer is a type of neural network. Stable diffusion is a specific type of deep generative neural network known as the latent diffusion model.

Transformer based neural networks are a new and exciting development in Natural Language Processing (NLP). ChatGPT can convert words into tokens and can remember and use earlier parts of your human-computer conversation later.

Both ChatGPT and Stable Diffusion use supervised learning for training purposes. The data they are trained on are labeled such that the computer knows the correct output for a given input.

Stable Diffusion adds Gaussian-based diffusion to create noise. Diffusion models work by adding noise to the image until it is a completely random image, and then removing the noise to remake the image. The addition of noise and its subsequent removal is known as latent diffusion.

During the training process, ChatGPT and Stable Diffusion trained the weights to be used for each neuron inside the neural network. Deep learning allows a neural network to have more layers between input and output. Deep learning was invented in 2006 and later popularized in 2012 with deep convolutional neural networks. Although neural networks have been around since the 1940s, transformers were first introduced in 2017 in a paper titled "Attention is all you need." Transformers focus on attention, which helps them outperform other models such as traditional NLP and CNNs. The transformers can be operated in parallel. Transformers are well suited for transfer learning because after being initially trained, they can be easily fine-tuned for specific projects.



Both tools, ChatGPT and Stable Diffusion, were trained on an enormous amount of data. A significant amount of computing power is required to train these models. But, once they are trained they can run on much less powerful computers. They need a lot of resources to be created, but require far fewer resources to run.

Conclusion

In conclusion, I used two machine learning tools to write and illustrate the geocaching article. I used ChatGPT to write the geocaching article. Neural.Love was used to create the images in the geocaching article. It was very important to enter high quality prompts so the computer would make the correct text and images. The article and pictures are a bit clunky. Both ChatGPT and parts of Neural Love are currently free to use.

From the Crest to the Dam - by Bob Barnes

On August 4, 2013, I recorded a debris flow coming down Percha Creek west of Hillsboro (video - see a framegrab from that video at the top of the following page). That mass of blackish timber is moving, tumbling over itself, a bore of ash and anything else which got in the way. The sound was not a roar, more like - well, I am not sure what it was like: loud, snapping trees, a deep guttural rumble, the evacuation sirens going off in the background. A debris bore should be on everyone's bucket list.

On September 12, 2014, I recorded a similar event in and near Hillsboro (video). The series of photographs on pages 73-74 show the debris bore as it came through the canyon at the high bridge west of Hillsboro. These high water events were greatly influenced by the Silver Fire which swept through much of the Black Range during the summer of 2013 (*The Silver Fire - As We Lived It*).

Evan Dethier et al. published the results of a massive study of 414 of the world's major rivers, a study of sedimentation rates and flow over the last half century, in "Rapid changes to global river suspended sediment flux by humans", *Science*, 24 June 2022, Volume 376, issue 6600, pp. 1447-1452. Their team developed effective tools for the study of river sedimentation and established a baseline of information which can be used in the analysis of myriad public policy issues associated with sediment in water. Sedimentation in water is a complex multivariate multi-polity issue.

Here we will use the Dethier study as a springboard to articulate the multiplicity of issues associated with the water, debris, and sediment in the two high water events referenced in the first paragraph.

Our personal assessments of the issues associated with sediment flow are often governed by when and where we sit. Our opinions about the phenomenon are likely to be situational and generally poorly informed. Here we present some of the issues associated with the changes which humans have caused in stream and river flow.

As we consider these issues, the one truism which few (there are always deniers) will argue with is that humans have changed the characteristics of stream and river flows throughout the world.

Starting at the crest of the Black Range, we will follow the water in Percha Creek until it passes Percha Dam on the Rio Grande. Along the way we will highlight some of the issues associated with the waters of our creek.

Assume for a moment that a rain event in the summer of 2012, a year before the Silver Fire, is our normative



value. The difference in the effect of a rain event in 2012 and the events in 2013 and 2014 is dramatic. The Silver Fire was the cause of that difference. Human decisions and capabilities associated with fire suppression resulted in a significant amount of debris, sedimentation, and flow in the 2013 and 2014 high water events described at the beginning of this article.

The Silver Fire burned much of the ground cover in the Percha watershed; when the rain came there was nothing to stop it from simply running off the steep slopes of the Black Range.

Much of the soil of the Black Range was fried (amounts varied; see soil map from Black Fire [BRN 5-4, p. 19] for variability) causing water to be shed rather than absorbed. The giant funnels, which are the canyons of the Black Range, aggregated the vast majority of the rain which fell from the sky, creating a surge of water flowing down the watercourses - water laden with ash, soil, and debris, up to and including logs of significant size.

Fire suppression is the first public policy issue which we come to in our story about these rain events. The historical suppression of fire by some of the European colonizers was not true to nature and altered the lands of the west. It is important to note, at this point, that the European view of fire suppression was not monolithic. The timber industry believed strongly in fire suppression and in many places in the American west that industry was the dominant client of state and federal forestry agencies. The mining industry which generally wanted a ready supply of wood for its shafts and sometimes smelting activities, was also supportive of fire suppression efforts, as were most town folk, who feared the ravages of uncontrolled fire. The ranching industry was less uniform in its attitudes about fire suppression and, indeed, actively engaged in burning grasslands and forests to increase fodder for their cattle. This history had a detrimental effect on the environmental health of forests and their overall productivity. Beginning in the second half of the 1900s, fires were increasingly allowed to burn until they were naturally extinguished, and controlled burns were used to increase long-term forest health and productivity.

Although the Black Range has a long fire history (see Larry Cosper article in BRN 2-1, pp. 2-10), the fuel loading of the forest was quite significant at the time of the Silver Fire. The denuding of the mountain slopes near the mining communities was a thing of the past, and neither mining nor forestry had significantly affected the forests in the last few decades. Until recently fire suppression was the dominant paradigm in the Black Range. When the Silver Fire erupted, the US Forest Service was faced with a fire raging in steep terrain with a significant amount of dry fuel, low humidity, and high winds. In general, there were few human structures (which the agency tends to prioritize) in the mountain range. Faced with the high costs associated with fighting such a fire, demands for fire suppression resources in other areas, and the inherent difficulty and danger of fighting fires in the Black Range, the Forest Service had to watch much of the Black Range burn, sometimes very hotly (which diminished the ability of the soil to absorb water). The Forest Service did a yeoman's job, saved the mountain communities close to the fire from burning, and eventually brought the fire under control. Fire suppression philosophy and capability increased sedimentation (soil, rock, ash) and debris in the events of 2013 and 2014. It is hoped that the forests in the Black Range have been reset and will continue as healthy productive ecosystems. From a forest health and general environmental impact perspective the Silver and Black Fires had a silver lining.







The photographs above and the one on the following page were taken on September 12, 2014, and show a debris bore entering the canyon at the bridge two miles west of Hillsboro. This flow was more than a year after the Silver Fire. Debris (a nice word for wood the size of twigs to timber) was still coming off the mountain. Note, however, that at this late date the debris is concentrated at the front of the bore and the water loading is mud, not ash.



When the surging waters merged and began their flow down the forks of Percha Creek, there was little to stop their flow, other than friction, until they reached the Caballo Reservoir. As the water flowed over the relatively flat slopes to the east and west of Hillsboro there was nothing to slow their progress or to cause them to dump their load of sediment and debris. The role of check dams in slowing the flow of water is well understood by nearly all of the public and private parties in this area, but there were no check dams along the Percha to cause it to unload its rich cargo of sediment and ash, products which could create more grass for the local ranching community. The populations of small fish which existed in the Percha Box east of Hillsboro were washed away and have not recovered. Fauna in other watersheds was adversely affected but has recovered somewhat. Some sensitive flora populations suffered a significant setback. Temporary check dams on the private and public properties of the Black Range watershed could have diminished this damage and even improved the productivity of some of the riverine environments.

The study by Dethier et al. noted the effect that dams have on the sediment loading of water. In general, significant amounts of sediment are unloaded by water in the areas above dams. This occurs as the water slows. The study focused on the potential negative effects of diminished sediment/nutrient flow on the oceans.

Let us spend some more time above the dams before we dig into the issues associated with the dams. The Dethier et al. study noted the significant increase in sedimentation that results from degraded land, degradation often resulting from human activity. Overgrazing, poor farming practices, landform stripping associated with construction, and various other human activities have significantly increased the sediment flow in most streams and rivers. All of these activities are driven by short-term economic values. Modifying those behaviors would create long-term value and diminish the amount of sediment in stream and river flow. In those areas of the country where there are commercial fisheries, the amount of sediment in river and stream systems is detrimental to the basic survival of resident fish and their ability to spawn. In our area, some types of sport fishing are diminished by the current levels of sedimentation.

Dams are built for multiple purposes but primarily for flood control, recreation, irrigation impoundment, river transport, and power production. They have benefits and they have costs associated with them. One of the costs associated with dams is that the areas upstream from the dams begin to fill with sediment. When this happens it diminishes all of the benefits of the dam. (Some of the detrimental effects of having river sediment settle out behind dams are referenced in the Dethier study, although that study's general focus is on the ecosystems of estuaries and oceans.) Dredging upstream of dams is sometimes employed to deepen the impoundment area. Like all things to

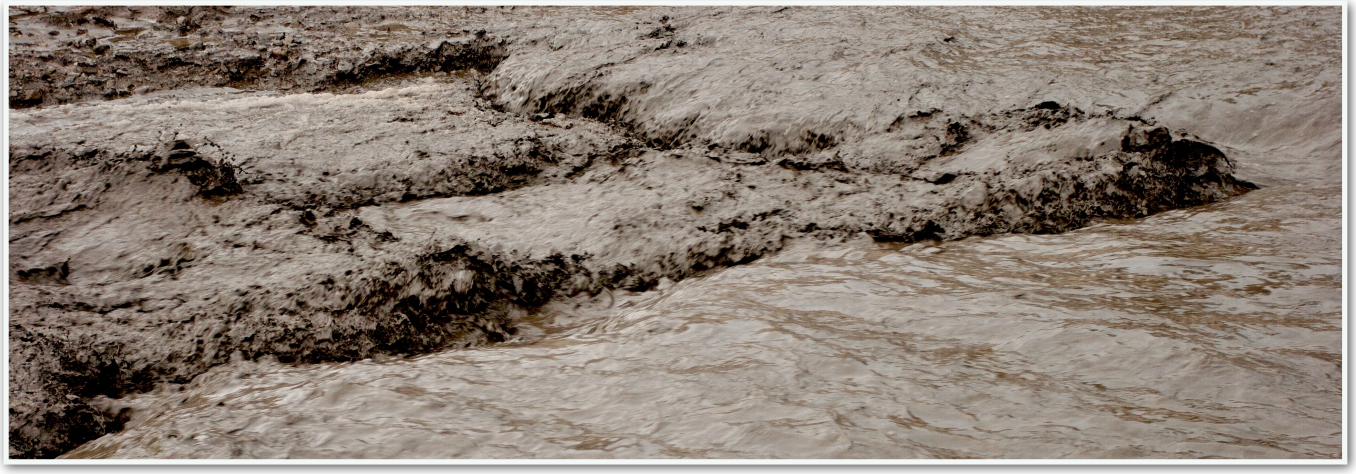
do with sediment, this is not straightforward, however. All of that human activity upstream from the dam (ranching, farming, mining, residential and industrial activity) dumps heavy metals and other materials into the water system. Dams concentrate those human additives. Some sediment deposits behind dams are so concentrated that they would qualify for superfund cleanup and present some liability to those doing the dredging as they create potentially harmful runoff for parties downstream.

When water passes through a dam, it is often changed in significant ways. It may be colder than it would otherwise be, it might carry less sediment than it would otherwise hold (yes a two-edged sword), and the rate and timing of its flow will probably be controlled for human use and will not match the needs of extant ecosystems.

Of course our bit of streamflow will probably become involved in someone's water rights litigation, creating some sort of state, regional, or international furor. But let us leave that for the lawyers.

There are individuals and public and private bodies lined up on all sides of the issues we have discussed above. Some are responsible, some are not, all are human. That bit of water and its contents that I recorded on the two events mentioned above, is a surrogate for the water issues we must deal with as a society, and thus far our efforts have created mixed benefit and significant cost.

The hope of Dethier et al. is that the study they have performed will give the public and policy makers the tools they need to make "good public policy". I fear, however, that the myriad demands of humanity far exceed the capability of the collective to balance them.



Information about the Illegal Killing of Mexican Gray Wolves - Reward

The reward for information leading to the arrest and prosecution for illegally killing Mexican Gray Wolves is now $40,250. Report illegal killings to the United States Fish and Wildlife Service at 844-397-8477 or email FWS_TIPS@FWS.GOV.

The Study of Lightening Goes 3-D

Lightening is a big deal in the Black Range. Everything from the tree next door being blown apart, the electricity being out (momentarily or for hours), or the start of the latest forest fire is attributed to lightening.

Xuan-Min Shao and others have performed research leading to a greater understanding of the bolt from the blue. See "Three-Dimensional Broadband Interferometric Mapping and Polarization (BIMAP-3D) Observations of Lightning Discharge Processes", in the *Journal of Geophysical Research: Atmospheres*, 31 January 2023. As noted in the study:

> A new 3-dimensional broadband radio frequency interferometric mapping and polarization system (BIMAP-3D) is developed and deployed at Los Alamos National Laboratory for lightning research. BIMAP-3D provides an unprecedented capability in high-resolution, time-evolving 3D lightning source mapping and 3D source polarization detection for detailed study of lightning discharge physics. In this research, we described the BIMAP-3D system, introduced a suite of advanced data processing techniques, and demonstrated BIMAP-3D's capabilities with actual lightning observations. This new capability is expected to lead to a range of new understandings and discoveries for a variety of lightning discharge processes.

Studies like this bring us one step closer to understanding the dynamics of lightening.

In an upcoming issue we will discuss lightening sprites. For now, see "New Crownsourced Science Project Will Study Sprites."

Living With Wildlife in the Black Range
by Nichole Trushell

We choose to live in a beautiful, wild area. With that choice come some challenges with area predators. A principle of living with wildlife: if prey such as chickens or other livestock are present, predators may arrive to eat them. One predator may be killed, but if the food source remains, another predator will likely take its place. This initiates a cycle of killing of both livestock and native predators.

Wildlife can become aggressive if cornered. However, the animals on this list are not typically a threat to humans. Wildlife are opportunistic - some may eat chickens or other livestock if readily available and vulnerable. Free-roaming cats and dogs can also find conflict with predators. Protecting our animals is our responsibility. With that in mind, here is some basic information on common native wildlife that may be predators on domestic animals.

Coati or Coatimundi

Coatis are omnivores. They eat a variety of fruits and small animals. The fruits are of many plants such as cacti, manzanita, oak (acorns), juniper cones and cultivated species. They also eat insects, spiders and occasionally reptiles. They are not strong, fast hunters but may occasionally catch rodents. Coatis are out in the daytime. These animals are not an issue for pets or poultry. Coatis live in groups, with each group having a home range of about 8.5 square miles.

Ringtail, Ring-tailed "cat"

Omnivores. A relative of raccoon and coati, they are not a cat. They are nocturnal, and excellent climbers. Their typical habitat is rocky walls of canyons. They den in tree hollows, caves and abandoned burrows. They sometimes use mines, sheds, and attics of homes. They eat small mammals, birds, lizards, insects, fruit and plant materials. Ringtails are not a danger to pets, but they may prey on chickens.

Raccoon

Like their relatives the coatis and ringtails, raccoons are omnivores. Raccoons are never far from water. Their preferred foods are in the water, including aquatic invertebrates and fish. But they also consume beetle grubs, fruit, small vertebrates and carrion. Raccoons have excellent manual dexterity and extremely sensitive sense of touch. Raccoons may reach through chicken wire to grab birds – careful fencing is critical for poultry security. They are nocturnal, so chicken protection at night is critical. A male raccoon may have a 20 square mile range, a female 1-6 square miles. They often live in groups.

Skunks

Omnivores. New Mexico's has four species of skunks: the striped skunk, western spotted skunk, hog-nosed skunk, and hooded skunk (see BRN 4-4). All are opportunists, and eat available insects, rodents, fruit, carrion, and garbage. Skunks may live in burrows made by other animals, caves, or manmade structures. Skunks are primarily nocturnal, but are sometimes active in the day. Skunks may go after both eggs and chickens. Their approach to entering chicken pens is to burrow under the fence. Extending the fencing underground, or surrounding the inside and outside of the pen with rocks is effective.

Coyote

Coyotes are omnivorous. They prey mainly on rodents and rabbits, eating hundreds during a lifetime. They also eat birds, reptiles, amphibians, fish and invertebrates plus a variety of fruits and fleshy Juniper cones. Coyotes are intelligent but are typically timid. They are cautious of humans, but may be defensive when they have young. Proper fencing of domestic animals is critical. Coyote home ranges may cover up to 40 square miles.

Gray Fox

The native fox in our area is the Gray Fox. It is omnivorous. Foxes eat many rodents, including wood rats, mice, and ground squirrels. They also consume cottontails, insects, lizards, and snakes. Fruits they eat include hackberry, cactus, manzanita and Juniper cones. Foxes are primarily nocturnal, but can be encountered in the day. Foxes may prey on small livestock such as rabbits or chickens. They are good climbers, so a complete cover over a chicken pen is needed to exclude them.

Bobcat

Bobcats are carnivores. Bobcats are highly adaptable. Studies have shown that bobcats can have home ranges averaging 10 square miles, but can localize their activity where prey is concentrated. They are secretive hunters, and may be active in day or night. They primarily prey on cottontails, jack rabbits, and rodents, but also snakes, lizards and birds. They may feed on chickens if pens are not fully covered. Bobcats are not a threat to humans.

Mountain Lion or Cougar

Cougars are carnivores. They are generalist predators, and will eat a variety of animals from insects to large ungulates. Their main prey in our area is likely deer, javelina, and elk. They also eat raccoons, squirrels, birds, various small animals, and bighorns where those are available. Cougar attacks on humans are extremely rare. Hiking alone at dawn and dusk, without a large dog, is the time to be most aware. It is best in our country to hike with a partner. Attacks on small livestock are relatively uncommon, but careful containment in secure pens or sheds from evening through morning is recommended. An individual animal's home range can vary in size from 40 to 300 miles.

Birds of Prey

Hawks and owls may prey on free-roaming chickens. All raptors are protected under federal law. You cannot, under any circumstance, intentionally kill one. Raptors can also get into coops that do not have overhead wire netting. Careful penning of chickens is the solution.

Wildlife Protection Laws in New Mexico

Many species listed here are protected. Check online for details of their legal status and more information on their natural history.

As of April 1, 2022 trapping is illegal on New Mexico public lands. If you suspect abuse of these protections call: Alan Edmonds, Program Director, Animal Protection, New Mexico 505-265-2322 Ext. 29, alan@apnm.org. Alan responds quickly, is knowledgeable and helpful.

A Game and Fish call may result in the trapping & killing of the animal. This should be a last resort and used in cases where you suspect the animal is diseased. Even padded traps can severely damage legs. Box traps and relocation may be effective in many cases; however, working with an experienced wildlife biologist is critical for selection of a proper habitat. Some Game and Fish staff will work with you on this approach; some will not.

Other deterrents to consider: Capsicum based granular repellent (such as Havahart's Critter Ridder), noise-making devices such as motion sensor alarms or a motion activated sprinkler. Dog repellent products may work on coyotes and foxes. Guard dogs can be very effective.

Fencing Chickens

If prey animals like chickens are available, predators will come.

Removing the predator is not a viable solution, as the niche will be refilled if prey are present. Proper penning of animals is critical so that predation will not reoccur, creating an inhumane "cycle of killing" of both prey and predator.

Chicken wire keeps poultry in. However, it is not strong enough to keep predators out. Welded wire hardware cloth, poultry wire or electric fencing is necessary to keep chickens safe. Chickens penned from at least evening through morning will minimize predation since most of our predators are out during this time.

And remember, if a chicken can get out a predator can get in.

Key elements of a proper chicken enclosure:

- Install fine-mesh hardware cloth (1/4-1/2") particularly around the base of the pen. This offers more security than chicken wire. Raccoons will reach through chicken wire and grab birds, so it is critical to have the lower parts of the pen fenced with the hardware cloth or other small diameter material.
- A 6 foot high fence is recommended, but enclosures must also have sturdy, well secured wire over the top. House cats, Raccoon, Fox, Bobcat and Cougar can all climb well. Bobcats can jump as much as 4 feet. A cougar more. Hawks can fly in.
- Make sure there are no holes in your hardware cloth or other wire sections. All runs of fencing must be carefully wired together. Most predators will easily push through a hole or weak area.
- Since many predators will dig under, dig a trench and bury wire down at least 2 feet; you can also establish an l-shaped footer (outward) or do a poured concrete footer. Electric fences may be useful, but be cautious to install them correctly.
- Raccoon are very dexterous. Use snap hook or carabiner clips as fasteners to stop them from opening latches and gates.
- If you are doing free-range, do not let chickens roam early or late in the day and pen at night.
- Keeping the chicken coop clean helps diminish drawing in scavengers that may become predators.
- Consider motion sensor lights for a startle effect. Large dogs are an excellent deterrent, but must be trained to live with chickens.

Many different species of wildlife are opportunistic. Poor pen construction and improper animal management create unnecessary problems with predators. Again, if you choose to let your chickens roam, only allow them out in the day. However, this does not assure they will not be preyed upon. If you choose a free-range lifestyle for your chickens, even only in the day, losses must be accepted. Remember, removing a predator will not work in the long run; if there are prey, another predator will return.

Domestic and feral house cats can also kill chickens, particularly chicks. Cats are a common predator of young chickens. Domestic cats, like dogs raised carefully with chickens, can, however, coexist.

Snakes may come to the coop for eggs. However, rodents that come for chicken feed may be drawing the snake more than the eggs. Diminishing places for snakes to hide and keeping areas rodent free will diminish this problem. Watching for snakes in chicken coops is always advisable.

Sources: Mammals of Arizona by Donald F. Hoffmeister, AZ & NM Game and Fish online information on specific species, University of New Mexico, Arizona Sonora Desert Museum, Journal of Mammalogy online, communications with southwest-area biologists, personal experiences of chicken owners.

Bears of Durango

This video describes the efforts made in Durango, Colorado, to find solutions to "bear problems". Informative and a good lesson about the possibilities of coexistence. Visit their website at the link above, or it may be available on PBS when you read this.

The Front and Back Covers

Photographs of Mexican Spotted Owls taken in the Black Range by Steve Metz; see also pages 20 and 21.



The Natural History of the Gila Symposium's mission is to provide a venue for researchers, land managers, conservationists, and educators to meet and share information and ideas gathered from the Gila Region, including watersheds and neighboring areas extending into southwestern New Mexico, southeastern Arizona, and Mexico.

The Tenth Natural History of the Gila Symposium is scheduled for February 29 - March 1, 2024. The Symposium is free for all participants.

Planning for the event is now under way. You can help make this event as successful as the past nine in a number of ways: Make a donation to defray costs; consider making a presentation; and share information about this event with as many of your peers as possible.

Make A Donation

It may be free to attend, but it does cost money to make it a success. Luckily for all of us, doing your part is easy:

- **Submit a check to WNMU Foundation with Natural History of Gila Symposium in the memo to: PO BOX 1158, Silver City, NM 88062;**
- **Go online @ //wnmu.edu/donate; or**
- **Contact WNMU Foundation via phone to make a credit/debit card contribution (575-538-6310)**

Donations made in this manner are targeted for use by the Symposium and the funds will be allocated by the Chair of the Symposium Steering Committee.

If you wish to make a donation for a specific purpose, you may do so simply by making that known when you make your donation.

Funds are needed for several administrative and program initiatives, including:

- **Student Travel Awards, a fundamental part of the Symposium's outreach program, enabling young naturalists to attend;**
- **Advertising, including such efforts as a poster contest and recognition of winners;**
- **Plaques to recognize the efforts of individuals who support the goals stated in the Symposium mission statement;**
- **Printing (name tags, programs, etc.);**
- **Symposium coordinator, technical editing, and website administration;**
- **Daily coffee and snacks at the Symposium and "Meet and Greet" social event;**
- **Defraying the costs of guest keynote speakers;**
- **Space rental; and a variety of other costs.**

Make A Presentation or Participate in the Creative Voice Segment of the Symposium

The Symposium will have multiple tracks with concurrent presentations. Presentations are typically scheduled for 20 minutes with a 10 minute Q & A session. As a result, the Symposium offers a high quality educational experience which is rich in content and diverse in topics. It also means that there are many presentation slots available. The opportunities to meet and greet with the leading practitioners in the fields of natural history abound.

The Creative Voice segment of the Symposium recognizes and supports the collaboration between the arts and science – a collaboration which enhances both.

The program for the 9th Symposium may be viewed at this link.

Hybrid

The 9th Symposium was offered in a hybrid format, successfully integrating virtual and on-site presentations and experiences.

Other events in the Silver City area, such as the Southwest Word Fiesta, have successfully utilized hybrid formats, growing the regional expertise in this type of effort immensely. The hybrid format effectively opens up the Symposium to the world and offers presenters and attendees an excellent forum to share concepts and knowledge.

Keynote Speaker

Know a renowned high quality speaker on natural history whom you can convince to make a presentation as a public service? Know of key topics which should be addressed? The Symposium planners would like to talk with you.

For information contact Dr. William Norris at norrisw@wnmu.edu.

In our next issue, we discuss the coordination between the symposium and the Aldo Leopold centennial celebrations. An extensive suite of experiences is planned.



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