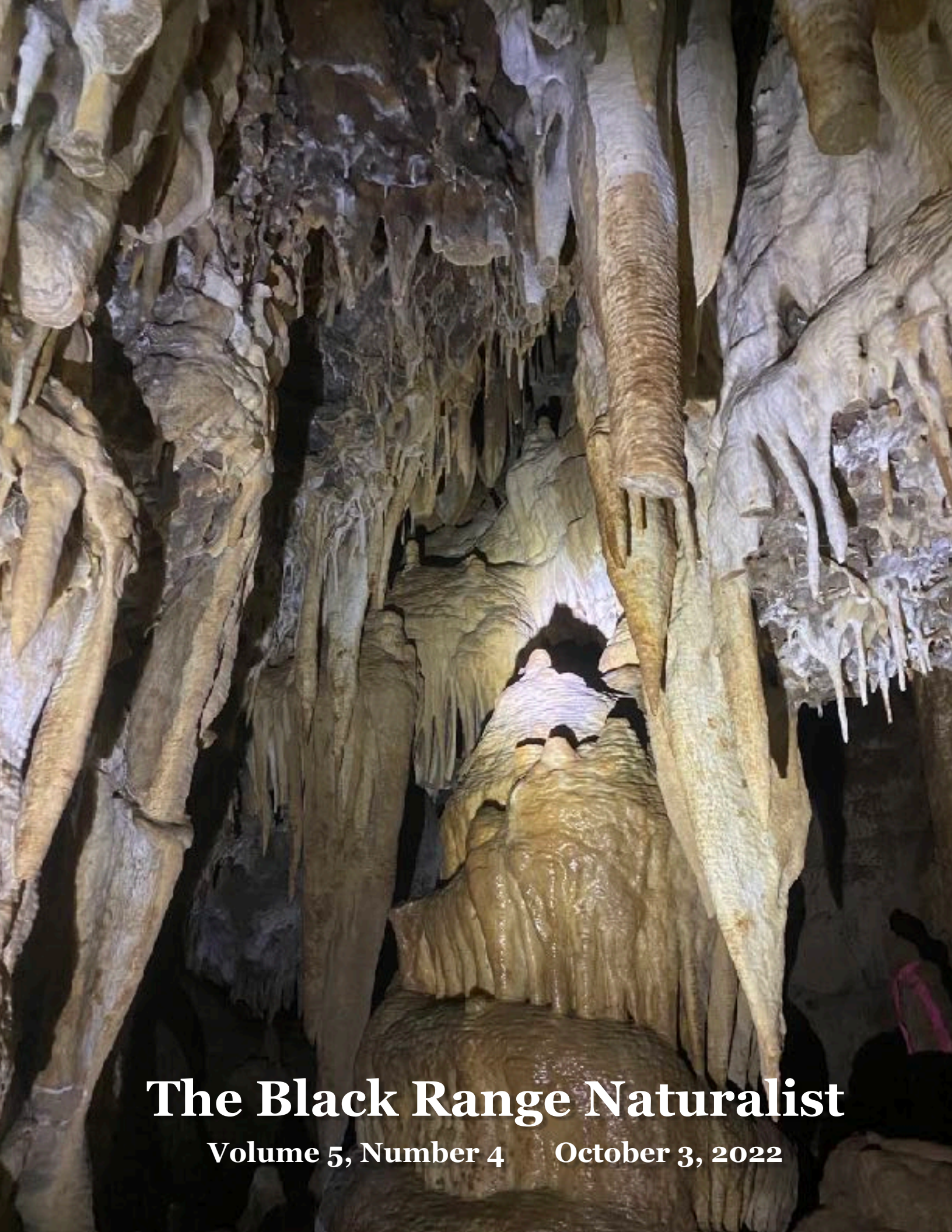

The Black Range Naturalist

Volume 5, Number 4 October 3, 2022

IN THIS ISSUE

Five Years And Counting

When we began the experiment which is the *Black Range Naturalist* we were not sure that it would succeed, by any definition, not sure at all. After all, the concept of a community sharing its knowledge is noble but may not be practical. With this issue we complete the fifth year of publication and look forward to (at least) another five. The success we have had is due to the contributions, advice, and encouragement of many of you. In particular it is appropriate to recognize the following, who have contributed material and information to the magazine:

Abernathy, Michael
Absher, J. R.
Arehart, Betsy
Barnes, Jonathan
Barnes, Michael
Barnes, Robert
Barr, Lloyd
Barrett, Chuck
Batchelder, Gigi
Batchelder, Ned
Berman, Gordon
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Elam, Steve
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Unattributed material is contributed by the editor.

Steve Morgan in Coffee Cave

Visiting Black Range Caves - Coffee Cave

First of all, the disclaimers: caves are inherently dangerous places, things can go wrong in caves, it can be hard to find people in caves, etc., etc. For all of its inherent beauty and interest, the natural world can be dangerous, something like living among humans. Things can go wrong; just be aware of that.

Caves can be worlds of beauty and wonder. Stepping through the entrance of a cave is a transformative experience: "Hey, this is different".

Many people do not use "cave" and the "Black Range" in the same sentence. But as noted in the July 2021 issue of this magazine ("Black Range Surface and Groundwater"), there is a lot of karst topography in the Black Range. Where there is karst topography, there are caves.

Caves can be full of magical stuff, fragile stuff, and great care must be exercised when you visit a cave to preserve that magic; a careless, thoughtless, or sophomoric act can destroy millions of years of creation - in a moment.

Among the services that the U. S. Forest Service provides in the Black Range is a "cave volunteer", Steve Morgan, who can answer inquiries about the caves of the Black Range. Morgan, who lives near many of the caves, in Kingston, has been entranced by the worlds found within the earth for decades. The two photos above prove that. He was not living in the Black Range when the bottom photograph was taken.

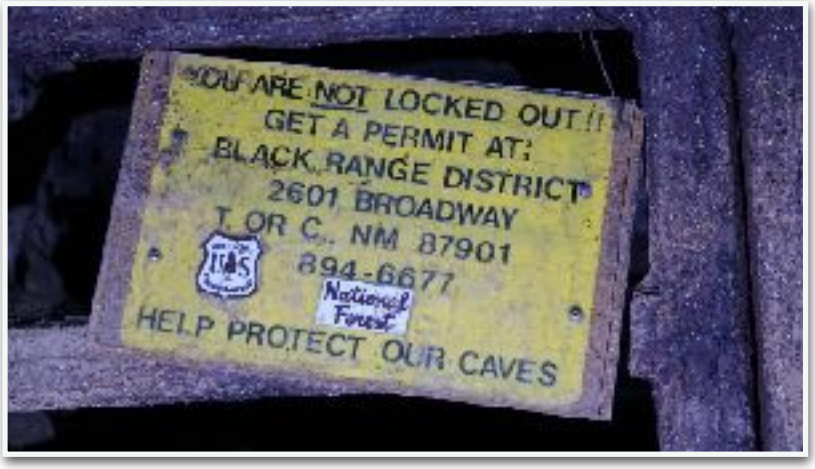
In the top photograph, taken in Coffee Cave in the Black Range, Steve describes how the columns in the cave might have sheared, and when. He can also advise you about some of the kit that is useful when venturing underground (that may be the same hard hat in the two photos), what to expect, physical requirements (caving can be very strenuous at times), and the protocols necessary to protect the cave(s). Steve can be reached at aldoleopold1909@gmail.com (Aldo Leopold Living History, https://aldoleopoldlivinghistory.org/.

Coffee Cave

Except as noted, all of the cave photographs in this issue of *The Black Range Naturalist* were taken in Coffee Cave.

The entrance to Coffee Cave, which is located on the slope north of Mineral Creek, is gated. To gain entrance check with the Black Range Forest Service District Office in Truth or Consequences. There you can pick up a key (subject to scheduling) and complete some simple paperwork. This is the only cave gated by the USDA Forest Service in the Black Range.

This section of the gate can be unlocked. You must climb up the gate, go through the small door, and climb down the other side to gain entrance. A few feet after the gate you enter the first main room (photographs to the right). To gain access to other rooms you must crawl, and the entrance door is a good indicator of whether you will fit in the crawl space or not.

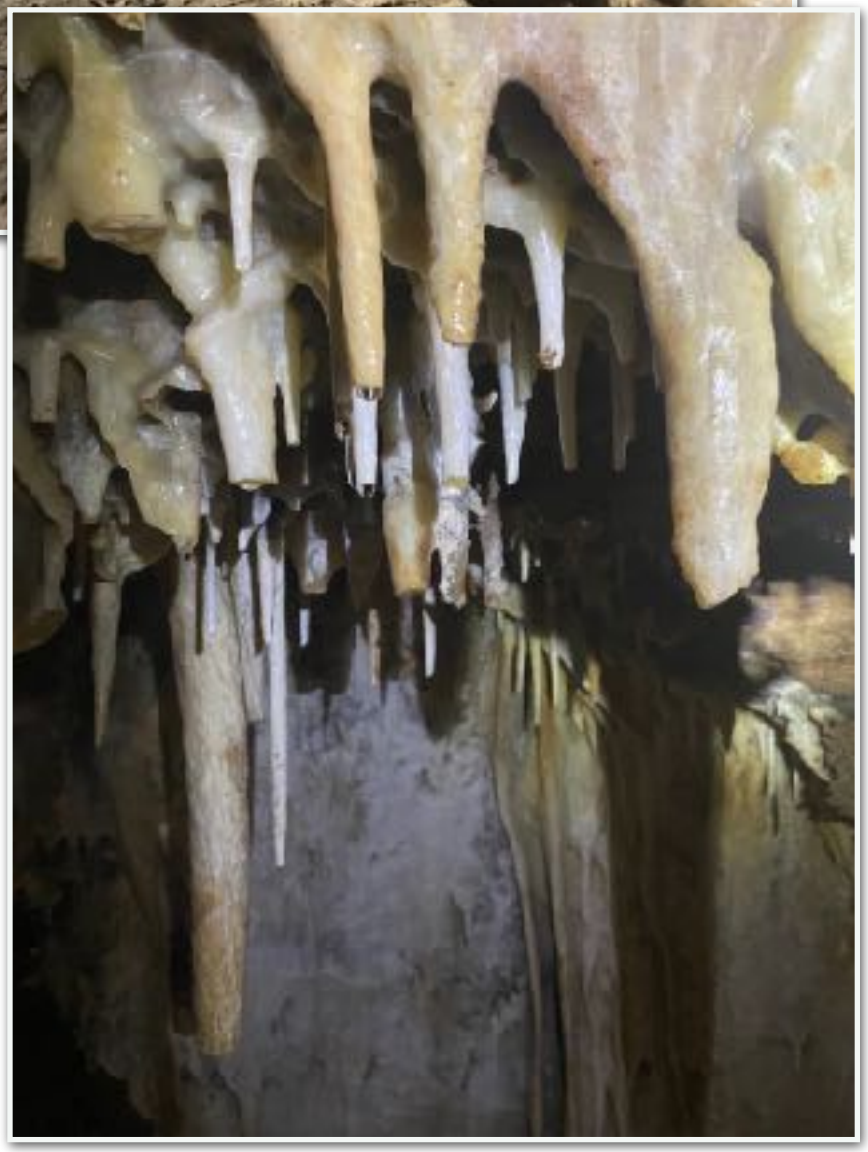


There is a fair amount of breakdown present in the initial part of this cave. Breakdown simply refers to rock which has fallen from the ceiling or the walls of the cave, onto the floor. The rock which becomes breakdown often separates from the rock above (or at the sides) along bedding planes but also along fissure lines if there is significant fracturing. Some of the breakdown is large, much is smaller.

Bats (possibly Arizona Myotis, *Myotis occultus*) have been found roosting in the initial room during March.

A crawl space leads from the initial room to the rest of the cave. The surface of the floor and side walls becomes more muddy as you enter the crawl space. At times there is a pool of water toward the end of the cave.

Gilberto Martinez took the photographs on this and the following two pages on March 15, 2022. Gil was using his cell phone to take the photographs. In case there is anyone who still believes that top of the line camera equipment is required to document natural history and/or make photographic art, this is proof to the contrary.



How Cave Structures Form

Most of the caves in the world are formed within limestone strata, karst formations. The most spectacular caves are found in limestone layers hundreds, even thousands, of feet thick. Most of these caves are solution caves which are formed when the limestone is dissolved by rainwater, which is a weak form of carbonic acid (formed when carbon dioxide dissolves in water). Limestone strata can be fractured, full of joints and/or faults, and are sedimentary in nature, meaning there are bedding planes (it forms in layers). Water percolates down through limestone, along fractures and bedding planes. Cavities are formed as the carbonic acid slowly, very, very slowly, dissolves the limestone. During the dissolution process cavities are often completely full of water. Water being what it is, and cracks in the rock being what they are, the acidic water can seep along cracks, eventually

Visit this National Park Service page on speleothems for more information on this topic.

cases where water drains from the cavities formed by the dissolution process.

Once the water table has dropped below the limestone cavity, the water which has seeped through the rock above is exposed to air as it enters the chamber. At this point, much of the carbon dioxide that was dissolved in the water drops out of solution (degasses), leaving behind a water solution which is rich is calcium bicarbonate (or some other precipitate). Some of the precipitate adheres to the surface as the water drips away, leaving a small film of mineral. This film begins to grow downward as layer on layer of the precipitate is left behind. This is the process in which speleothems are formed. For our (simplified) purposes, there are a few types of speleothems. The ones which form from the roof of the cavity are called stalactites. In the top detail image, the circle to the right highlights a place where water has seeped through the rock at a point. Such situations form the classic stalactite. The circle to the left on that detail image highlights an area where the precipitate is forming along a crack or a seam. There are many variations in "seepage" and precipitation, so many types of formations are possible.

Not all of the precipitate adheres to the roof of the cavity, however. Gravity being what it is, the drop of water which fell from the roof falls directly below the formation on the roof and deposits some of the precipitate that was left in the water. Layer on layer of this precipitate builds upward forming the structures which are highlighted in the detail image at the bottom left. This type of speleothem is called a stalagmite. When a stalagmite and a stalactite merge they form a column.

The image at the middle of this page is full of structure. From the roof of Coffee Cave, small stalactites (both of the point type and the shield type) are forming. At the bottom, center right, a stalagmite has formed. In the past the two large features on either side of the image formed substantial columns. At some point, something happened to shear the column apart, probably a collapse of the floor since this shear pattern is not common in the cave. One image, a lot of geology. There are many other features formed in this way.

forming long passageways or even underground rivers, large chambers which contain a lot of water, or . . . let your imagination go. If you can imagine it, it probably happened, somewhere.

The water table varies over time, and rock structures, relative to the water table, are not as stable as our human-life-span-limited concept of time would lead us to believe. Whether it is a lowering water table or rock rising above the water table, there are many

Bats and White-nose Syndrome

A plague has erupted across North America and is thought to have made it to New Mexico. White-nose Syndrome is caused by a fungus, *Pseudogymnoascus destructans*. It first came to light in New York state in 2006 and has since been found in many parts of the world. Cases in North America apparently are more severe than in other locales. At some locations, all of the bats present in a cave have died.

Since this is a fungal infection it is relatively easy to spread. It can be spread by the bats themselves, by spelunkers who have previously been in "infected" caves, or other unknown means. Fungal spores are very resilient. The image at the lower left is an infected Little Brown Bat. (Photo by Marvin Moriarty, USFWS, location unknown.)

How physical do you have to be?

Another way of sorting caves is by reference to the human-cave interface. Is the cave commercial in nature or is it a "wild cave"? Generally speaking, commercial caves do not require you to get down on your hands and knees and crawl around. They often have paved walks and subdued lighting. In almost all cases, a fair amount of disruption has occurred in the cave to make it "commercial". Sometimes that disruption is hard to fathom. In the early part of the 1900s there was a plan to blow out a portion of the Big Room at Carlsbad Caverns so a road could be built through the caverns; yes, the Carlsbad Caverns Auto Loop. Some commercial caves offer "wild tours" which require you to don a hard hat and knee pads and crawl around (over a well established route).

Wild caves can be rather gentle to very strenuous. The navigation of such caves may require crawling, sliding on your back or stomach, bumping your head, route finding.... As noted previously, all of the photographs (except for the bat photograph at the lower left on page 9) in this article are from Coffee Cave and they provide a general idea of the exertion which is required.

Caves can be dangerous. Rock fall is possible, for instance - although it is more likely that your head will "fall" to the rock above; thus a hard hat is not a fashion item. Coffee Cave is not a cave in which you are likely to get lost, but worst case - without a light - you have a problem.

Although the beginning of Coffee Cave feels like a dry cave, the deeper you go the more mud you encounter, even some water.

Either know what you are doing or go with someone who does!

Other Caves

Our original intent was to include material from Robinson's Cave in this issue as well. But life happens, in this case in the form of the Black Fire and the area closures.

Robinson's Cave is located in the same stratum or strata as Coffee Cave and is found in the North Percha drainage less than a mile to the northeast.

In some sources Robinson's Cave is called North Percha Cave, in others Robert's Cave or Robertson's Cave. There are reports that javelina are using the cave to get out of the heat. If that is the case, meeting some in a narrow passage when you are between them and the entrance would not be a good experience - for you or the peccaries.

The human use of Robinson's Cave is problematic, with graffiti and "cave art" being sculptured in place.

Various sources have references to the following caves in the Black Range: Mad Hornet Cave, Cactus Cave, and Cold Spring. References to Cactus Cave may be to Coffee Cave.

Visiting Caves

There are a lot of turkeys in the world, and I don't mean Wild Turkeys. I mean human turkeys.

There are continuing reports of the poaching of Alligator Juniper in the national forest. Gun toting turkeys looking for slabs to make coffee tables. Unfortunately, people of this ilk destroy our natural and cultural heritage on a regular basis; they chop glyphs, they steal plants, they leave their names on cave walls.

There is another issue which is related to too many people in the world. That is the issue of use. Many parts of the natural world can sustain continued and regular use, others can not. Caves fall within the can not category. I hope that you are able to visit these caves and ponder their magnificence. Once. Each time you go through a cave you cause damage. That happens if you are a novice or a member of a spelunker group. It creates a dilemma for all.

Sitting in a cave like Coffee Cave, recognizing the timescales involved in forming the cave and its formations, the chemistry, drip by drip, for eons, can be overwhelming if you are willing to embrace the opportunity. And, being overwhelmed is a good thing. It helps define us.

Horned Lizard Update

Volume 2, Number 1 (January 2019) of this magazine included Randall Gray's "Horned Lizards of the Black Range". In his article, Gray described the range and natural history of horned lizards and noted that in our area we have three species: Texas Horned Lizard, Roundtail Horned Lizard, and Short-horned Lizard. Good reference material is also cited in his article.

On July 13, 2022, Kathleen Blair and Jan Richmond reported seeing all three species on a hilltop on the western edge of Hillsboro. A mini bio-blitz.

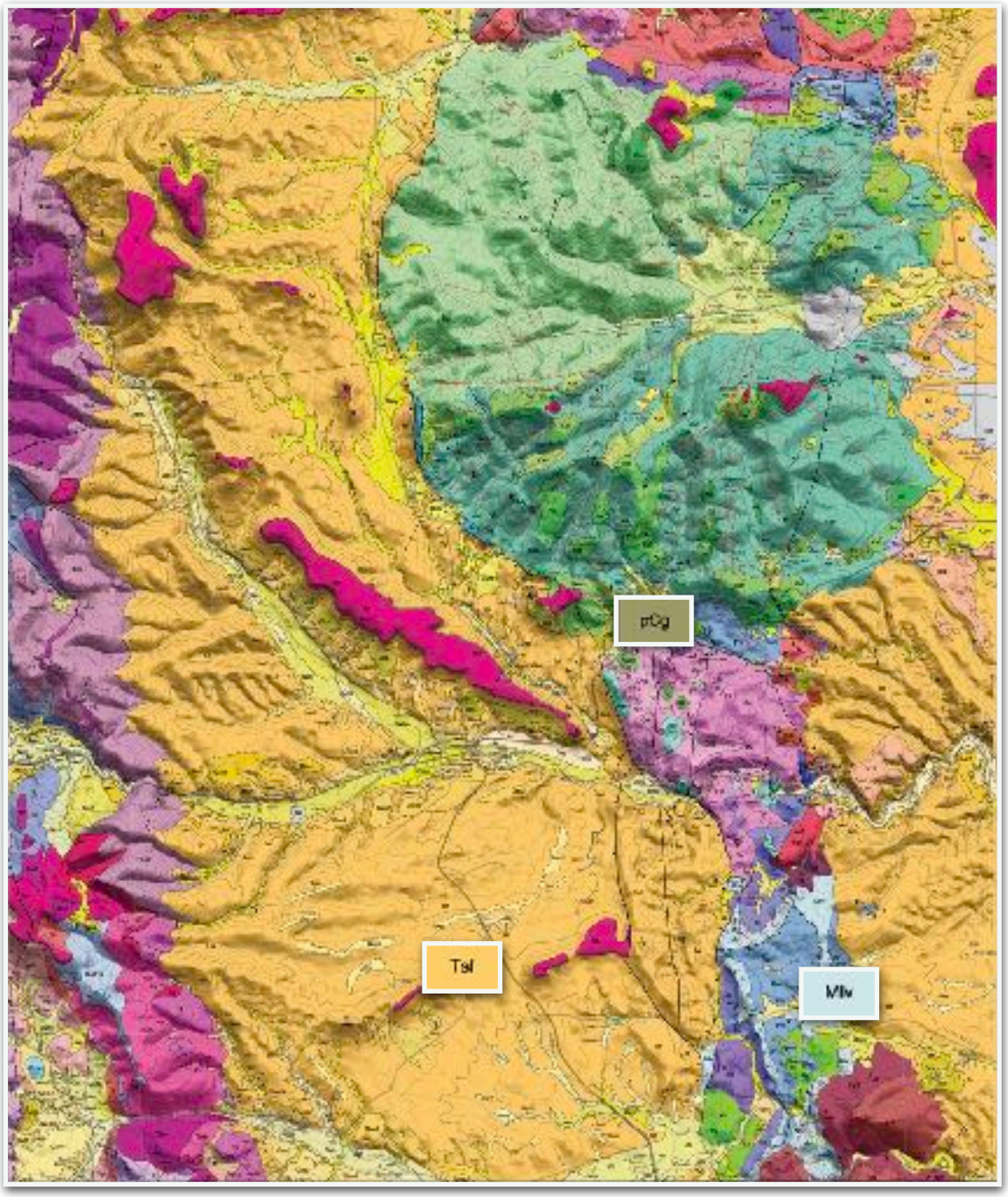
A Percha Creek Timeline

From the Work of Harley Shaw and Judy Majoras

The geologic forces and the timescales involved in forming Coffee Cave (and all the others) is not knowable to humans. Not knowable in the gut. We can all spout the numbers, but our basic frame of reference is the human life span, and that is an incredibly poor instrument to assess many of the natural forces and timescales. Nonetheless, let us give it a try, starting with an overview of our geology.

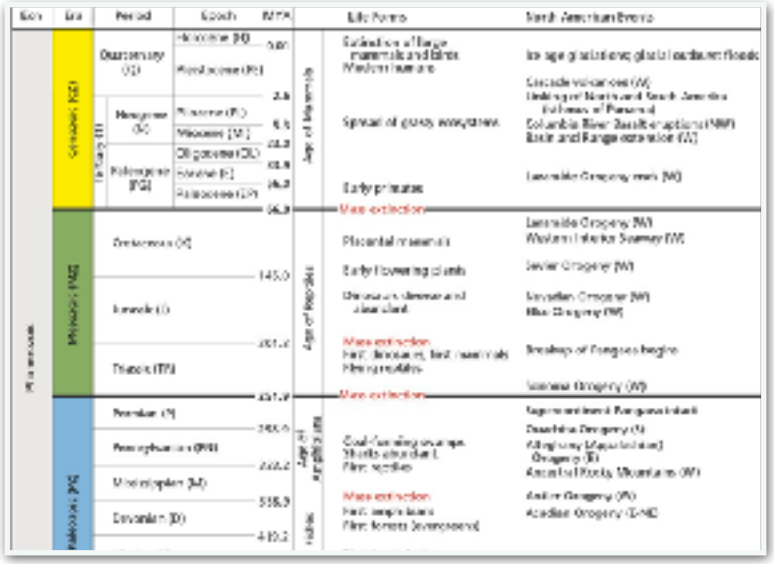
One of the sources for the following material is an article first published in *Guajalotes, Zopilotes, y Paisanos*, Vol. 8, Number 4 by Shaw & Majoras. It has been reformatted and modified.

MYA/Ma/Myr - In astronomy Myr is generally understood to mean "million years". This is the same usage as Ma in geology (referring to elapsed time: as in 40 Ma is a period of 40 million years). MYA, in geology, is generally considered to mean "million years ago", a specific point in time. So 300 - 100 MYA means a period which started 300 million years ago and ended 100 million years ago (a duration of 200 Ma). But arguments about usage exist.



Geologic Map of the Hillsboro 7.5-Minute Quadrangle
Report supporting the above map

Between 300 and 100 million years ago this area was alternatively covered by tropical forests and shallow seas. Sedimentary deposits. Much of the early rock showing in our region is sandstones deposited between 300 and 100 million years ago, when the area that we now call southwestern New Mexico alternated between being covered by tropical forests or shallow seas. At that time, the landscape lay within a large continent which straddled the equator. A narrow belt of sandstones deposited during this period can still be seen near the present Gila National Forest boundary (not shown on the map on the previous page).



Graphic from National Park Service.

100 MYA | 80 MYA | 60 MYA | 40 MYA | 20 MYA | 2.5 MYA | Now

Between about 80 and 40 million years ago, collision of the continent that became North America with the tectonic plate to the west (the Farallon Plate) compressed the landscape and pushed up mountains made up of the earlier sedimentary deposits. Mountains collapse due to weakness of continental crust.

In our area, the compressional force changed and became extensive about 17 million years ago. Weakening of the crust and hot magma fractured the mountains into blocks which tilted and collapsed, leaving the rugged Basin and Range mountains that exist in the western United States today.

The Rio Grande Rift began forming between 35 and 29 million years ago as the colliding continents slowly rebounded and pulled the North American plate apart. We now know this rift as the Rio Grande Valley, a place that the first humans visiting North America found attractive when they arrived over 12,000 years ago.

Plate slippage shifted to north-south direction. Friction between plates creates massive volcanic action. Further collapse and fragmentation of mountains and crust creating complex mixed age jumble of rocks. Subduction of the plates under the continent from 60 to 20 million years ago caused major volcanic activity. Plate movement shifted from E-W toward a N-S orientation between the continent and the Pacific Plate, creating the San Andreas Fault.

Small eruptions that continued until about 2.5 million years ago created the numerous lava flows that cap the buttes and mesas throughout the region, including the one across the mesa top north of Hillsboro. During this time, soils and rocks washing from the slopes of the caldera that was to become the Black Range left deep deposits that form the many outwash plains that we pass through between Hillsboro and Interstate 25. Faulting, fragmentation, and erosion formed the deep canyons, such as Percha and Animas Creeks, that interrupt these plains.

Spreading accentuated volcanism, forming the Mogollon-Datil volcanic field. Roughly 35 million years ago, a giant mountain was pushed up by these volcanic forces at the southeastern edge of this volcanic field. This mountain grew and collapsed inwardly, apparently more than once, forming what geologists call the Emory Caldera. We now call its rugged central remains the Black Range.

pCg — The oldest rock near Hillsboro is mesoproterozoic granite from the Precambrian. This and a similar outcrop near Kingston date from 1.6 BYA

Mlv — Limestone formations, like Lake Valley Limestone, are found in the area. The maximum thickness is about 240'. These limestones date from 358 to 298 MYA.

Tsf — The Santa Fe group (a conglomerate with a maximum thickness of 669') is the most common surface stratum around Hillsboro, dating from ca 20 MYA to 4 MYA.

Please review the October 2019 issue of this magazine for more information about the geology of this area. The Geology Page on the Black Range website has links to many resources on the geology of the area.

As noted on the preceding pages, there has been a lot of "geology" going on in this area over the past hundreds of millions of years. All of that stress was bound to create some fracture in the limestone in which Coffee Cave formed. It is Pennsylvanian (358 MYA to 289 MYA) of the Magdalena group, which, in total, is roughly 600' thick. (See - Bulletin 33, *Geologic Section of the Black Range at Kingston, New Mexico*, by Frederick Kuellmer, 1954.)

A Bigger Picture

It is very difficult to grasp the time scales involved in the making of even small caves, like Coffee Cave. The timeline on the previous page helps a bit. But wiggle your head around and zoom out. The timeline starts at about 300 MYA and gets earnest at about 100 MYA.

Pangea was beginning to form about 300 MYA, – yes, the super-continent – and began to break up at about 200 MYA. While the strata in which Coffee Cave formed were being deposited, super-continents were on the move. Forgot what Pangea looked like? Nick Routley mapped the continent with the boundaries of modern nation states superimposed (see below). Since current boundaries are used, the overall depiction is "rough".

Fire History of the Black Range - Update

Larry Cosper's detailed account of the fire history of the Black Range appeared In the January 2019 issue of this magazine. In that article, he described the fire history of the Black Range from 1987 to 2016. The map on the following page was part of the article. He also included a firsthand account of the 1951 McKnight Fire (48,052 acres), as viewed from Hillsboro.

Since he wrote his article, we have had two fires (Elk Creek and Johnson) in the Black Range which met the reporting requirements outlined in the article, as well as, several smaller ones. At times, some of the trails in the Black Range have been closed because of fire.

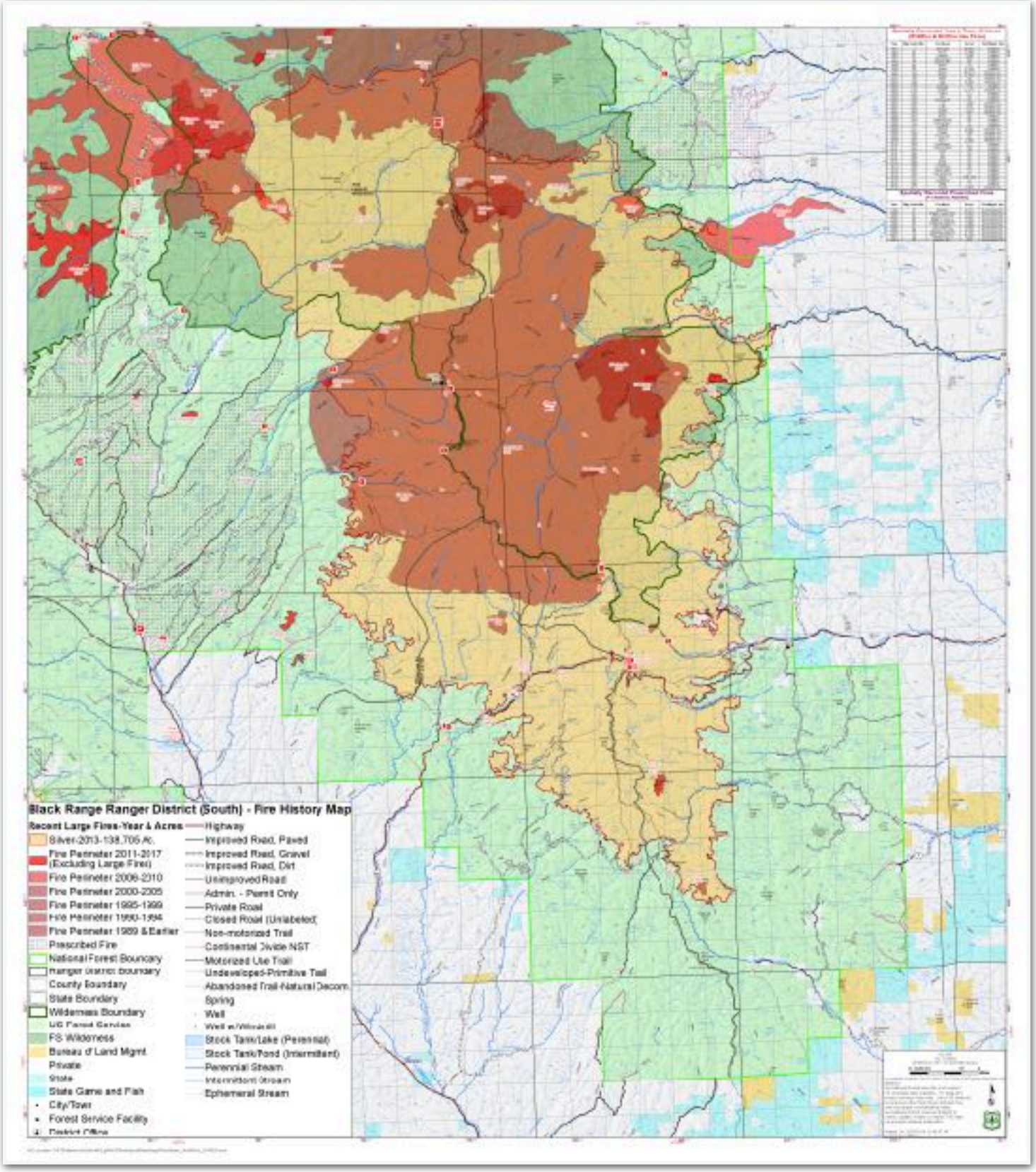
On May 13, 2022, a human started a fire in/near Black Canyon on the west side of the Black Range. This fire became known as the Black Fire, and it burned 325,000+ acres (132,000+ hectares, 1315+ square kilometers, or 508 square miles) before it was extinguished by the rains. The Black Fire is notable because of the nearly complete lack of rain in the preceding months, single digit humidity, high winds, and ample fuel. The well oiled machine which is U. S. Forest Service firefighting took on the fire in terrible conditions and some of the worst terrain imaginable from a fire fighting perspective. Luckily no fire fighters were killed in the effort.

It is not known who started the fire. We do not know if it was a rancher burning to create more grass, a camper, a hunter, a cigarette smoker, or someone with a hot catalytic converter parking over dry grass. We do know that it was a human and that this fire did not have to happen.

On June 4 the Black Fire "*produced a large smoke plume due to heavy fuels burning in the Board Gate Saddle area in the McKnight Canyon" (USFS, Black Fire Daily Update June 5, 2022).* The area of "heavy fuels" was approximately 15 miles from Hillsboro at this time. Aspen leaves (upper right photo) and ash fell from the sky in Hillsboro as part of that event. When heavy upwelling occurs debris can float for miles on the wind, and spot fires often occur when it lands in extremely dry environments. Harley Shaw's photo of aspen leaves is a bit unsettling, especially when paired with the middle photo which he took, showing how far away the fire was at the time.

Photographs directly above and below by Harley Shaw.

This fire is the second mega fire in the Black Range in less than a decade. (See The Silver Fire - As We Lived It for a record of the first.) Smoke from the Black Fire was dramatic from the front porch of a house in Hillsboro (bottom photo).



In such times, people want the latest information available about fires, and the interagency InciWeb site does a good job of providing daily updates. Over the years additional resources have become available, such as real-time (satellite feed) heat maps from sites like ZoomEarth (caution: ads). Two examples of maps available at this site are shown on the following page. This site is based on Google Earth overlays (in this case heat signature), so it is "zoomable", enabling a viewer to see significant levels of detail.

One of the more telling graphics produced by the Forest Service is a map which depicts how the fire spread over time. Some days the increase in the area burned was incredible. For example,

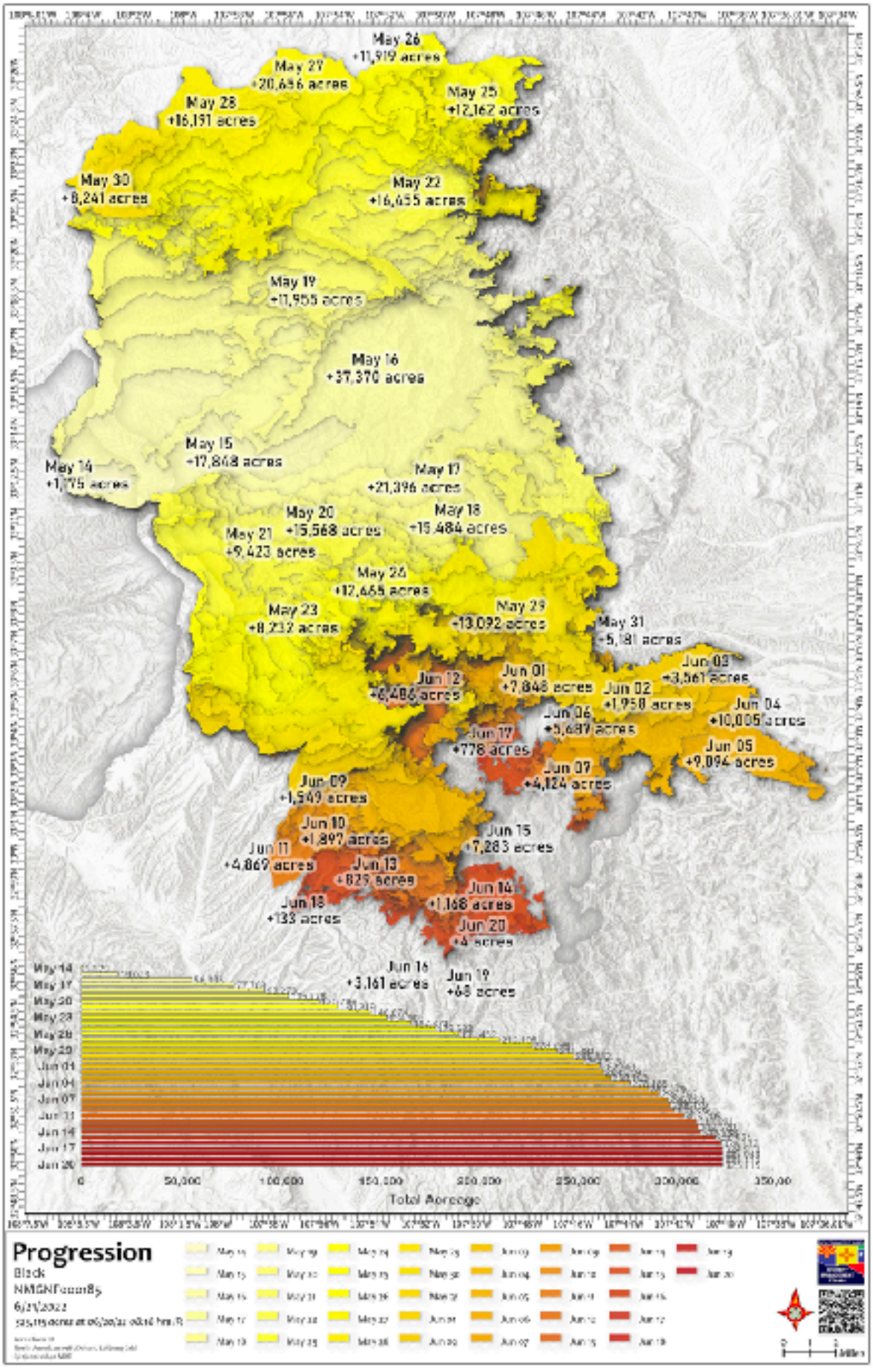
the fire spread by more than 37,370 acres on May 16. On June 4, the day when aspen leaves fell in Hillsboro, the fire spread by more than 10,000 acres. This was a big fire.

The fire progression map on the following page shows the significant variability in the daily progress of the fire. In the end the Black Fire burned over 325,000 acres - the second largest wildfire in recorded New Mexico history.

The fire initially spread west to east (with the winds) from Black Canyon and then north and south. The fire was fought from the boundaries because the Black Range terrain is very rugged, read "dangerous for fire fighters".

In the second half of June 2022 the rains came.

The Super Scooper (which can collect 1500 gallons of water at a time) pictured below, and the night medivac helicopter were both available for use by the fire crews. Photographs from the USDA Forest Service.



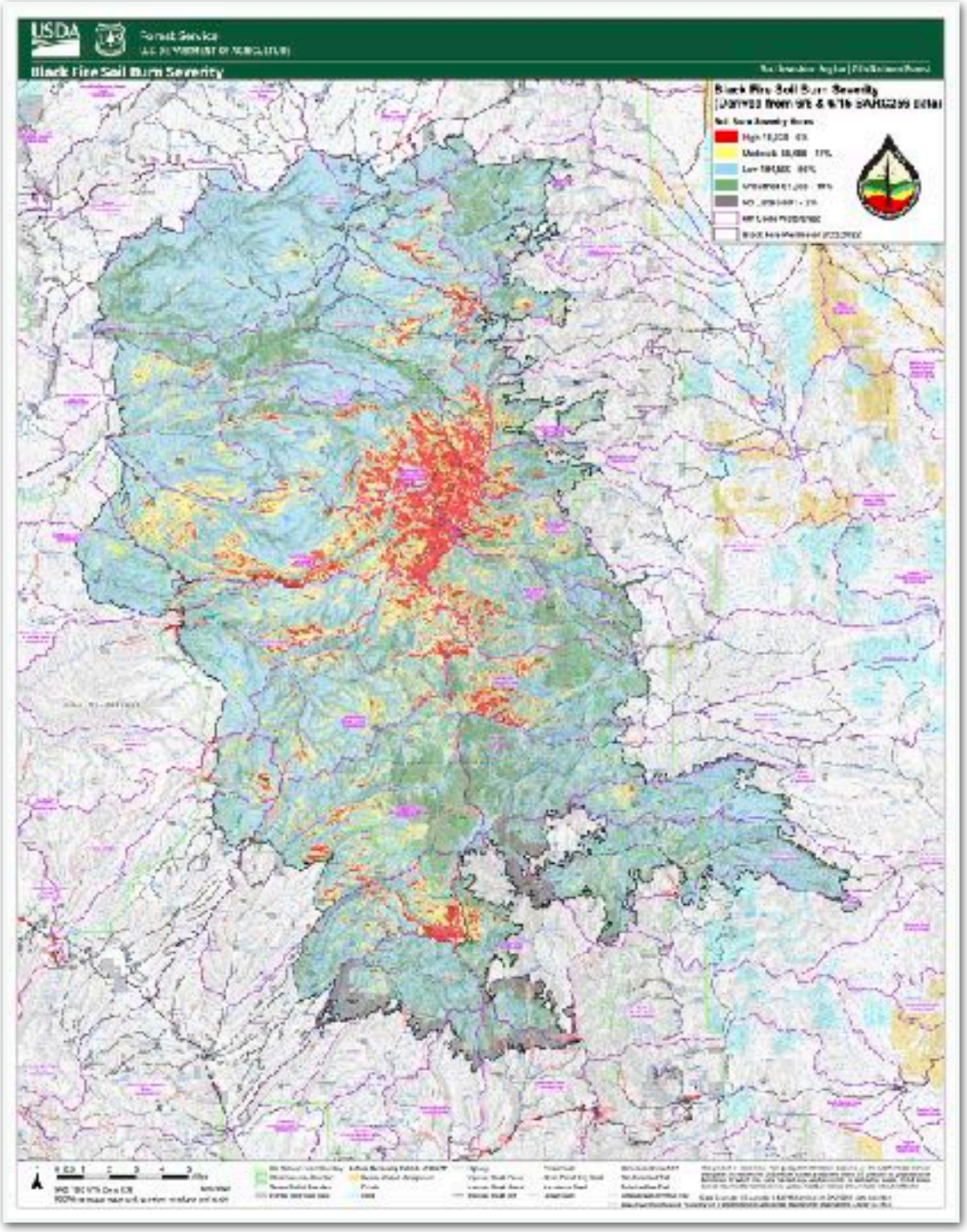
The third day of the Black Fire, May 16, 2022 (USFS Photo)

The USFS "Black Fire Soil Burn Severity" map shown on the following page is available as a full-sized .pdf at the link above. As we venture back into the forest to conduct our fire assessment (one of many which will be happening - and hardly the most technical or sophisticated) this map will be used regularly.

Roughly 75% of the acreage within the Black Fire perimeter has soils which were unburned (61,388 acres or 19%) or where the amount of burn severity was low or very low (184,590 acres or 56%).

The USFS defines areas of low soil severity burn as:

> ***"LOW severity areas generally have intact and recognizable litter layers (organic material on the forest floor, such as pine needles and twigs). These litter layers may be charred,***



but are not consumed. Underlying topsoil is intact and near-surface fine roots are unburned. These soils have enough cover to protect them from erosion during rain events because their natural porosity and structure allow rain to soak into the soil instead of running off, while fine roots provide stability. In low severity areas, burns may have been patchy–islands of green vegetation and intact canopies may be present."

The USFS defines areas of high soil severity burn as:

"HIGH severity areas generally have had all their pre-fire surface litter layers consumed by fire. White or gray ash may be present on the soil surface. Fine roots are often fully burned/consumed within several inches of the soil surface, and even large tree roots may have burned deep into the soil. Soil may be powdery or grainy and loose, unable to bind together and retain water. These soils are very susceptible to erosion and often have high surface run-off during rainstorms."

These are the red areas on the map. Six percent (18,938 acres) of the acreage within the fire perimeter experienced a high soil burn severity.

At the micro scale, areas which have experienced low severity soil burns may have experienced significantly more severe fire burns. Although the same is true of high severity burn areas (some micro sites may have been burned less severely), it is less likely.

Black ash runoff at Hermosa, above, and in the lower reaches of Diamond Creek below (USFS photographs).

Black Range Clouds (Lenticular and Mammatus)

Sometimes we see things we would rather not, like the smoke beneath the large lenticular cloud pictured below, in a photograph of the Black Fire, by the US Forest Service. Unfortunately, visitors from Armageddon, like this cloud, are not associated with precipitation. Clouds like this form when strong winds blow perpendicularly across mountains. As the wind approaches the windward side of a mountain, the air current is forced up. Ater it crosses the mountain, gravity pulls it down. This forms a standing wave in the air current. Lenticular clouds form when the wave is created. Rare in itself, it is rarer when these waves cause condensation to occur. (Note that air currents exist in the air even when clouds are not present.)

Lenticular clouds are often associated with strong gusty winds in small areas, while nearby areas are unaffected. Bad news for fire fighters. Since this type of cloud is an indication of strong turbulence, aircraft tend to steer clear of areas where such cloud formations are visible. These waves appear to be fairly stationary. The cloud forms as the air current approaches the crest of the standing wave and dissipates as the current falls away from the crest. The cloud is constantly forming on the side nearest the mountain and dissipating on the side farthest from the mountain. Although apparently stationary, the phenomenon is full of strong winds and significant turbulence.

There are three types of lenticular cloud, named for their altitude above the surface: stratocumulus standing lenticular (SCSL) clouds found at lower levels, altocumulus standing lenticular (ACSL) clouds found at mid-level, and cirrocumulus standing lenticular (CCSL) found at higher levels.

Want to know a bit about "classifying" clouds so you can put them in a box and give them a name? Visit What's That Cloud? Your Guide to Cloudspotting by Jusine E. Hausheer.

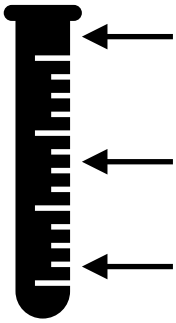
In our last issue we introduced our cloud series with a photograph of mammatus clouds taken in Hillsboro. On the next page, Véronique De Jaegher of Kingston shares more photographs of this cloud type.

If you have taken photographs of interesting cloud types in the Black Range, and would like to share them, please email the image (the highest resolution possible) to the editor at rabarnes@blackrange.org. Include any information you have about the cloud type. It will be very helpful and undoubtedly of interest to many.

Photographs by Véronique De Jaegher

Ice

Photographs by Véronique De Jaegher



212°F / 100°C / 373°K - The temperature at which distilled water generally boils at sea level, but evaporation is different.

32°F / 0°C / 273°K - The temperature at which distilled water generally freezes at sea level.

-40°F / -40°C / 233°K - The temperature that water has been found in high altitude clouds, it has also been found at -55°F in the lab.

Here in the Black Range we have ice, fresh water ice. It is not a simple fact; ice is not simple, what we know about ice grows by the year, and it always seems to get a bit more weird with each new discovery. There is much more to ice than can be discussed here. So we will not discuss the differences between ice formed from salt water and ice formed from fresh water, for instance.

Water, as we all learned in kindergarten, has a chemical formula of H_2O. It is a compound. Just a couple of elements stuck together. Well, sort of. That simple compound is prone to dissolving other things and either forming new compounds or holding the dissolved material in solution. In both situations, the ice which forms when the body of water is frozen is affected by the presence of the other material(s), either in solution or as a compound. Ice formation also changes with the physical circumstances under which it is formed, including (but not limited to) factors like elevation, wind direction, wind speed, and material in the air. There are lots of variations in ice. Even "water freezes at 32° F, 0°C, and 273.15°K" isn't quite, or always, right. Liquid water has been found in the natural world at -40°F. The more pure the water (the more it is simply H_2O), the lower its freezing temperature is. For example, seawater typically freezes at about 28°F. Sea ice does not contain salt.

Ice crystals take on many forms because of the factors discussed above. Although hard to come by in June, ice crystals can often be found in the Black Range during January. Here we discuss some of those crystals you may see on a chilling morn.

William Bentley, who lived in Jericho, Vermont, at the end of the 1800s and beginning of the 1900s, had ample opportunity to study ice crystals. Between 1885 and 1931 he photographed over 5,000 snowflakes and in the process both revolutionized and enhanced our understanding of ice crystals, a good bit of non-institutional science. For those with a particular interest in Bentley's efforts, his article in the February 1922 issue of *Popular*

Snowflake image by William Bentley from about 1910.

***Mechanics* (Vol. 37, No. 2) entitled "Photographing Snowflakes" is interesting in terms of technique and history.**

We can't hope to replicate Bentley's efforts here in the Black Range - we have so much less to work with - but there are those among us who seek out the beauty of the winter crystals. Véronique De Jaegher's photographs of ice crystals at her home in Kingston and along the middle Percha are often intriguing and always beautiful. Unless otherwise attributed, all photographs in this article are by her.

Habit is the term used to describe the typical shapes of crystals. In the case of snowflakes, there are four basic habits: needle, column, hexagonal plate, and dendrite. In general, these are fractal objects and our perception of their beauty may be driven by our love of fractal formations.

The shape of an ice crystal is governed by the atomic structure of water. The layers added onto the basic structure of the atoms can attach only in a particular manner. Despite this limitation, the variability which can occur is immense. Note the basic structure of the snowflake on the previous page and the bit of structure in a sheet of ice in the photograph above. Not a snowflake captured by the ice but rather a crystal which has grown there, just as the snowflake grew as it fell through the atmosphere.

What we think of as the "snowflake shape" is a crystal formation which is ephemeral in duration, but these same shapes can manifest themselves as ice crystals (see next page) which are much more durable.

Although the shape of ice crystals is based on chemical processes occurring in physical environments, the shape of individual crystals may not fit into a particular "type" very well. The formation of an ice crystal is dynamic and it takes some time, so the crystal does not form in a static environment. Generally, however, the shape can be traced back to the original hexagonal prism on which it is based. This six-faceted shape is the snowflake "type".

Temperature, humidity, and particulates are the drivers of shape. If you wish to delve into the dynamics described in *Fundamentals of Physics and Chemistry of the Atmospheres*, Guido Visconti, Springer publications, 2016, ISBN 978-3-319-29447-6, don't let its 816 pages fool you into thinking that it covers everything. Remember this stuff is complex. At page 276, Visconti discusses the "Formation and Growth of Ice Crystals".

Icicles

Icicles form in a narrow temperature range and in particular locations (a place where they can hang freely). For an icicle to form, water must be present and flowing (usually very slowly) downward. The water may come from a variety of sources, including snow or ice being melted by the heat from sunlight or the heat radiating from the surface of a building or rock. As the water flows

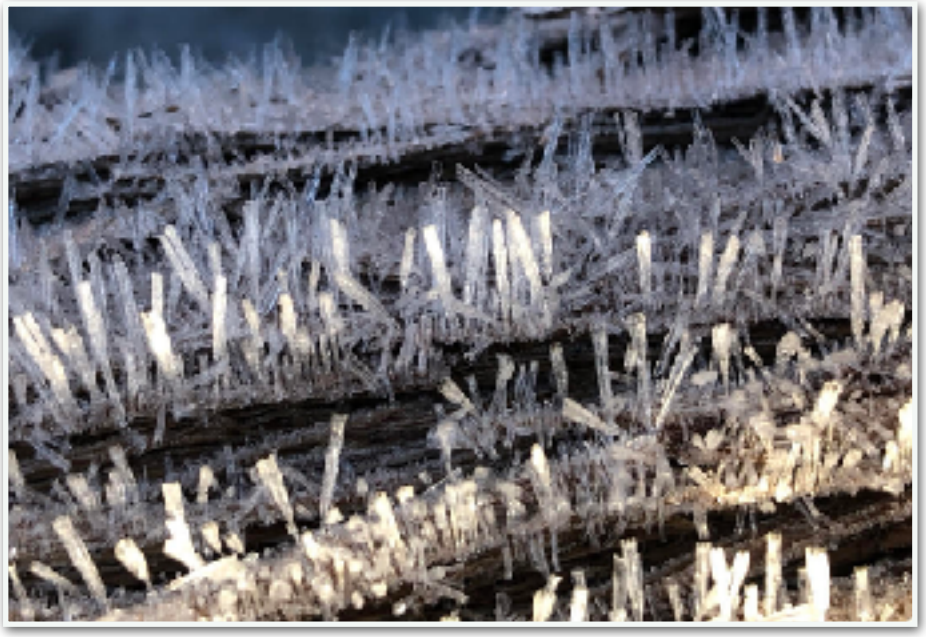
downward it cools because of the difference in temperature of the surface it is flowing over and the temperature of the air. The temperature range is very narrow; you must have water and freezing must be possible. In any case, icicles are another iconic form of ice crystal.

In optimum conditions, icicles can lengthen by more than a third of an inch every minute, but the process is generally much slower. If you break an icicle and look at the cross section, you will often be able to see a tube inside the structure. Water flows down the tube when icicles are growing in length. The outside shape of an icicle may be influenced by impurities in the water, wind, direction of water flow, etc. As a result, icicles can take many forms. (See "A Model of Icicle Growth", Lasse Makkonen, *Journal of Glaciology*, Volume 34, Issue 116, Cambridge University Press, 2017.)

Ice and water are different states of the same material. This difference in state (structure) causes ice to absorb light at lower (energy) wavelengths. That is why ice crystals will often look blue, redder tones not being absorbed as readily.

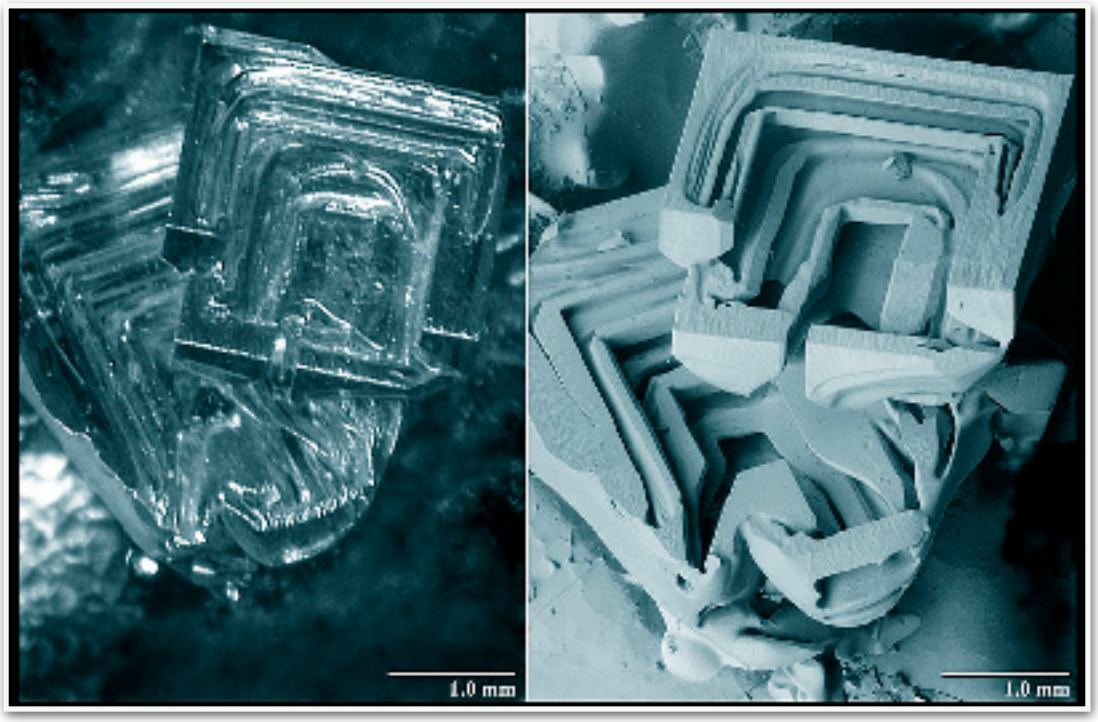
Feather ice crystals form at low temperatures (-22°F/-30C). This is a type of hoarfrost (radiation frost) which forms on the windward side of structures. Hoarfrost ice crystals form directly on objects which are exposed to open air. In this case, water vapor comes into contact with an object which has a temperature below freezing. When this happens the water vapor freezes immediately. As the crystals grow, due to the addition of more water, they form structures like that shown above. The shape of this type of feature is strongly influenced by the speed, direction, and variability of wind. Structurally they are composed of many columnar ice crystals which attach to form the matrix we see.

Columnar ice crystals: There are three types of rime ice, which form when the temperature of atmospheric vapor drops below freezing (this occurs when there is nothing for an ice crystal to form on - no "seed crystal" or nucleus) and the vapor comes into contact with a surface and freezes quickly. The crystals dissolve when the temperature rises just a bit, as when the sun rises.

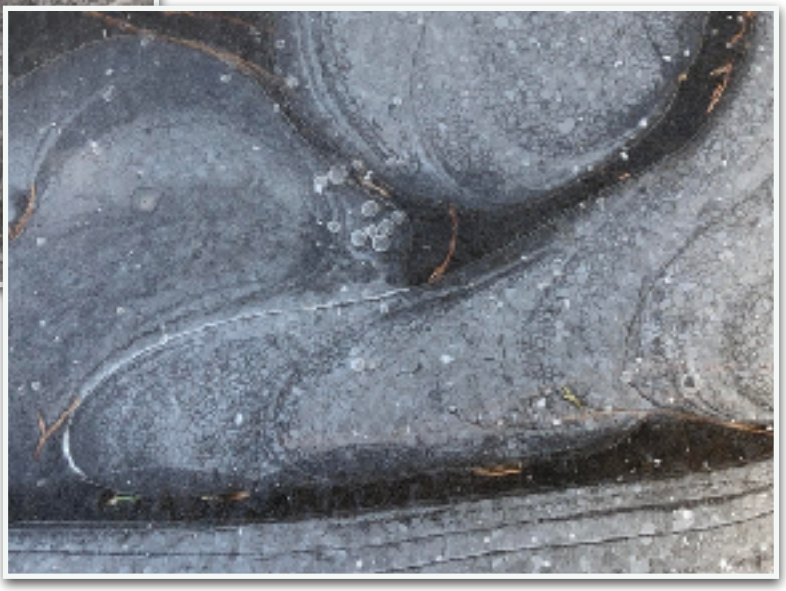


Possibly Depth Hoar: The crystals formed in this structure bond poorly to each other. In large snow packs this type of crystal structure causes snow to be prone to avalanching.

The images below, from the U. S. D. A. Beltsville Agricultural Research Center Electron and Confocal Microscopy Unit, show the structure of some depth hoar crystals as an optical image (left) and from a low temperature scanning electron microscope (right).

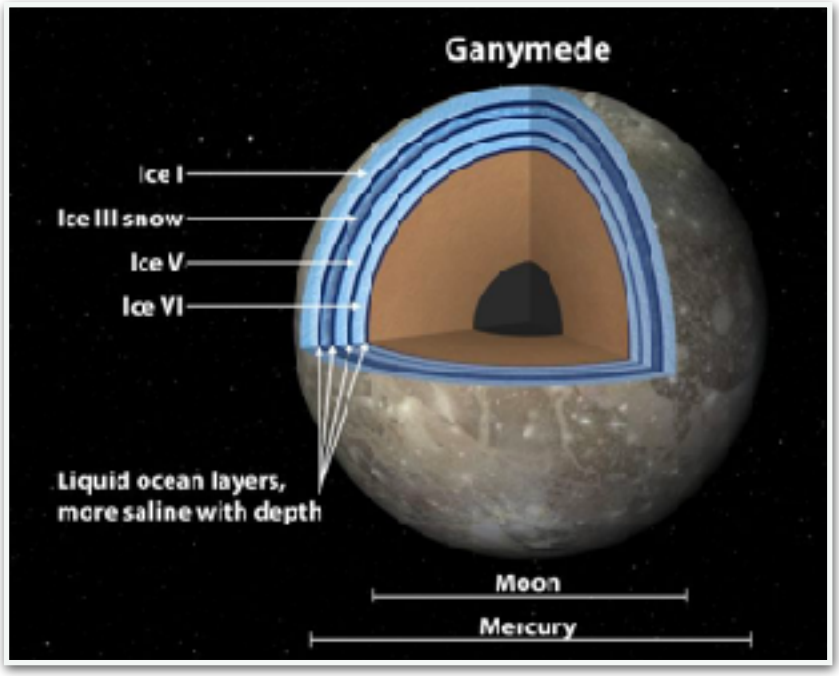


insight into the form and motion of water. Fracturing of the ice, created by physical pressure and changes of temperature, also creates refractory patterns. Sometimes the leading edge of frozen water will show more fracturing than other parts of the ice, adding to an impression of movement as the light is refracted more intensely in such areas. Partial thawing and refreezing over several days creates beautiful ice.



The beauty of ice is generally a function of chemical and physical interaction. The form of ice crystals is established by the atomic structure of water: the crystals build on that, but they are also influenced by a variety of physical features like wind, temperature and temperature gradients, and the flow of water. The movement of water can be seen vividly in streams frozen in the moment. The effect is often accentuated by impurities in the water, including air. These impurities cause light to refract differently, providing

And then there is what we neophytes call frost. The coating of water which adheres to surfaces and then freezes, usually tightly held. Many a winter morning is spent looking at gleaming jewels as the light of dawn filters through myriad crystals.



(Image credit: NASA/JPL-Caltech)

As complicated as the formation of ice crystals is at one earth atmosphere of pressure and "standard" earthly temperatures, it does not begin to scratch the surface of the formation of ice from water. For instance, ice VII exists at pressures equivalent to about 29,000 earth atmospheres and continues in ice form at temperatures of up to 662° F (350° C). Its structure is cubic, and as the previous sentence would indicate, very strong. It turns out there are many forms of ice. (The normal water we usually encounter forms ice I_h.)

The ice layers of Ganymede, which is not in the Black Range, are depicted in the NASA/JPL-Caltech image to the left. These layers are "strata" which have significantly different properties but may have the same (or only slightly varied) chemical structure. Sometimes we have to look afar to understand the potential of what sits next to us.

A Few Nectaring Insects

by James Von Loh

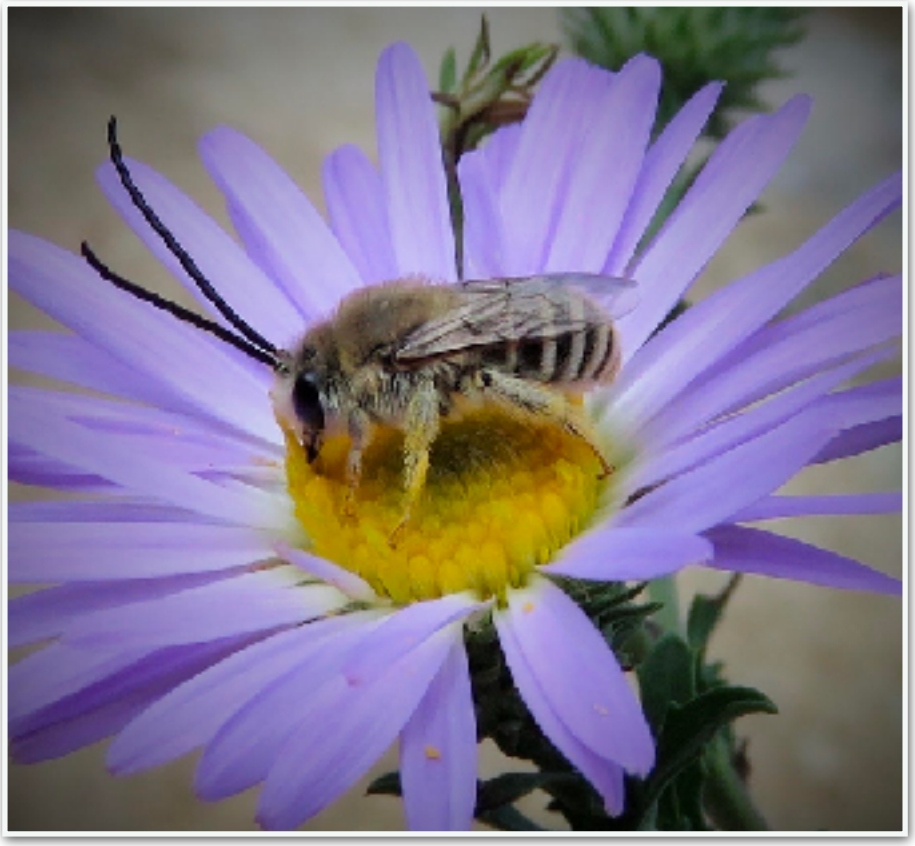
In the April 2022 issue of this magazine I reported on the nectaring activities of a number of butterfly species. During the preceding two summers I had photo-documented butterfly activity and taken photographs of a number of other species nectaring on flowers as well. Here, I share some photos of those other species.

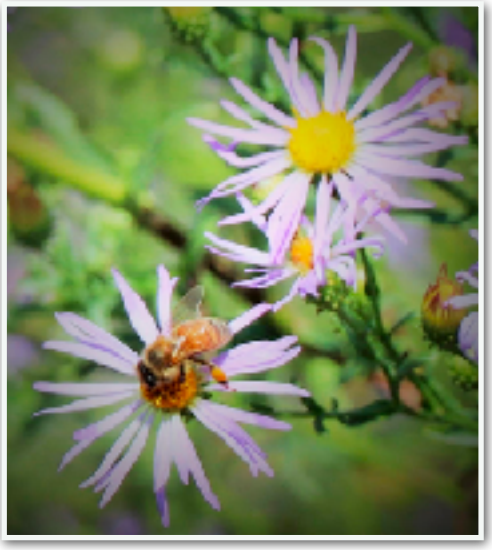
Several insect species besides butterflies visited Spine-aster flowers and plants both to nectar and to forage for pollen and other nutrients, and a few are presented here for context. During 2021, I observed that the number of bee and wasp species and individuals, in particular, was notably low when compared to my observations of 2019 and 2020 for this river-reach. The extended drought period leading into 2021 summer monsoon rainstorms apparently limited their numbers, greatly.

Sonoran Bumblebee, *Bombus sonorus* (Say, 1837)

I rarely observed this species in 2021. The individual shown on this page is light yellow compared to the typically bright-yellow coloration.

Some authorities consider this species to be a subspecies of *Bombus pensylvanicus,* which is found in most of the United States.





Photograph directly above by Gordon Berman.
Photographs in right column by James Von Loh.

Western Honey Bee, Apis mellifera (Linnaeus, 1758)

Some sources you encounter will list the Western Honey Bee, *Apis mellifera*, as extinct. Clearly, these photographs by Gordon and James are not of an extinct creature. What is the story?

You probably know that this species is native to Europe and is described in many sources as the European Honey Bee. The European Honey Bee was domesticated early, more than 4,600 years ago, and spread throughout the world as a domesticated animal. This is the species which pollinates our crops and makes our honey. It has also established feral populations, and these photographs are, most likely, of feral individuals.

The International Union for Conservation of Nature and Natural Resources (IUCN) assesses the status of wild species; it does not assess the status of introduced or domesticated species. In its most recent assessment of the European Honey Bee, done within its native range*, the IUCN concluded that it could not ascertain the status of this species, that information about its status was "data deficient". This species has been domesticated for so long, has gone feral, individuals have become redomesticated, etc., etc., that the IUCN could not determine if there were native bees in Europe or not. Some sources jumped on the bandwagon and concluded that the species was extinct, not even making a more nuanced conclusion that it was "extinct in the wild", in Europe (which may or may not be true).

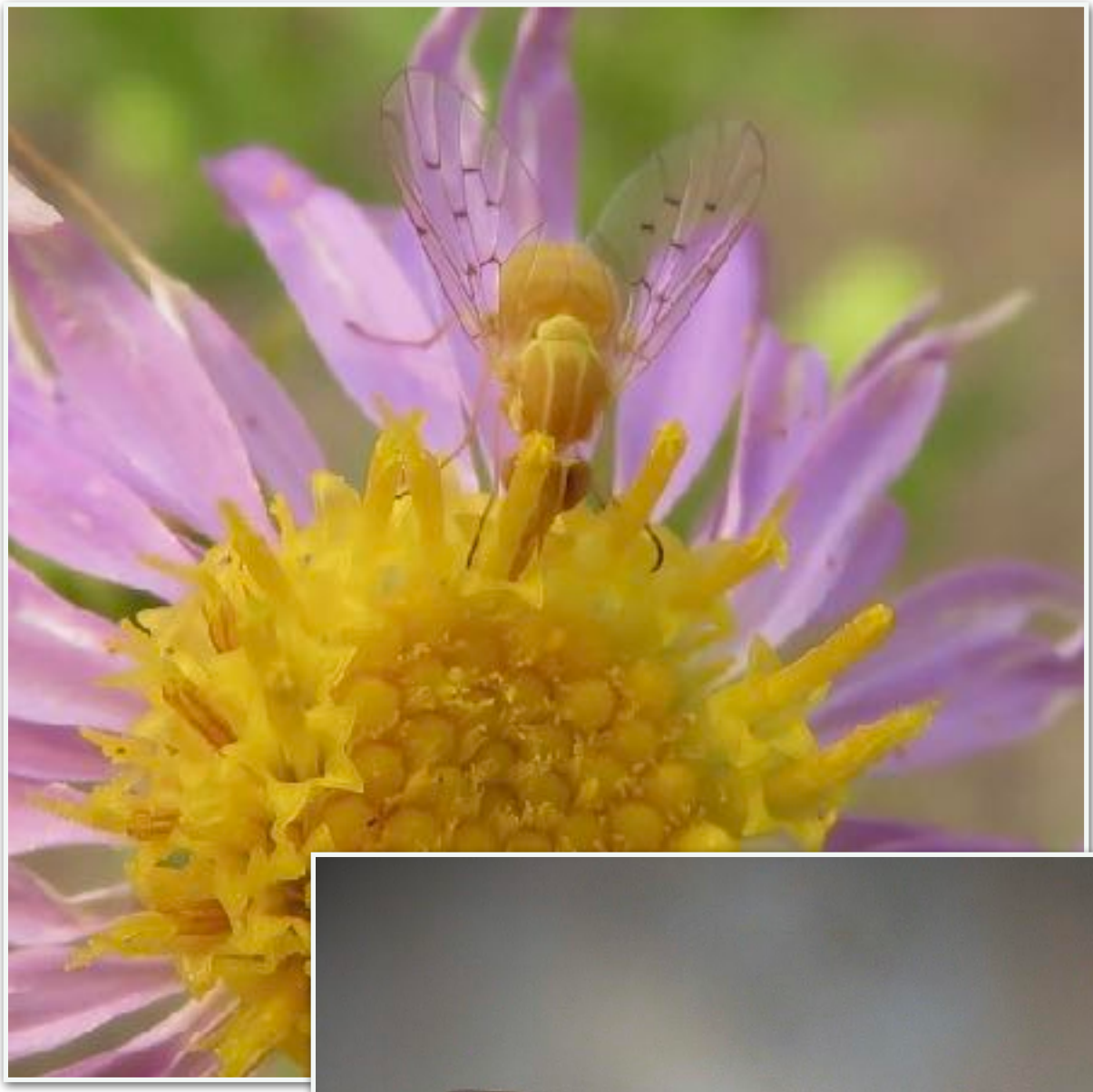
Clearly, the Western Honey Bee exists in the wild. I, myself, have photographed wild colonies near Hillsboro (and paid a price I might add).

There are currently 31 recognized subspecies of the Western Honey Bee. Recent studies, however, indicate that the nominate form *A. m. mellifera* does not hybridize with other subspecies (Oleksa, A., Wilde, J., Tofilski, A. (2013), "Partial reproductive isolation between European subspecies of honey bees", *Apidologie*, 44 (5): 611–619).

This species is under significant stress from human and non-human threats: disease, parasites (the Varroa mite), insecticides like neonicotinoids (courtesy of Bayer), and colony collapse disorder (whatever that turns out to be). In the meantime, you are likely to find them flying about. Enjoy.

***Even the native range of this species varies with the source. Some believe that it initially evolved in Africa or Asia and spread from there.**

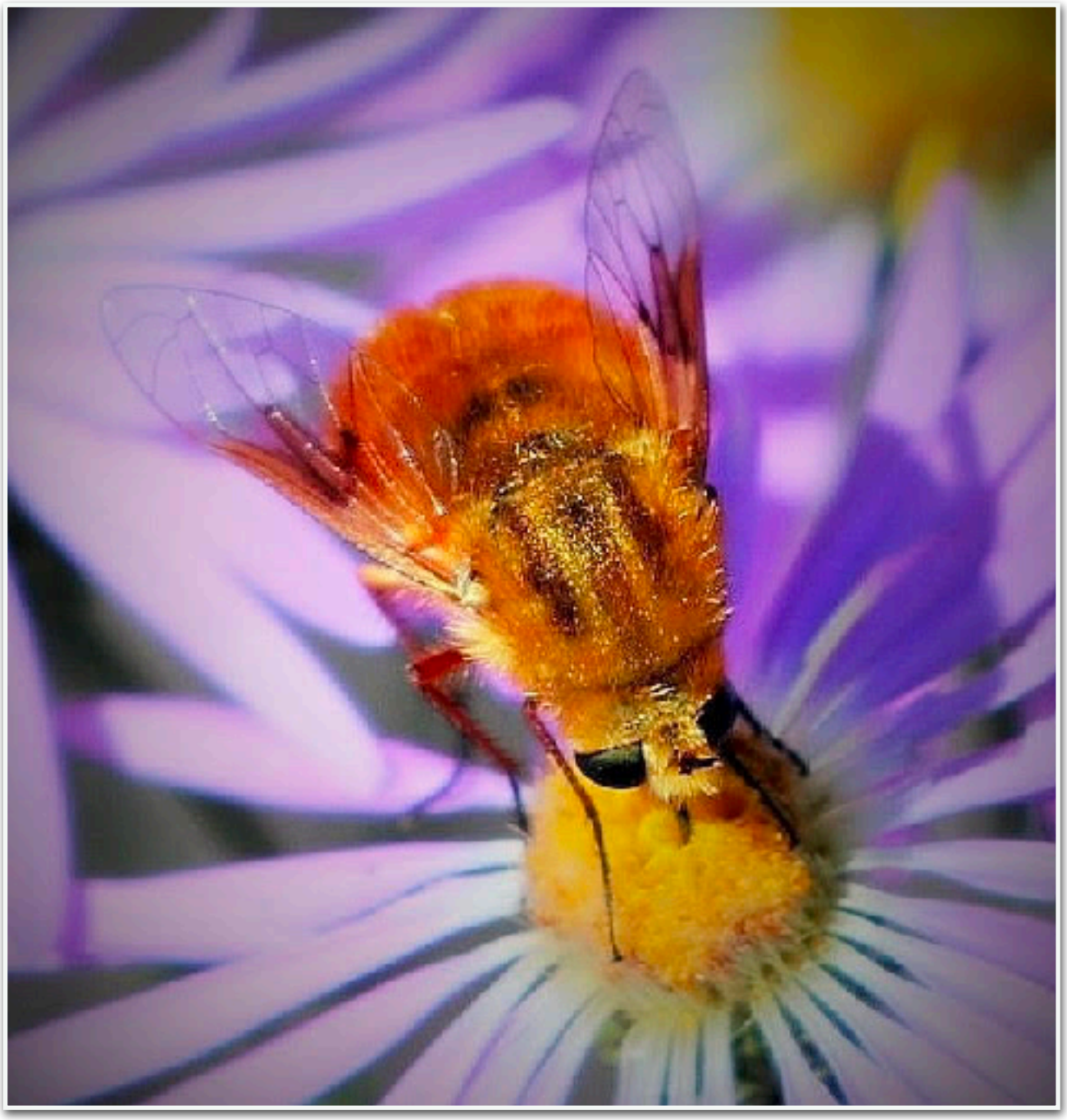
- The Editor



Bee Fly, *Poecilognathus* (Jaennicke, 1867) sp.)

These photographs were taken by Gordon Berman and can not be determined to species. There are 8 species of *Poecilognathus* found in the US and Canada.

***Poecilognathus unimaculatus,* which this individual may be, is shown below in a photograph from Texas, by "yukioz". - Ed.**



Bee Fly, *Lordotus* (Adelidea Marquart, 1840) sp.

Note how hairy this Bee Fly is compared with the hairless Bee Fly on the previous page. There are 27 species in this genus in Canada and the U.S. This individual may be *L. striatus*. Wing venation is important in the identification of such individuals to genus and species. Photographs by James Von Loh. - Ed.

Rough Stink Bug, *Brochymena affinis* (Van Duzee, 1904).
Photographs on this page by James Von Loh.

Jewel Beetle (Metallic Wood-boring Beetle), *Buprestidae* (Leach, 1815).

This species was often observed foraging in the flowers of many plant species.

Tarantula Hawk Wasp, *Pepsis* (Fabricius, 1804) sp.), foraging from Horsetail/Whorled Milkweed flowers; its length is 2 to 2.25". The curled antennae indicate it is a female. They are effective Milkweed flower pollinators, extracting and transferring many pollen packets while foraging. Dr. Justin Schmidt has personally analyzed the sting of Tarantula Hawk Wasps in human terms, as follows: "Blinding, fierce, shockingly electric; a running hair dryer has just been dropped into your bubble bath." The best thing to do, according to Dr. Schmidt, "is just lie down and scream: the pain is so debilitating, screaming is satisfying". Fortunately these large wasps are singularly focused on foraging from milkweed flowers and are not aggressive; I'm often within a few inches of them while capturing images of butterflies and other arthropods. I surmise that Greater Roadrunners are wise birds to avoid these wasps. Photographs by James Von Loh.

Photographed east of Hillsboro.

A Few Black Range Spiders

The Black Range is a great place for spiders. Sometimes they are amazingly easy to find, sometimes they prefer to stay hidden. In almost all cases they are difficult to identify.

Their anatomy and behavior are intriguing and difficult to understand. Life forms, like all complex systems, can be difficult to understand because each component or variable may have a large range of functions and set of actions, each of which may influence other parts of the system differently. Significant variability can be maddeningly difficult and consumingly intriguing.

Before we provide a few examples of the spider species found here, we would like to point you to some of the resources which are available, should you become intrigued.

Resources

There are several excellent sources of information about spiders. The identification of spiders to species, like that of many small crawling things, can be challenging and often requires the close inspection and/or dissection of a specimen.

Some sources which will be useful in any study of spiders in our area include The Spiders of the Arid Southwest. According to the website it is ". . . a site at New Mexico State University edited by David Richman, Allen Dean, Sandra Brantley and Bruce Cutler. . . . This site focuses on the Arizona-New Mexico-Trans-Pecos Texas part of the arid Southwest, although it should be useful in the other mentioned areas." As of the date this is published, the site list contains 57 families, 272 genera and 1083 species.

The American Arachnological Society site has information on more than 1,000 species. It also has links to a variety of other resources. An excellent site to "bookmark".

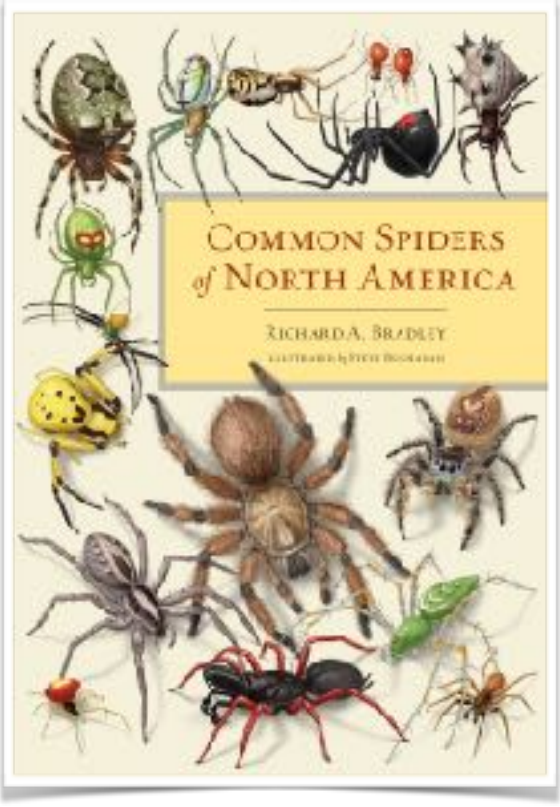
And lastly, the reference section on Arthropoda on the www.blackrange.org website lists other sources.

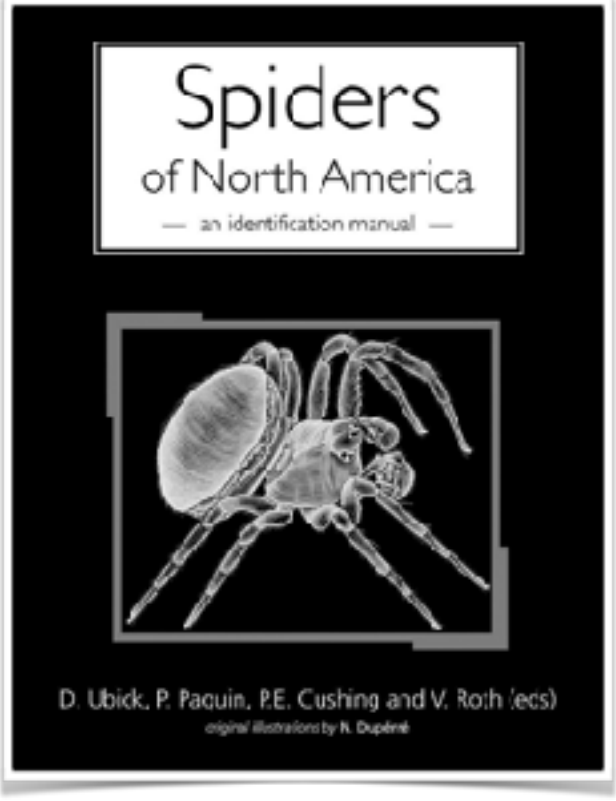
A word of caution: many popular sources of information about spiders on the internet are virtually useless.

Disclaimer

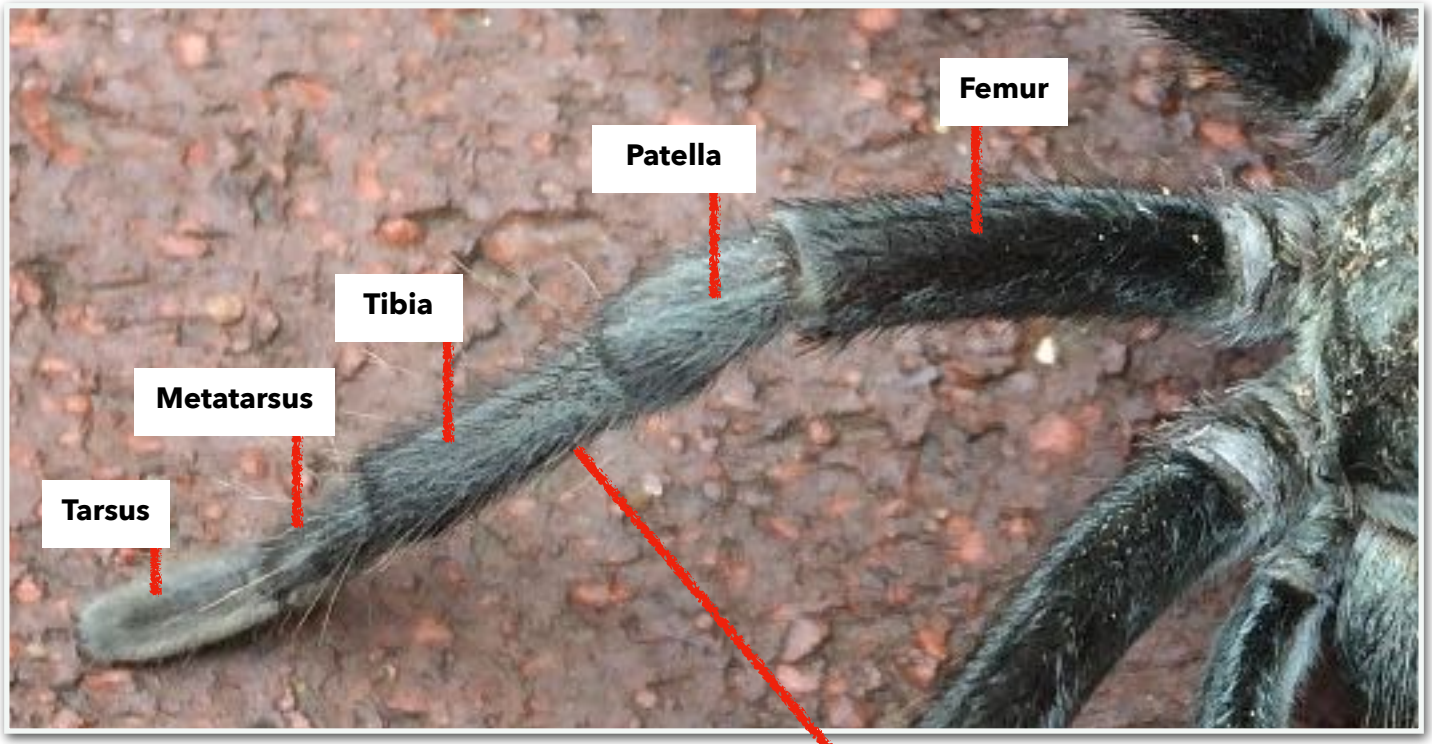
Putting creatures into taxonomic boxes can be difficult and especially troublesome when dealing with subjects where there are already many known species, the species are minute, and species differentiation may require learned dissection. Add to those problems the limitations inherent in working with images of such critters, rather than the critter itself, and a situation is created where error is possible and specificity may be limited. In some cases you might be able to identify something only to family or perhaps, with luck, genus. Please consider these factors when reviewing the identifications made in this article. If you are able to correct errors or provide greater taxonomic specificity we would really like to hear from you.

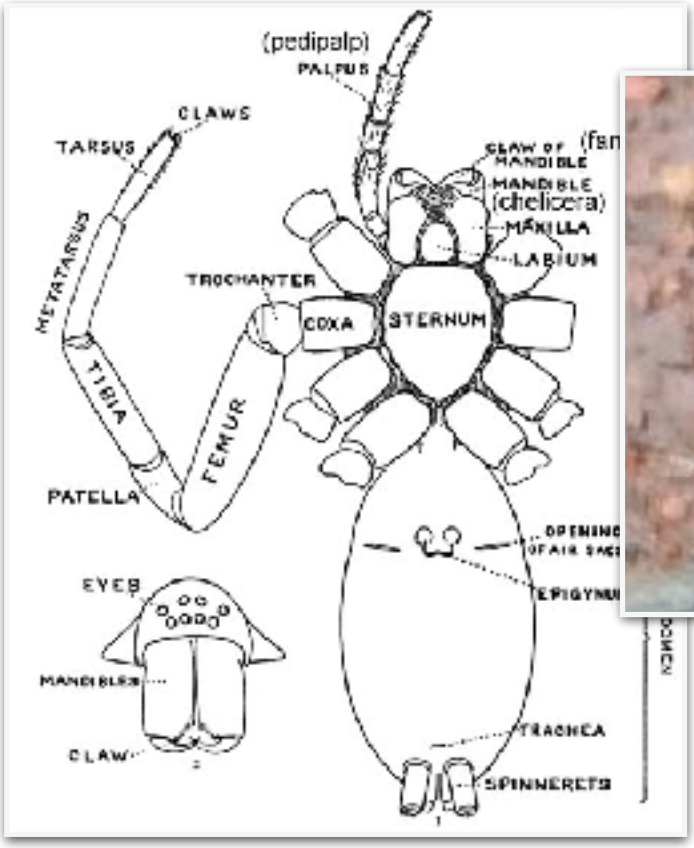
If you have an aversion to spiders, please stick with this and you may become intrigued with life so different from our own that you have to wonder at the differences between their world and our own. Being intrigued does not mean that you have to embrace, literally, our fellow creatures.





This Photograph (and detail images on the following two pages) are by Tom Lander.





***In at least some species, (see the discussion of Phidippus johnsoni* later in this article), the hairs on the legs (other parts of the body as well?) may be "auditory" as well as tactile sensors.**

[Spider Anatomy from BugGuide]

Anatomy of A Spider

The anatomy of spiders is complex, and a spider's view of the world, and interaction with the world, is significantly different from that of humans. It is not possible for a human to understand the world in the same way that a spider does. The factoids presented on these four pages do not even begin to scratch the surface of what is known, which in turn is feeble when compared with what could be known.

There are many ways to "slice and dice" spider eyes. One way to do that is to distinguish between web weaving spiders and hunting spiders. Most spider species have eight or fewer eyes. How those eyes function together is intriguing, but for now let's note that web weaving spiders have poor eyesight. Their eyes distinguish between light and dark well and use the amount of light to trigger web weaving (which, and how, varies by species). Although most hunting spiders have good eyesight, not all do. Some have to live with being able to distinguish movement and changes in lighting. This trantula has good eyesight, but not as good as the wolf spider species, some of which are also found here. A trantula will depend on the sensory input from its hairs a great deal, perhaps more than on visual inputs. Some spider species can see polarized light and some can see ultraviolet light (jumping spiders, for instance).

Spiders have two types of eyes, principal and secondary. Principal eyes have small fields of view but can detect color and fine detail. Secondary eyes do not move (principal eyes can), are very sensitive to motion, and have a wide field of view. Secondary eyes "tell" the principal eyes where to look. Eye function and capability vary widely by species.

The chelicerae (mouthparts) end in fangs which are connected to venom glands. (Sometimes these glands are part of the chelicerae.) There are three types of chelicerae:

- Three-segmented chelate chelicerae (in our area this type is found in those arthropods we call "harvestmen" or "daddy longlegs");
- Uncate chelicerae have two segments (in our area, true spiders and sun spiders have this type of arrangement); and
- Jackknife chelicerae, which vinegaroons have.

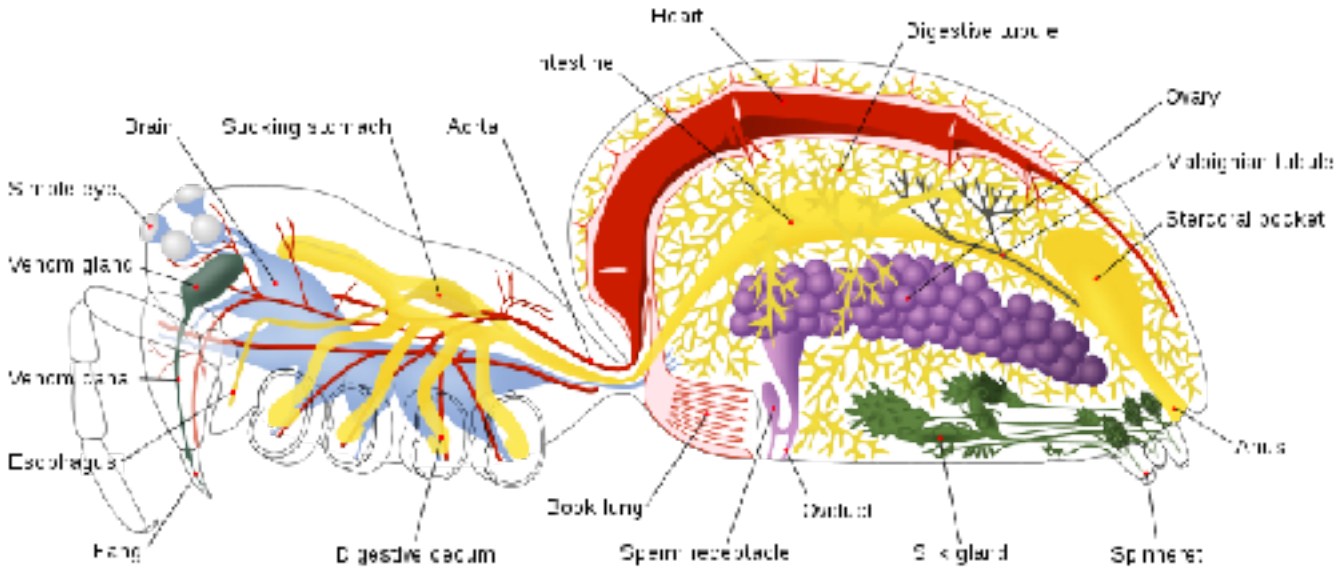
Like the legs, the palpus (pedipalp) has chemical detectors which are used for taste and smell. The last segment, the tarsus, has a structure called the palpal bulb (or organ) in mature male spiders. This structure is used to transfer sperm to the female during mating. Pedipalps are used in various ways during courtship displays by male spiders. Use varies with species.

The palpus (pedipalp), which is not a leg, has the same segmentation as the legs of a spider.

The diagram of the internal organs and systems of a spider, at the top of the following page, is an adaptation from John Henry Comstock's 1912 treatise entitled *The Spider Book*. Many editions have been published since. The book is a classic, and the diagram is considered to be one of the very best in the English language version of Wikipedia. Comstock (1849-1931) was a prominent entomologist and arachnologist. The John Henry Comstock Graduate Student Award, given by the Entomological Society of America, recognizes the outstanding graduate student of the year in each of the Society's six branches - and the contributions of Comstock. His wife, Anna Botsford Comstock, illustrated many of his articles. She did not, however, make the one shown here. Anna Comstock excelled in many fields and was a prolific writer. Her "*Handbook of Nature Study*" has gone through 20 printings.

The abdomen is not connected to any legs. All of the legs connect to the cephalothorax. Among other things, most of the respiratory organs are found in the abdomen, but not all spiders have the same respiratory system. There are two basic systems - book lungs and tracheae.

The spinneret is used to produce spider silk. See the description of web weaving for more detail about these organs. They produce a variety of "different" silks. All made from the same substance, silk is woven to specification, depending on how it will be used.



Photograph by Tom Lander.

Prey

Many find it difficult to disassociate "spider" from "predator", and as useful as that may be for some, it is not terribly informative. Much of the following has been derived from the NMSU Website.

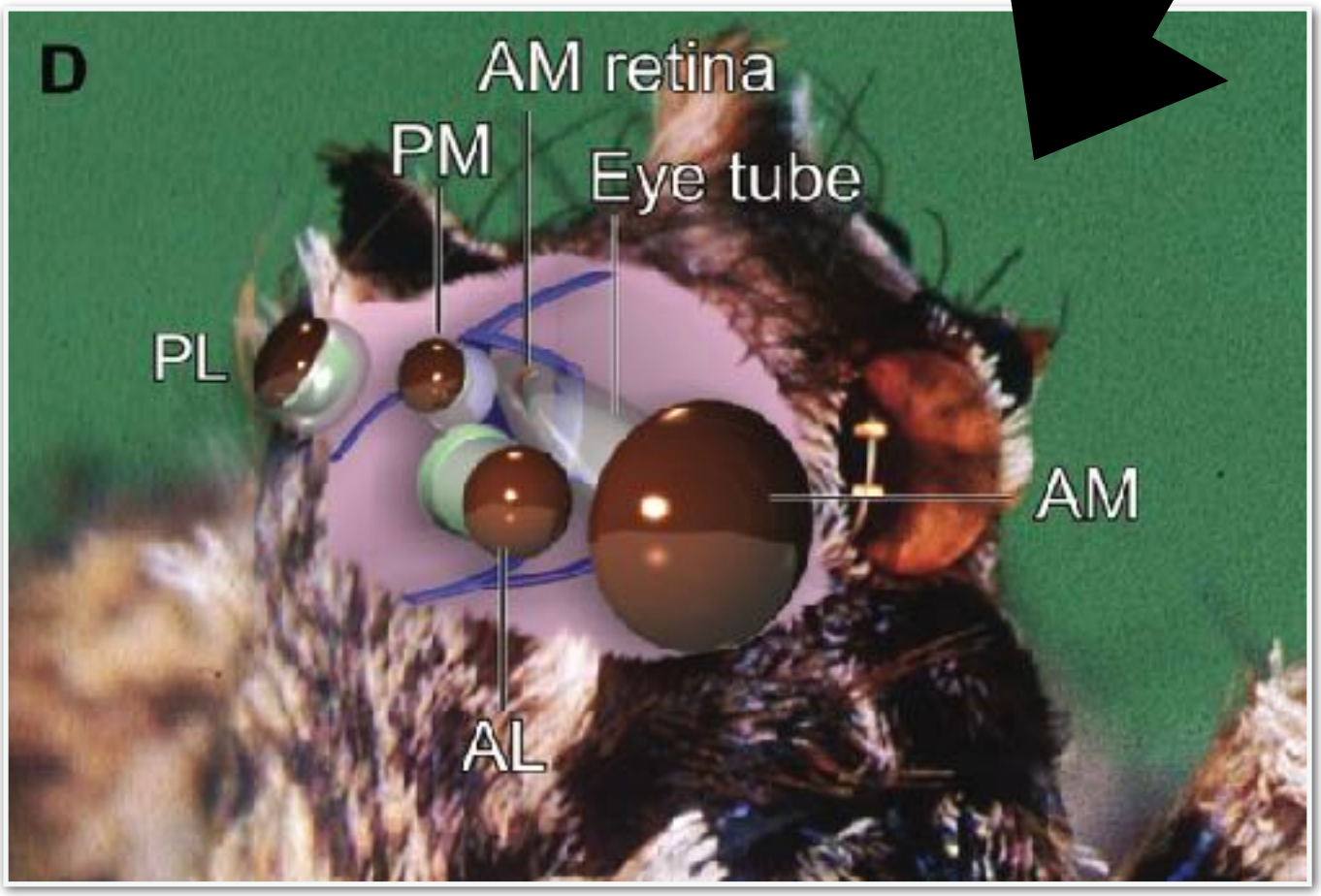
There are more than 48,000 described spider species in the world. Roughly 3,800 are found in North America, and about a third of that in the arid southwest of the United States. Developing a system which aids the understanding of the individual species, for such a large number of species, has proven to be difficult. One of the current systems of organizing spider species into something understandable focuses on hunting techniques and hunting locations. Techniques and locations are used to define "guilds" (see William Kish's, *Standardizing Spider Guilds and Seasonal Guild Diversity*).

While many spiders are generalist in their pursuit of prey, others are very specific when it comes to their food preferences. "It may be noted that orb-weavers catch few non-flying insects, flower-dwelling crab spiders few non-pollinator insects, and wolf spiders few actively flying insects. Spiders thus tend to act as if they were in guilds of prey-capture specialists (Culin & Yeargan 1983a, b, c, Young & Edwards 1990, Richman, et al. 1990) as well as being in an overall generalist predator guild as defined by Wise (1993). The multi-guild character of spider faunas has only been appreciated in relatively recent times and needs to be examined more thoroughly." NMSU Website

Prey capture behavior can vary when spiders have good eyesight. The jumping spiders (*Salticidae*) provide a good example of this. (See Jackson, R. R., and R. Wilcox. 1998, "Spider-eating Spiders", *American Scientist,* 86: 350-357, and Harland, Li, and Jackson, "How Jumping Spiders See the World", DOI: 10.1093/acprof:oso/97801953 34654.003.0010, March 2012.)

The way that jumping spiders see is fundamentally different from the way that humans see. Spiders do not have compound eyes, like dragonflies and many other types of life. Like the eyes of humans, each of a spider's eyes "sees" a full image. But jumping spiders have eight eyes to the two of humans. Four times better? Big mistake. Human and spider visual systems are fundamentally different. "Better" has little meaning in evaluating such systems because every step of the analysis becomes value laden. It is the same type of mistake

"The carapace of *Portia fimbriata*, a spartaeine species from Australia, with drawing of the internal arrangement of the eyes superimposed over the top. The cornea of the large forward-facing anterior median eye (AM) sits in front of a long mobile eye tube surrounded by muscles (blue). A complex layered retina sits at the back of the AM eye tube. The smaller secondary eyes, anterior lateral (AL), posterior median (PM), and posterior lateral (PL) have wide-angle lenses. The AL eyes, like the AM eyes, point forward, with binocular overlap of their fields of view. In salticoid salticids, the PM eyes are much reduced in size and considered vestigial." Ibid, Harland, Li, and Jackson, "How Jumping Spiders See the World", p. 134.



which happens when humans talk about (and generally act as if) "Darwinism" and "progress" are synonymous. The problem, of course, is in the (value-laden) definitions. If progress is thought to mean getting continually better, that can fit with the concept of natural selection, but it is what comes after that that matters: What is "better"? If someone believes that humans are better than ants because of natural selection, then they understand neither - ants or natural selection. Natural selection is about providing competitive advantage in a particular situation, sometimes called niche, but that seems to be an incomplete concept. That competitive advantage may involve becoming simpler; that is, the systems involved become less complex. In a world where "complexity" and "better" are often used in the same thought, the concept that something can provide competitive advantage by being simpler may seem foreign to some people. Our point here is not to argue about the misunderstandings associated with natural selection but rather to point out that we are on firmer ground when we seek to understand; and when we seek to compare, it is only in the most rigidly defined terms.

Arguably, it is the visual system of jumping spiders which is their defining characteristic. Because of their acute visual capability they are able to both stalk (including planning activities like a detour route ahead of time) and attack prey (by jumping) with significant effectiveness. It may be that their ability to modify their behavior, routinely, is also related to their visual capability and the assessment of options which that enables.

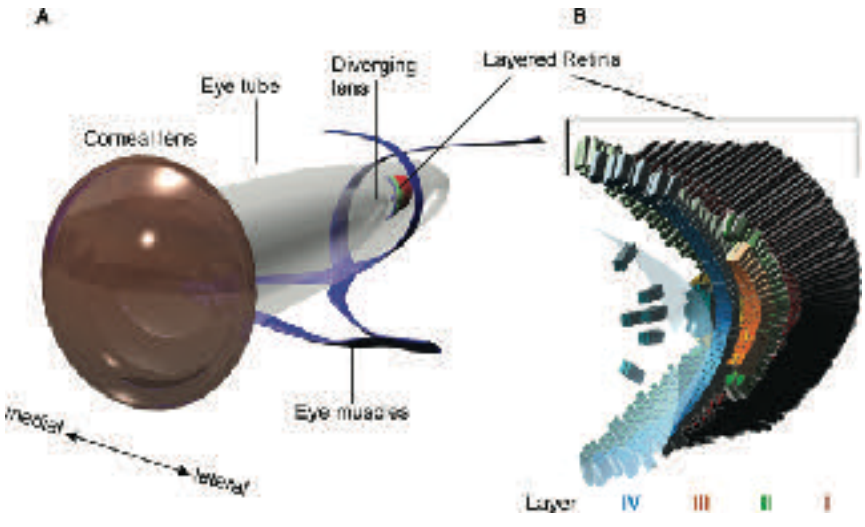
Brain bias, that tendency to equate intelligence with brain size (except in those animals with larger brains than our own) is a continuing roadblock to our understanding of the natural environment. To that we should add the bias of brain structure, the belief that humans have the best and most capable brains, in part because of structure. Those who adhere to this premise didn't miss a beat when it came to the initial findings about how bird brains work and what their capabilities are (their brains have a different structure). Harland, Li, and Jackson address some of these issues at page 136 of the cited paper: "It is as though a brain is an expensive item that small animals are inclined to avoid putting into their toolkit whenever they can manage without it and, whenever possible, small animals that already have brains try to bypass getting into situations requiring a lot of brain processing. Yet, we have to wonder whether salticids, by seeming to welcome the kaleidoscope of information that vision based on high spatial acuity provides, have broken ranks with other small-brained animals. Perhaps they have somehow solved the processing problem, despite the minuscule size of their brains, or else they are relying strongly on peripheral processing in ways that have thus far eluded us." (Dispersed cognition is a particular interest of the editor, thus this bit of disruption in focus - pun is indeed intended.)

The primary eyes of jumping spiders have significant color acuity, including the ability to see ultraviolet radiation in addition to the light wavelengths that humans see. They certainly see differently and perhaps more and "better". Harland, Li, and Jackson describe the visual functionality of jumping spiders in great detail, and it is a worthy read if you have an interest in the topic.

"Other non-web-building spiders are more stereotyped in their prey capture, with some crab spiders (family *Thomisidae*) simply waiting for an insect to land on a flower on which they have hidden themselves. Web-building spiders are fairly stereotyped in their prey capture behavior within their species, but the variety between species is quite staggering. They range from very complex orb webs to simple sheet webs, with a few having abandoned the web for a pheromone lure, as in *Mastophora* and several other *araneid* genera." NMSU Website

Webs

The well-known wheel-shaped web takes shape in the following sequence: A single strand is placed between two objects; the outside of the web is laid out; and web spokes between the outer web and the center of the first strand are constructed. The concentric strands of the web are then constructed. In this process the spider appears to use its own body length to measure the various components. Interestingly, this means that smaller spiders often make finer webs. A "retreat" where the spider can hide is generally constructed to the side. The construction of other web types is covered extensively in Foelix, R. F., 2011, *Biology of Spiders*, 3rd edition, Oxford University Press, New York.



"Morphology of the salticid principal eye. A: The large corneal lens has a focal length much greater than that of any of the secondary eyes. Instead of the cup-like retina typical of single-lens eyes, a small retina sits at the end of a long eye tube. The high magnification afforded by the corneal lens is boosted further by a diverging optical surface directly in front of the retina. B: The retina is complex and organized into four layers of receptors." From Harland, Li, and Jackson, "How Jumping Spiders See the World", p. 141.

For those of you who are photographers, stacked sensors are now becoming available. They provide much better definition and enhance image acuity.

Spigots in a Spinneret

"Spider spinnerets are organs located on the abdomens of spiders from which spider web silk is extruded. The individual spinnerets move independently yet in a highly coordinated manner to build cocoons or webs. Each spinneret is dotted with many tiny spigots, through which various types and thicknesses of silk are extruded. The strong muscles that move the spinnerets also force liquid silk through the narrow spigots. This pressure, as well as external pulling by the spider, rearranges the liquid silk molecules into a solid but flexible thread. Although spider web silk is only about one millionth of an inch thick, it is considered a natural high-performance polymer. The strength of some silk exceeds that of steel, and its toughness exceeds that of kevlar."

Image and text copyright Dennis Kunkel. From "The Smaller, the Better: From the Spider-Spinning to Bubble-Electrospinning", J. H. He, *Proceedings of the International Congress on Advances in Applied Physics and Material Science, Antalya 2011, Vol. 121, No. 1.*

Web Weaving

Spinnerets are organs used to spin silk. A spider will have two, four, or eight spinnerets, depending on species. The spinnerets may move independently or in tandem - which goes a long way in explaining the complexity of some spider webs. The capability of a spinneret is much more than that of a simple jet, like that found on the most sophisticated ink-jet printers or even 3-D printers. Each spinneret has numerous spigots, each of which produces a singular filament. (To use our printer analogy, a spigot is more like an ink-jet printer.) The arrangement of spigots and when each is used allows a spider to produce many types of silk. Spiders do not use the same type of silk for all purposes but rather use specialized silk for specific purposes. The specialization of the silk is enabled by the way it is woven, back to the spigots and spinnerets.

As one example of the complexity of the spider silk which is used to build a web, some strands are sticky (sometimes wooly) and some are not, although all are made from the same material. Although spiders can move along the sticky strands, they generally travel along the non-sticky ones.

Courtship

Courtship behavior varies with the general living conditions of the spider. For instance, in web-weaving spiders courtship signals are generally transmitted by causing the web strands to vibrate. Running spiders often use pheromone attractors, and in spiders like the salticids, with their excellent eyesight, full-on courtship displays by the males occur. Such displays involve differing postures, brightly colored body parts, and the erection of hairs. Interestingly, these courtship displays often involve a significant amount of audible stimulus which is not discernible by humans.

Unfortunately for many males, the last act of courtship is not the transfer of sperm but rather serving as the evening meal for the female.

Egg Sacs and Maternal Behavior

Virtually all spiders create egg sacs. Some will leave the sacs in their web and some, such as wolf spiders, will carry them around (see images later in this article). In nearly all spider species, the females will defend their egg sacs vigorously. Generally, once the spiderlings emerge from the egg sac, the female spider ceases to have any interest in them. Wolf spiders are different, however; in these species the spiderlings climb onto their mother's back and are carried around until after their first molt.

"The God that holds you over the pit of hell, much as one holds a spider or some loathsome insect over the fire, abhors you, and is dreadfully provoked. His wrath towards you burns like fire; he looks upon you as worthy of nothing else but to be cast into the fire." So wrote Jonathan Edwards in his 1741 sermon "*Sinners in the Hands of an Angry God*". Your soul aside, Edwards studied how spiders travelled, especially spiderlings. They shoot out a strand of web; light and floating in the air, they fly away in a process which is called ballooning. Edwards described the process in a letter to Paul Dudley on October 31, 1723. Dudley was a member of the Royal Society of London, who lived in Massachusetts. An excerpt from that letter is at the top of the following page.

Defensive Actions

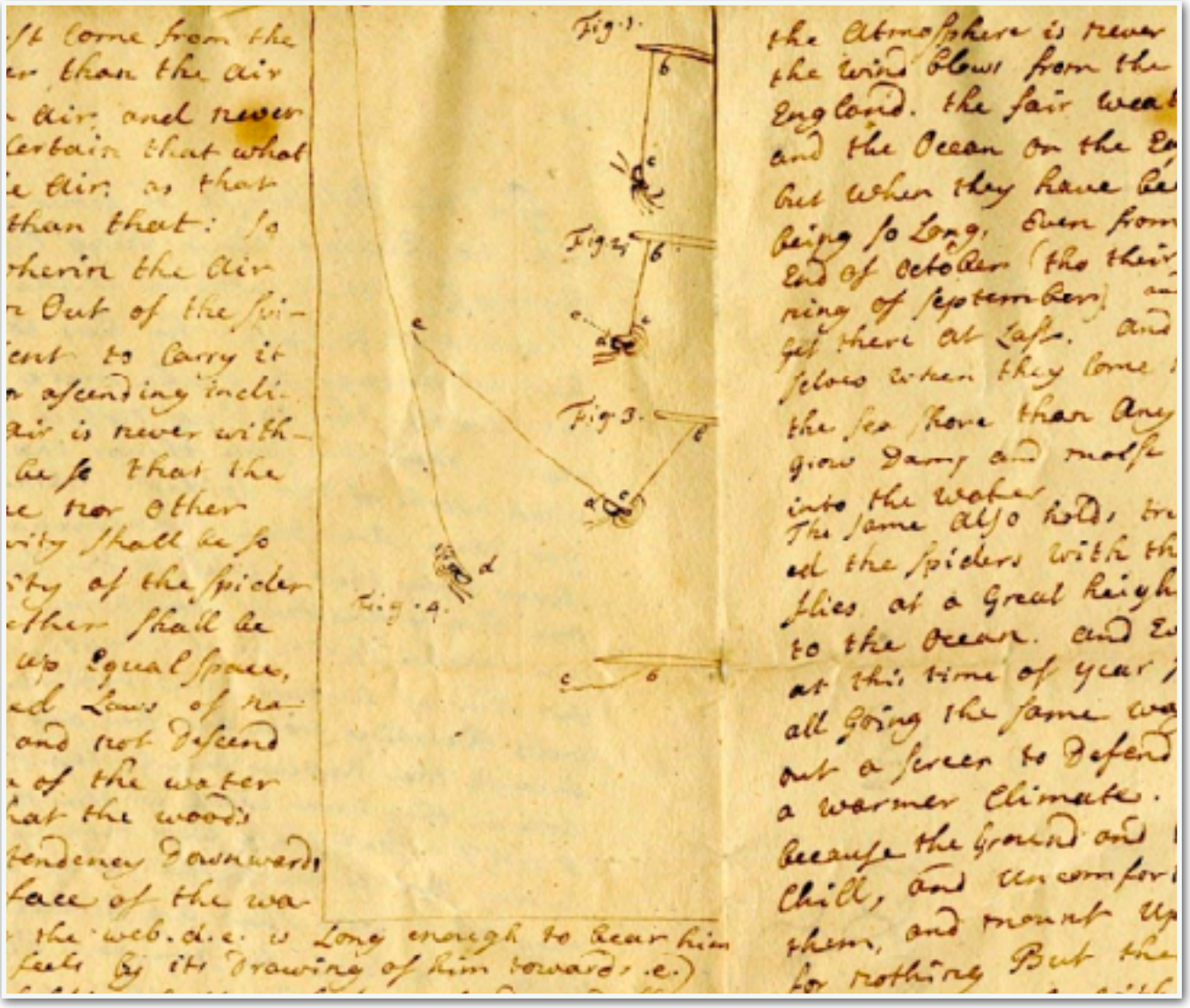
Spiders employ the full range of defensive actions when threatened. Everything from acting like something else (mimicry) and playing dead, to threat displays which may lead to attack. (Never poke your hand into a Black Widow web with egg sacs, for instance.)

Although we tend to associate mimicry with prey and we generally do not think of spiders as prey, they are certainly in the food chain. One set of species which some spiders are said to mimic is the velvet ants (see photographs at the bottom of the following page). Based on personal experience, the sting of a velvet ant can be excruciating.

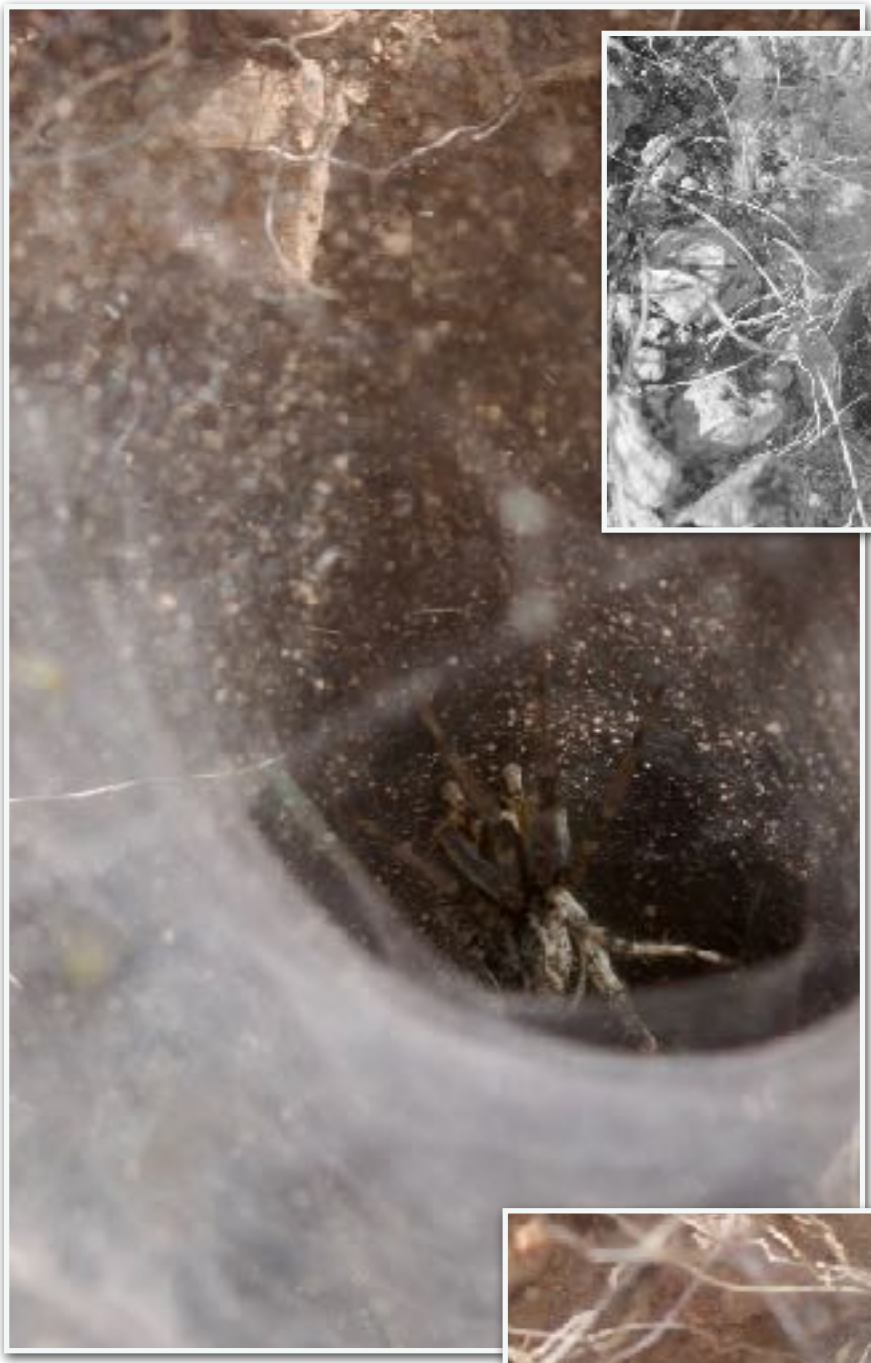
Examples of Spiders from the Black Range

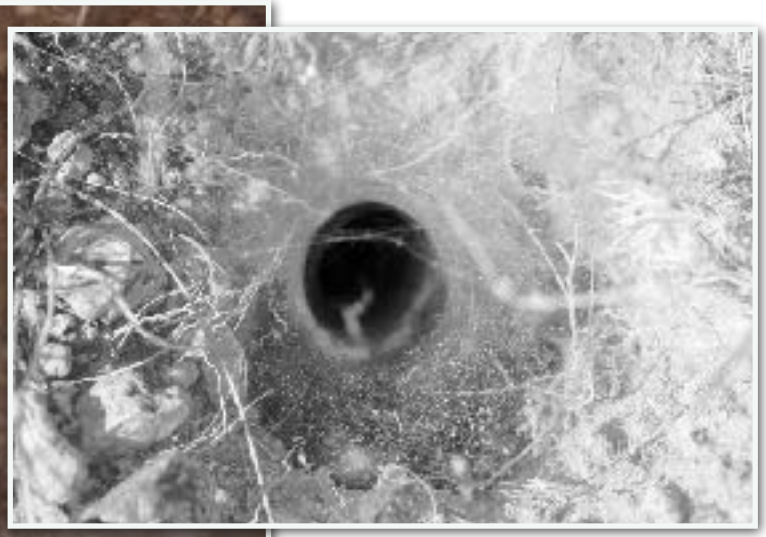
On the following pages we provide some examples of the types of spiders which can be encountered in the Black Range. In some cases, we have provided some species-specific narrative.

One of our multi-year tasks is the development of a *Spiders of the Black Range* publication. If you have images of spiders taken in the Black Range and care to share, that would be helpful - as would any information you have about the species photographed. Contact the editor at rabarnes@blackrange.org.



A Velvet Ant (above) of the genus Dasymutilla (possibly D. magnifica or D. klugii) photographed in Ready Pay Gulch east of Hillsboro, New Mexico. Females of the genus are wingless; it is the wingbeat of the male wasp that the spider hears.

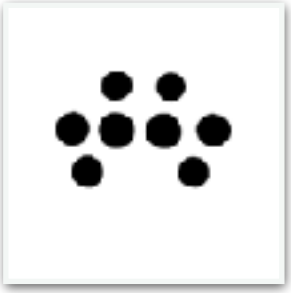




Agelenopsis aperta (?)
Western Funnelweb Spider

There are at least six species of *Agelenopsis* found in New Mexico. Given the image, this identification must be treated as tentative.

About the images: This is a very timid species, and very sensitive to what is happening around it. The best strategy for photographing the species is to take a chair, sit next to a funnel web, and hope something flies into the web. The web of this species is not sticky, and the spider will be very fast in identifying the intruder as prey, biting it, and taking it down into the funnel.



Eye arrangement. Drawing by *Lynette Elliott,* used here under the provisions of a Creative Commons License.

Chiricahuan Gray Trantula, *Aphonopelma gabeli*, by Jan Richmond, October 2, 2021.

Aphonopelma gabeli

Tarantulas are large spiders, so they should be easy to identify, right? Wrong. Not only do taxonomic classifications change and vary, but for those with an aversion to picking spiders up and studying them, some of the key features may be difficult to study. See *Taxonomic revision of the tarantula genus Aphonopelma Pocock, 1901 within the United States* by Hamilton, Hendrixson, and Bond.

Aphonopelma marxi

The individuals shown previously (pp. 40-43) are members of the *Aphonopelma* genus and are probably in the "marxi" species group. This group of species includes *A. vorhiesi*, *A. marxi* and *A. peloncillo*, among others. If you have an interest in this group I recommend Michael Jacobi's video on the subject. These individuals (pp. 40-43) were photographed in/around Kingston and Hillsboro in the Black Range. Based on the lower elevation (5,100') of the individuals photographed near Hillsboro, the spider may be *A. vorhiesi*. See video.

Aphonopelma madera

Photographs to the right and above were taken on a hike into Rabb Park on the west side of the Black Range, November 2020. The spider was slowly ambling across the trail and delayed progress for quite a while.

Araneidae

The two individuals shown here (left and at the top of the following page) are in the family *Araneidae*, the Orb-weaving spiders. World-wide there are 3,067 species in 177 genera in this family. Some do not look, at all, like these two. At least fifty-seven species of *Araneidae* are known from the "desert southwest".

It is possible that the individuals shown here are in the genus *Araneus.* which accounts for at least 17 of the *Araneidae* in the southwest.

The photograph to the left was taken by Matilde Holzwarth on September 11, 2012.

Family *Araneidae,* Hillsboro, New Mexico, October 16, 2016.

Araneus gemmoides/ illaudatus

The common name for *A. gemmoides,* shown to the right and on the following page, is Cat-faced Spider. *A. illaudatus* has no common name. Although the taxonomy of the genus *Araneus* is in periodic flux, the problem here is much more simple. I do not know which it is. Ask me the question on two different days and you will get two different answers. There are at least 50 species in the genus *Araneus* in Canada and the U. S. Note the smaller spider at the right in the middle photograph and the "horns" on the abdomen of the *Araneus*. Females of *A. gemmoides/ illaudatus* are from 13 to 25 mm (.5"+ to roughly 1". Photographs shown here and on the following page were taken in Hillsboro, New Mexico, during July 2022.

Entelegynae, Lycosidae, Camptocosa texana
Hillsboro, NM, August 2022

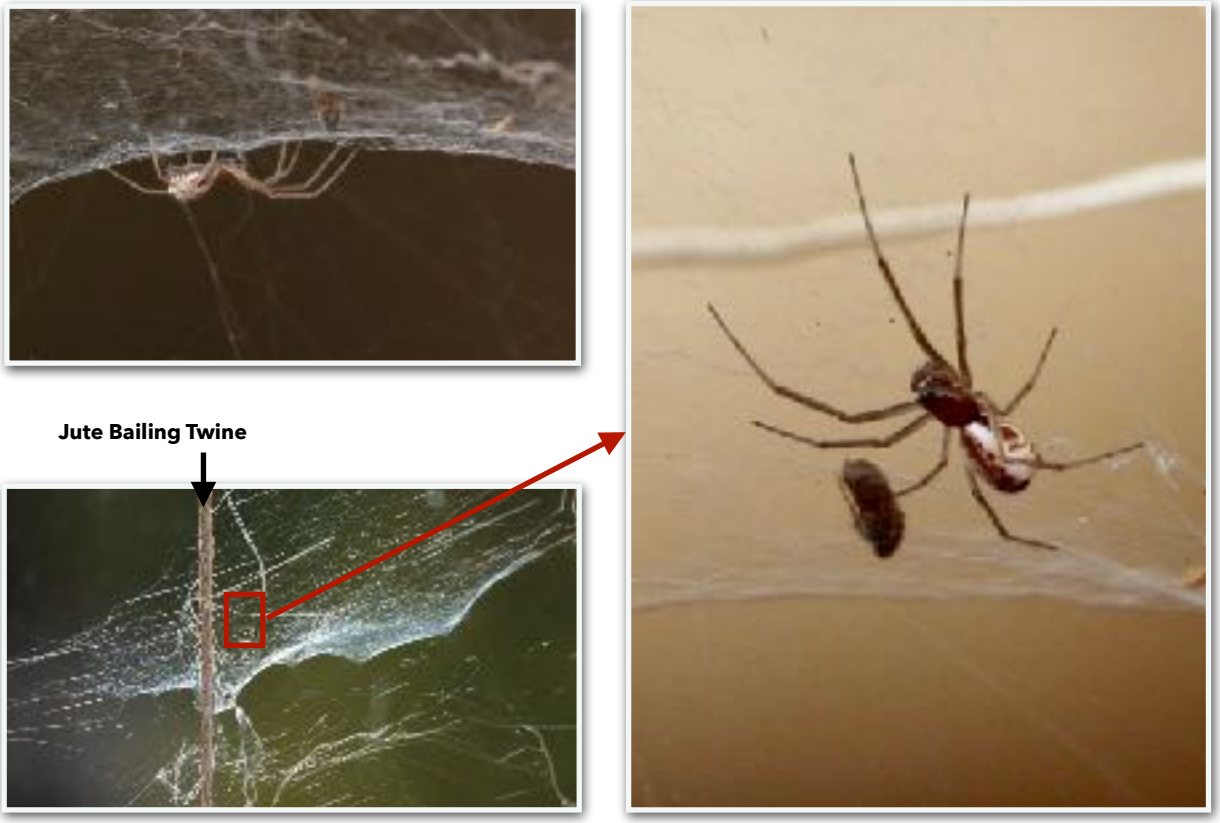
There are roughly 240 species of Wolf Spider in Canada and the U. S. Those species are dispersed through 21 genera. The genus Camptocosa was described in 2005 by Dondale, Jiménez & Nieto. *Camptocosa parallea,* formerly *Allocosa parallela* (Banks, 1898) is the type species for this new genus. This individual might be of that species: there are published records from New Mexico. Although there are published records of *C. texana* from Texas and Arizona, there are none from New Mexico.

Spider Size

To the right we provide an example of the significant size differences between the various spider species. It turns out, however, that size is not always a helpful characteristic. Adults of the same species may vary in size by a factor of two.

In general, spiders are between .02 and 3.5 inches in size (body length). The smallest spiders (.5 mm in length) can be difficult to discern. The largest spiders can cause one to wish they could not be discerned. Sometimes their leg span can be in the range of seven inches or more (think about a spider as large as a 5"x7" index card). Within the same species, female spiders are generally larger than the males, sometimes by a factor of two. When it comes to eating each other, this gives the female a distinct advantage.

In the image to the right, a tarantula is superimposed over the web of the *Frontinella huachua*, shown on the following page. In the top image on the previous page, the *Araneus* (which is not a huge spider) dwarfs a smaller spider at the bottom left.



Frontinella huachuca (above)

This individual was photographed in Hillsboro during December 2021. As you can discern from the jute bailing twine in the image above left, these spiders are very small. Given its small size, the lack of infrequent reporting of this species may be a function of observation rather than distribution. (Although unlikely, this individual is possibly *F. pyrametela,* which is found mostly in more humid areas of the east.) Spiders in this genus are commonly called Bowl and Doily Weavers because of the shape of their webs.

Photograph by Matilde Holzwarth on August 1, 2007. *Geolycosa* sp.

Geolycosa sp. (?) (left)

We certainly have burrowing wolf spiders in the Black Range. This is quite possible one of them, in the genus *Geolycosa*.

This image is a great example of spider identification difficulties. On the surface, this individual displays helpful identification characteristics. It is hairy; many species of spider are not. There is the general shape of the body, and there is that fine example of a black streak down its abdomen. It is that streak which led me to the possibility of an identification, a *Geolycosa*. But you can not see the eyes well in this photograph, and it turns out that the number of eyes and their placement are helpful characteristics when you are seeking to identify an individual. So I leave it at *Geolycosa* and note that may be in error.

Hogna frondicola (?)

This individual is most likely of the genus *Hogna (H. frondicola?)* There are roughly 240 species of Wolf Spider north of the Mexican border with the U. S. Of these 19 are in the genus *Hogna*. Spiders in this genus have eight eyes, as shown in the drawing to the left by Lynette Elliott (used under a Creative Commons License agreement). These spiders are large and live in burrows dug vertically into the ground. Photographs taken by Matilde Holzwarth on April 27, 2004.

Holocnemus pluchei

Marbled Cellar Spider

The presence of this Marbled Cellar Spider in a shed in Hillsboro is not necessarily good news. This species was introduced into California in about 1974, from the Mediterranean. It is the only species of the genus *Holocnemus* found in the United States and Canada.

Cellar Spiders (Family *Pholcidae*) are often called "Daddy Longlegs". There are 49 species of this family in Canada and the United States.

Lycosidae
Wolf Spiders

The photograph to the right, is probably of a *Pardosa*, Thin-legged Wolf Spider. It was photographed by Jan Richmond in Hillsboro. It is informative on several counts, not the least of which is the blue (silk) egg sac which it carries on its spinnerets. (See Web Weaving above.)

The identification of this spider to genus, *Pardosa,* is pretty certain. However, it may be a member of any one of a number of species: as of 2004, 23 *Pardosa* species had been identified from New Mexico. (The taxonomic listing at BugGuide, at the link above, is not complete.) There are 14 groups of *Pardosa* species in the United States. The genus is in the family *Lycosidae*, Wolf Spiders.

As wolf spiders go, the genus *Pardosa* includes relatively small spiders, with body lengths between 3 mm and 12 mm. For comparison, a US dime is about 18 mm in diameter. With legs, the largest species in this genus is about the size of a dime.

There are no apparent hairs on the bodies of many spider species. Wolf spiders, however, are covered in hair which is generally gray, black, and/or brown.

The spider at the lower right was photographed on August 22, 2013, in Railroad Canyon, Black Range. The image at the lower left was taken at Bald Hill Spring, north of Kingston. Both may be the same species, which may be *Arctosa littoralis*.

Additional Resource: "A Review of the Spider Genera Pardosa and Acantholycosa (Araneae, Lycosidae) of the 48 Continuous United States", Beatrice R. Vogel, *The Journal of Arachnology* 32:55-108, 2004, pp. 35 - 108.

Mecaphesa californica (?).

Crab Spider

There are 18 species of *Mecaphesa* in Canada and the United States, at least seven in New Mexico. Until 2008 nearly all of them were classified within the genus *Misumessus*.

This individual was found in Railroad Canyon on the west side of the Black Range during June 2019. It is possibly a female *Mecaphesa californica*.

Peucetia longipalpis

The Lynx Spider shown on this page was photographed by Matilde Holzwarth on August 6, 2006.

She is shown guarding her egg sac. The spider is most likely in the genus *Peucetia*, probably *P. longipalpis* - the Lesser Lynx Spider, but possibly *P. viridans* - the Green Lynx Spider. *P. longipalpis* is found in the Southwest, south to Belize or Venezuela (depending on source), while *P. viridans* is found across the southern tier of the U.S. south to Venezuela.

Phidippus (sp.)

Gray jumping spider (*Phidippus* sp.) ingesting from captured pallid-winged grasshopper (*Trimerotropis pallidipennis,* Burmeister, 1838); the grasshopper was still alive and was attempting to fly when photographed. Soledad Canyon. Photographs by James Von Loh.

Spider Hearing

Asserting commonality across species lines when it comes to sensory capabilities can be tricky. Trying to do so across Phylum lines can significantly limit our understanding of the natural world.

In "Outsourced Hearing in an Orb-Weaving Spider that Uses its Web as an Auditory Sensor", *Proceedings of the National Academy of Sciences*, March 29, 2022, Zhou, Lai, Menda, and Miles report their findings that a species of orb-weaving spider uses its web as an auditory sensory device. This is apparently the first documented use of something outside the body of a non-human animal to "hear". On a following page we note that the body parts used for auditory purposes are not the same in all species. The referenced study notes that not only does the spider (*Larinioides sclopetarius* - a species found in the Black Range) use something outside its body to sense auditory signals, it "functionally adjust(s) and regularly regenerate(s) its external 'eardrum' according to its needs".

Phidippus apacheanus

The male Apache jumping spider, *Phidippus apacheanus* (Chamberlain & Gertsch, 1929), which is pictured immediately below and to the right was photographed by James Von Loh in 2019. It is ingesting its prey while a fire ant(?) attempts to scavenge from the moth. The plant is climbing milkweed (*Funastrum cynanchoides* [Decne.] Schltr.). The site is the Rio Grande near La Llorona Park.

Phidippus carneus

Jan Richmond took the photograph (right) of the Red-backed Jumping Spider, *Phidippus carneus,* in Hillsboro on August 29, 2021.

The subject is probably a female. Note black streak running down the back of its abdomen.

This species is distinguished from *P. johnsoni* by the white crescent on its abdomen and the white lines which run along the edge of the sternum (not visible here). That said, these species are highly variable, and *P. johnsoni*, following page, is not officially described from this area.

Additional Resource: "Revision of the Jumping Spiders of the Genus Phidippus (Araneae: Salticidae)", G. B. Edwards, *Occasional Papers of the Florida State Collection of Arthropods*, Volume 2, 2004.

Phidippus johnsoni

The Red-backed Jumping Spider[1], *Phidippus johnsoni*, can probably hear you coming. So what?

First of all, a major disclaimer. The genus *Phidippus* includes 60 or more species. I infer that the findings for the species *P. audax* (below) may hold true for *P. johnsoni*.

Spiders do not have ears (tympanic ears, i.e., with an eardrum). Creatures with ears "hear" sound by assessing pressure waves. It appears that the species *P. audax* can detect sound from 10 feet or more away by detecting sound (airborne acoustic cues) through the hairs on its legs.[2]

(The effort that was used, in this study, to ensure there were no extraneous stimuli is impressive. The description of the study design used by Shamble[2] et al. is reason enough to read the study.)

Understanding the sensing of airborne stimuli by hairs, as in this study, is not, in itself, great insight. Many species use sensory hairs to understand their environment. (It is the reason it can be so difficult to catch a cricket, for instance.)

Airborne sound is composed of two components, a pressure wave and particle velocity. While our eardrums perceive the pressure wave, the leg hairs of *P. audax* perceive the particle velocity. The physics of these two components differs and is influenced by a variety of factors, not all of which affect both in the same way. For reasons associated with the physics, it has generally been assumed that species that perceive particle velocity are able to do so at shorter distances than those which use pressure gradients.

The frequencies which *P. audax* detect most effectively are those which correspond to the wing sound of wasps which prey on the spiders. The study found that when this frequency of sound is detected, the spiders freeze. It has been posited that the sensitivity of the leg hairs may also play a role in the courtship dance of the species. (See below.)

Phidippus johnsoni, photographed in Hillsboro, New Mexico.

It is asserted that this species is a mimic of mutillid wasps (*Dasymutilla*) which have a very painful sting. A photograph of a *Dasymutilla* with a Phidippus was shown previously. I suspect that this assertion is a reach.

The Internet Archive Wayback Machine has an interesting series of photographs of a male and female *P. johnsoni* "dancing".

Statstrom, Hoy et al, in "Ogre-Faced, Net-Casting Spiders Use Auditory Cues to Detect Airborne Prey", *Current Biology*, October 29, 2020, explored the auditory sensory capabilities of another species of spider, finding an integrated sensory system which uses multiple inputs to make decisions.

And it is this, the differences in life forms and capabilities, which makes the natural world such a joy to behold. All too often, people take a human-centric view of the world. They seem to think that life is a pyramid and they sit on top of it. But life is a spiderweb. Creatures hear with eardrums and with hairs on their legs. Neither is necessarily better than the other; it is all a matter of definition. It is all a value judgement. A value judgement does not make a fact.

1. **"Life History of Phidippus johnsoni" by Robert R. Jackson, *The Journal of Arachnology* 6:1-29**

2. **"Airborne Acoustic Perception by a Jumping Spider", Shamble, Menda Golden, Hoy et al., *Current Biology*, November 7, 2016.**

Additions to the Galleries

Additional bug species have been added to the photo galleries of the Black Range Website since our last issue.

Lycus loripes

In June and July of this year, Hillsboro was swarmed by thousands of these orange flying bugs. It has no common name.

They remained for weeks, flying about everywhere. There were no obvious predators.

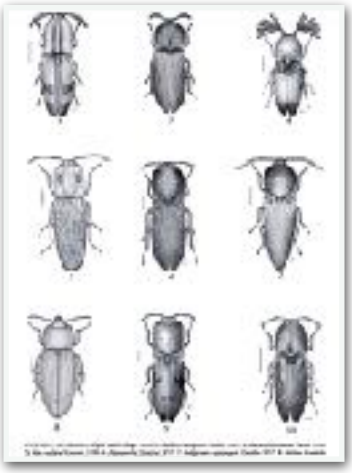
There are eleven species of *Lycus* in Canada and the United States.

Some authorities have broken Lycus into different genera. If that is followed, this individual would be *Lycostomus loripes*.

Members of this genus are found in the U. S. Southwest into Mexico.

By July 29, 2022, larvae of the genus were on the ground (see photographs at the top of the page), assumed to be larvae of the species.

If the taxonomy of this group of beetles interests you see, "Cladistic analysis of Hemirhipini with establishment of Propalaus gen. nov. (Coleoptera, Elateridae, agrypninae)", Sônia A. Casari, *Papéis Avulsos de Zoologia*, Volume 48, 2008, a page of which is shown below, may interest you.



***Alaus zunianus*, Casey 1893**
Zuni Click Beetle
Photographs by Tom Lander.

This beetle is typically seen between May and August. It is most similar in appearance to *A. lusciosus*. *A. zunianus* was once considered a subspecies of *A. lusciosus*. Species in this genus have large eyespots on the pronotum - nope, those big eyes on the "head" are not eyes. The eyes are behind the antennae. The pronotum is the upper plate of the prothorax, the front part of the thorax. The front legs of the beetle extend from the prothorax.

Arachis zuni

The photographs of *Arachis zuni* shown here were taken by Matilde Holzwarth in Railroad Canyon, southwest of Hillsboro Peak, on June 8, 2012.

The hand on which the moth sits is that of her husband, Lloyd Barr, pictured to the right. Matilde and Lloyd were professors, researchers, and naturalists who explored the environs of the Black Range during most of the first two decades of the twenty-first century.

We are in the process of gathering material for an upcoming publication on the moths and butterflies of the Black Range. Please review the April 2022 issue to see the species we already have covered. We will take the species accounts from that issue and use them as the core for the new publication. Our focus will be on photographs taken in the Black Range. If you can add material, everyone will appreciate it.

Antheraea oculea

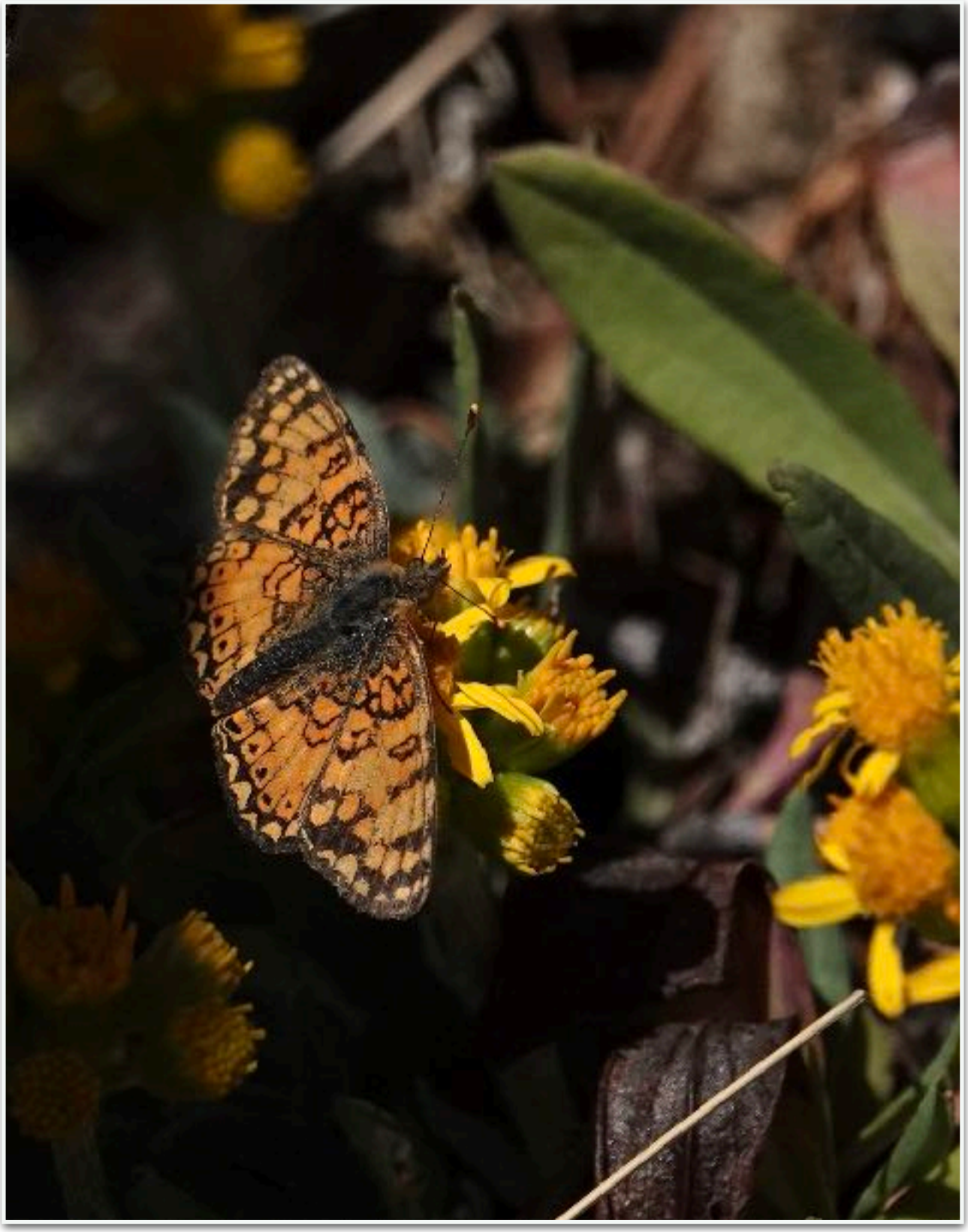
The photographs of *Antheraea oculea*, Western Polyphemus, shown here were taken by Tom Lander in Kingston during June 2022. Some consider it a subspecies of *Antheraea polyphemus*.

Epargyreus clarus

This Silver-spotted Skipper was photographed in Railroad Canyon, on the west slope of the Black Range, on May 13, 2022. This species does not like yellow flowers - other colors yes, yellow, no. At night, Silver-spotted Skippers can be found "perching" upside down on the bottom side of leaves. Sometimes they will exhibit this behavior on especially hot days. This species is found in most of the eastern U.S. and in much of the west.

Phyciodes mylitta
Mylitta Crescent

The Mylitta Crescents shown below and on the following page lack a black spot within the orange spot at the outer lower part of the forewing, distinguishing it from the butterflies in the Pearl Crescent group. Photographed along Mineral Creek, north of Kingston, NM, on April 22, 2022.



Enhancing Non-Institutional Science - The Black Range Exchange

The Black Range Naturalist, the Black Range website, and various associated efforts are happy to announce the establishment of a new initiative, The Black Range Exchange.

All of us need some help from time to time and often we are willing to help others in their worthwhile endeavors. How to obtain help, or how to help, can be difficult to ascertain, especially for those who are functioning outside of an institutional setting.

The mission of The Black Range Exchange is simple. It seeks to let those who need assistance and those who are willing to assist, know about each other. The Black Range Exchange website (www.blackrange-ex.org) has been established to align resources. The effort is in its infancy, perhaps ill-formed, certainly inclined to evolve, and maybe doomed to failure. But, if it succeeds in one instance it will have been a worthwhile effort.

A portion of the home page of the website is shown to the right. The home page describes what you need to do if you have a project which you believe others can support and how you can arrange to contact those with projects, should you wish to support their efforts. In general, The Exchange is meant to be a forum through which contact occurs. The Exchange is not involved in what happens thereafter. Projects should be focused on natural history. The project does not have to be focused in the Black Range. Assistance sought should not be financial.

At this time, three projects have been described. They are:

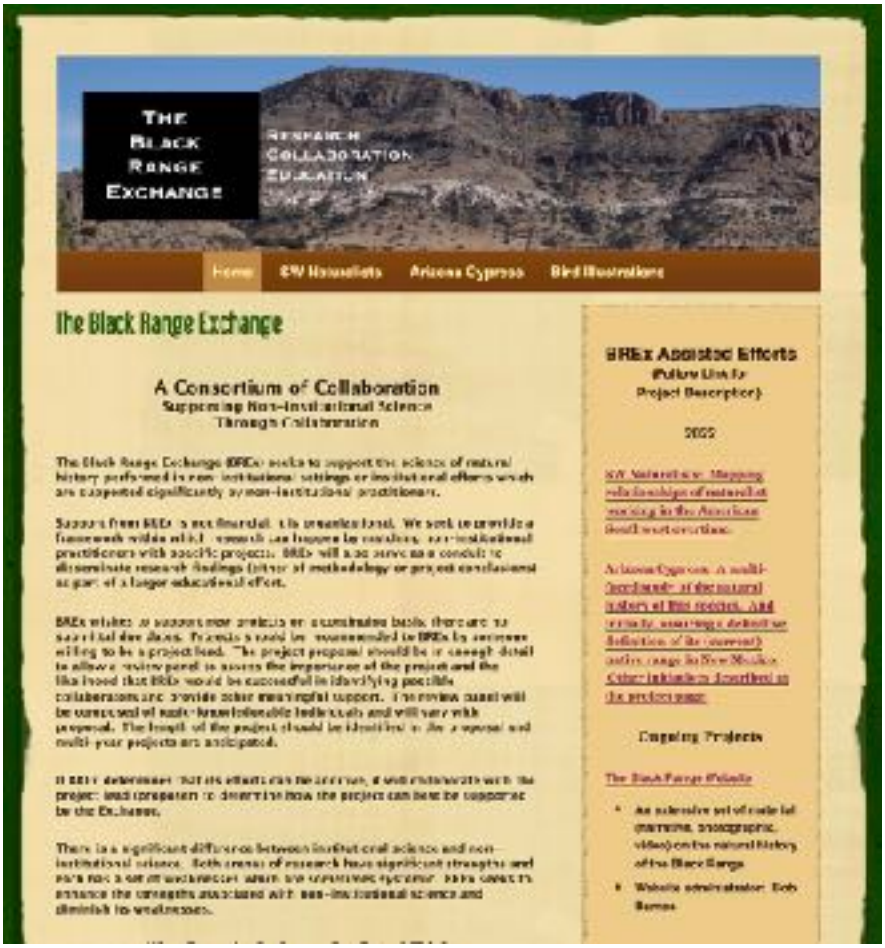
- **SW Naturalists - The initial step in this project was the publication of Early Naturalists of the Black Range. The next step in this effort will be the development of a relationship map of naturalists working in or on the natural history of the Southwest, in five-year increments, starting with 1700.**

  This project attempts to define the relationships between the early naturalists in the American Southwest, how they came to their knowledge, how they were influenced, and how they influenced others. This project is limited to post-contact exploration.

- **Arizona Cypress - In the last issue of this magazine we described our current level of knowledge about the Arizona Cypress in New Mexico.**

  In this project the focus will shift somewhat to include additional surveys to determine if there are other populations in southwest New Mexico and what environmental and/or geographic factors appear to support the establishment and continued existence of relict populations.

- **Bird Illustrations - This project attempts to catalog historical illustrations of avian species. Many source works are currently maintained on the website, compilations are underway (roughly 3,000 illustrations thus far), and material is being developed about early avian illustrators. But there is much more to do. You can help by identifying additional source material, developing the illustration extracts of the source material, or by researching and/or writing sections on the various artists or artistic ventures.**



Our hope is that we will not only be able to advance these specific efforts but also identify others to add to the inventory.

As always, all material will be made available under a Creative Commons license and the efforts of those involved will be acknowledged. For additional information, contact Bob Barnes at rabarnes@blackrange.org. Everything about this project is "up for grabs". Let's do this together.

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