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A glimpse into the aquatic macroinvertebrate diversity in Palomas Creek

by Andrew G. Cannizzaro, Mary P. Jones, and Dustin Long

Upon leaving the slopes of the Black Range, heading east on State Road 152 towards Truth or Consequences, aquatic animals likely do not immediately cross one's mind, especially upon taking in the landscape and viewing a sea of creosote, prickly pear, and yucca. However, even arid regions such as this can hold hidden jewels. Due to the relative scarcity of surface water in arid/xeric regions, waterways within these systems regularly display relatively limited connectivity. These waterways are often intermittent or run underground, and while this may seem detrimental for life, it also allows them to act as islands, which in turn grants them the ability to function as proverbial 'cradles' of biodiversity; the taxa that dwell within them are typically unique or relictual in nature. Examination of systems such as those in the Cuatro Ciénegas basin of Coahuila and the Lake Eyre basin of South Australia lends credence to this line of thought. Both systems lie in arid/desert environments and are host to suites of unique taxa, which are often endemic to the individual spring or waterway that they occupy (Murphy et al., 2015; Souza et al., 2018). Similar systems are present in the southwestern United States, but despite their penchant for containing unique taxa, relatively little attention has been given to most individual systems. This is especially true in the Chihuahuan Desert where for a majority of waterways inventories are lacking.

One such example can be observed in Palomas Creek. The creek is a tributary of the Rio Grande and is located entirely within Sierra County. Palomas Creek is sourced along the eastern slope of the Black Range near the Continental Divide, where it emerges as two distinct forks that eventually converge as they move further east. From here the now singular Palomas Creek then joins, intermittently, with the Rio Grande south of Truth of Consequences in the census-designated place of Las Palomas. Despite the creek's relatively large size, quite little is known about the aquatic invertebrate biodiversity in this system and similar systems in the region. During the summer of 2020, we sought to rectify this by conducting an inventory of a section of Palomas Creek located on the Ladder Ranch in Sierra County. In order to begin to gauge the aquatic invertebrate diversity present within Palomas Creek, four sites on the creek east of the confluence of the north/south forks were sampled, with a sub focus on the impact a beaver meadow located along the creek may have on community composition. Two of the sites were located above this meadow, and two were located within/below. To capture the full extent of diversity we selected habitats both dominated by vegetation (associated with lower flow) and habitats with less vegetation (associated with higher flow rocks and riffles) in areas both below and above the beaver meadow (see tables for locality information). In sampling, we recorded a surprising amount of diversity. In total, we observed several invertebrate taxa from 6 phyla, 11 classes, and 16 orders.



A Bladder Snail (*Physella* sp.). Members of this genus are common inhabitants of aquatic systems across most of North America and are the most common non-arthropod invertebrate in our samples.

Table 1. Site 1, road crossing near house, slow flowing water. (33.180917, -107.531194).

Phylum	Class	Order	Family	Genus	Species	Count
Mollusca	Gastropoda	Heterobranchia	Physidae	*Physella*	sp.	73
Mollusca	Gastropoda	Heterobranchia	Planorbidae	-	-	3
Mollusca	Bivalvia	Sphaeriida	Sphaeriidae	*Pisidium*	-	47
Platyhelminthes	Turbellaria	Tricladida	Dugesiidae	*Girardia*	-	8
Annelida	Clitellata	Rhynchobdellida	Piscicolidae	*Myzobdella*	-	1
Annelida	Clitellata	-	-	-	-	1
Arthropoda	Hexapoda	Hemiptera	Corixidae	-	-	8
Arthropoda	Hexapoda	Hemiptera	Veliidae	*Microvelia*	sp.	1
Arthropoda	Hexapoda	Hemiptera	Naucoridae	*Ambrysus*	sp.	1
Arthropoda	Hexapoda	Diptera	Simuliidae	-	-	1
Arthropoda	Hexapoda	Diptera	Chironomidae	-	-	11
Arthropoda	Hexapoda	Coleoptera	Gyrinidae	-	-	1
Arthropoda	Hexapoda	Coleoptera	Elmidae	-	-	2
Arthropoda	Hexapoda	Coleoptera	Haliplidae	-	-	2
Arthropoda	Hexapoda	Coleoptera	Hydrophilidae	-	-	1
Arthropoda	Hexapoda	Coleoptera	Dytiscidae	*Nectoboreus*	*aequinoctialis*	1
Arthropoda	Hexapoda	Odonata	Coenagrionidae	-	-	8
Arthropoda	Hexapoda	Odonata	Corduliidae	*Epitheca*	sp.	1
Arthropoda	Hexapoda	Trichoptera	Lepidostomatidae	-	-	18
Arthropoda	Hexapoda	Trichoptera	Helicopsychidae	*Helicopsyche*	sp.	21
Arthropoda	Hexapoda	Ephemeroptera	Baetidae	-	-	83
Arthropoda	Arachnida	Trombidiformes	-	-	-	1
Arthropoda	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*lacustris*	15
Arthropoda	Ostracoda	Podocopida	Candonidae	-	-	4
Nematoda	Chromadorea	-	-	-	-	1
Nematomorpha	Gordioida	Gordioidea	-	-	-	1
					TOTAL	**315**

Table 2. Site 2, road crossing near house, riffle area, ~25 m downstream from site 1.

Phylum	Class	Order	Family	Genus	Species	Count
Mollusca	Gastropoda	Heterobranchia	Physidae	*Physella*	sp.	12
Platyhelminthes	Turbellaria	Tricladida	Dugesiidae	*Girardia*	sp.	12
Annelida	Clitellata	-	-	-	-	1
Arthropoda	Hexapoda	Trichoptera	Helicopsychidae	*Helicopsyche*	sp.	30
Arthropoda	Hexapoda	Trichoptera	Philopotamidae	-	-	3
Arthropoda	Hexapoda	Trichoptera	Glossosomatidae	-	-	2
Arthropoda	Hexapoda	Trichoptera	Hydropsychidae	-	-	44
Arthropoda	Hexapoda	Trichoptera	Leptoceridae	-	-	2
Arthropoda	Hexapoda	Trichoptera	-	-	-	12
Arthropoda	Hexapoda	Odonata	Aeshnidae	-	-	1
Arthropoda	Hexapoda	Ephemeroptera	Baetidae	-	-	57
Arthropoda	Hexapoda	Ephemeroptera	Tricorythidae	*Leptohyphes*	sp.	5
Arthropoda	Hexapoda	Coleoptera	Elmidae	-	-	24
Arthropoda	Hexapoda	Coleoptera	Haliplidae	-	-	1
Arthropoda	Hexapoda	Coleoptera	Gyrinidae	-	-	2
Arthropoda	Hexapoda	Hemiptera	Naucoridae	*Ambrysus*	sp.	9
Arthropoda	Hexapoda	Diptera	Tipulidae	-	-	2
Arthropoda	Hexapoda	Diptera	Simuliidae	-	-	36
Arthropoda	Hexapoda	Diptera	Ceratopogonidae	-	-	4
Arthropoda	Hexapoda	Diptera	Chironomidae	-	-	9
Arthropoda	Hexapoda	Diptera	Empididae	-	-	3
Arthropoda	Hexapoda	Diptera	-	-	-	5
Arthropoda	Hexapoda	Lepidoptera	Pyralidae	-	-	1
Arthropoda	Arachnida	Trombidiformes	-	-	-	10
Arthropoda	Ostracoda	Podocopida	-	-	-	1
					TOTAL	**288**

In total, 1,196 individuals were observed across all four sites; of these the most abundant taxon, regardless of site, consisted of nymphal members of the mayfly family *Baetidae*, which accounted for 24% of the total individuals observed, and ~20-29% of individuals within sites. Following this, members of the genus *Physella* (an air-breathing aquatic snail) were the second most abundant, accounting for 15% of the total individuals observed. To better quantify the diversity both within and between our sites, we utilized four analytical methods of measuring biodiversity:

(I) richness (R), the count of the number of species present; since we were unable to identify all taxa to species, we used morphospecies as a proxy.

(II) the Gini-Simpson Diversity Index (1-D), a measure of biodiversity that takes relative abundance into account. Simply put this metric examines the probability that two randomly selected individuals from a sample will belong to the same taxon (Jost, 2006). The value can vary from 0-1, where a value of zero indicates that only a single species was present and a value of 1 indicates that there are multiple species within the community, and they are of even abundance.

(III) the Shannon-Wiener Species Diversity Index (H), this metric is similar to Gini-Simpson's but measures the "entropy" within a particular system. This is done by calculating the probability a randomly selected individual will be chosen from the sample; as a result, this metric puts more weight on richness when compared to Gini-Simpson's which emphasizes evenness (Spellerberg & Fedor, 2003). The index varies from 0 (no diversity) to R (the taxon richness), i.e., the higher the value the more diverse the community.



Above: *Nectoboreus aequinoctialis*, a predaceous diving beetle (*Dytiscidae*).

(IV) the Sørensen Index (S), a metric which measures the similarity between two habitats, by directly assessing similarity between two localities (Sørensen, 1948). This metric functions by examining the ratio of taxa shared between sites. The index varies from 0 (no overlap) to 1 (complete overlap).



Above: A baetid mayfly nymph. The most common invertebrate taxon observed across all sites.

Morphospecies richness among sites varied from 20-26 (R; Table 5). No strong trends were observed, with all sites showing similar values, although it appears that sites above the beaver meadow contained slightly more taxa (R; Table 5). Values of Gini-Simpson's index calculated here (1-D; Table 5), indicated relatively high diversity in all of the sites examined, with values all above 0.80. Between sites no strong trends were observed in this metric; the highest diversity was observed in site 2 (riffle habitat, above the beaver meadow), but other values were fairly similar, suggesting that habitat type and the beaver meadow did not play a large role in community diversity. Contrasting this, relatively low values were recovered for the Shannon-Wiener index, with all sites displaying values of ~2 out of a possible 20-26 (H; Table 5). This is likely due to the nature of the index, with it being much more sensitive to species richness, and if there are multiple 'rare' taxa that have low abundance (as was observed in our sites which were numerically dominated by only a few taxa), then the value will be reduced.

Examination of community followed similar trends, with most sites displaying relatively comparable similarities, regardless of habitat type and/or location relative to the beaver meadow (Table 6). One notable

Table 3. Site 3, beaver meadow, deep vegetated pool (33.182583, -107.524944).

Phylum	Class	Order	Family	Genus	Species	Count
Mollusca	Gastropoda	Heterobranchia	Physidae	*Physella*	sp.	40
Mollusca	Gastropoda	Heterobranchia	Planorbidae	-	-	22
Annelida	Clittellata	Rhynchobdellida	Glossiphoniidae	*Helobdella*	sp.	2
Arthropoda	Hexapoda	Hemiptera	Veliidae	*Microvelia*	sp.	2
Arthropoda	Hexapoda	Hemiptera	Naucoridae	*Ambrysus*	sp.	3
Arthropoda	Hexapoda	Hemiptera	Corixidae	-	-	39
Arthropoda	Hexapoda	Hemiptera	Belostomatidae	-	-	1
Arthropoda	Hexapoda	Coleoptera	Haliplidae	-	-	9
Arthropoda	Hexapoda	Coleoptera	Hydrophilidae	-	-	5
Arthropoda	Hexapoda	Coleoptera	Dytiscidae	-	-	27
Arthropoda	Hexapoda	Diptera	Culicidae	-	-	1
Arthropoda	Hexapoda	Diptera	Tipulidae	-	-	1
Arthropoda	Hexapoda	Odonata	Gomphidae	-	-	1
Arthropoda	Hexapoda	Odonata	Corduliidae	*Epitheca*	sp.	2
Arthropoda	Hexapoda	Odonata	Coenagrionidae	-	-	23
Arthropoda	Hexapoda	Ephemeroptera	Tricorythidae	-	-	7
Arthropoda	Hexapoda	Ephemeroptera	Baetidae	-	-	65
Arthropoda	Hexapoda	Ephemeroptera	-	-	-	1
Arthropoda	Branchiopoda	Cladocera	Daphniidae	*Simocephalus*	sp.	1
Arthropoda	Ostracoda	Podocopida	-	-	-	3
					TOTAL	**255**

Table 4. Site 4, downstream from beaver meadow, riffle area (33.182028, -107.524000).

Phylum	Class	Order	Family	Genus	Species	Count
Mollusca	Gastropoda	Heterobranchia	Physidae	*Physella*	sp.	55
Mollusca	Gastropoda	Heterobranchia	Planorbidae	-	-	34
Mollusca	Bivalvia	Sphaeriida	Sphaeriidae	-	-	1
Platyhelminthes	Turbellaria	Tricladida	Dugesiidae	*Girardia*	sp.	7
Platyhelminthes	Turbellaria	Tricladida	Dugesiidae	*Schmidtea*	sp.	1
Platyhelminthes	Turbellaria	Tricladida	Dugesiidae	-	-	1
Platyhelminthes	Turbellaria	Tricladida	-	-	-	1
Annelida	Clitellata	-	-	-	-	11
Annelida	Clitellata	Rhynchobdellida	Glossiphoniidae	*Helobdella*	sp.	1
Arthropoda	Hexapoda	Hemiptera	Belostomatidae	-	-	3
Arthropoda	Hexapoda	Hemiptera	Naucoridae	*Ambrysus*	sp.	41
Arthropoda	Hexapoda	Coleoptera	Ptilodactylidae	-	-	3
Arthropoda	Hexapoda	Coleoptera	Elmidae	-	-	4
Arthropoda	Hexapoda	Diptera	Chironomidae	-	-	10
Arthropoda	Hexapoda	Diptera	Simuliidae	-	-	4
Arthropoda	Hexapoda	Diptera	-	-	-	1
Arthropoda	Hexapoda	Trichoptera	Lepidostomatidae	-	-	2
Arthropoda	Hexapoda	Trichoptera	Hydropsychidae	-	-	25
Arthropoda	Hexapoda	Trichoptera	Helicopsychidae	*Helicopsyche*	sp.	28
Arthropoda	Hexapoda	Trichoptera	-	-	-	8
Arthropoda	Hexapoda	Ephemeroptera	Tricorythidae	-	-	6
Arthropoda	Hexapoda	Ephemeroptera	Baetidae	-	-	83
Arthropoda	Hexapoda	Odonata	Calopterygidae	*Hetaerina*	sp.	6
Arthropoda	Arachnida	Trombidiformes	-	-	-	2
					TOTAL	**338**

Table 5. Values for the measures of biodiversity calculated within all sites

Site	Type	Location relative to beaver meadow	R	1-D	H
Site 1	Pool	Above	26	0.84	2.24
Site 2	Riffle	Above	25	0.90	2.57
Site 3	Pool	Below	20	0.86	2.24
Site 4	Riffle	Below	24	0.87	2.41

Table 6. Sørensen index values calculated for all combinations of sites.

Sites	S
Site 1 vs. Site 2	0.50
Site 1 vs. Site 3	0.47
Site 1 vs. Site 4	0.52
Site 2 vs. Site 3	0.31
Site 2 vs. Site 4	0.57
Site 3 vs. Site 4	0.31
Above vs. Below Beaver Meadow	0.66
Riffles vs. Pools	0.57

Table 7. Macroinvertebrate biotic index (MBI) values calculated for all sites and a combination of sites. MBI values from 5.01 - 5.70 are considered fair, while values below that are considered good to excellent, and values above are considered poor to very poor.

Sites	MBI Value	Rating
Site 1	5.25	Fair
Site 2	4.85	Good
Site 3	5.53	Fair
Site 4	5.44	Fair
Sites above Beaver Meadow	5.08	Fair
Sites below Beaver Meadow	5.47	Fair
All sites combined	5.24	Fair

exception was observed in Site 3 (the pool created by the beaver meadow). This habitat was notably deeper than the others and contained much more vegetation, and this different habitat likely is the cause for the dissimilarly observed. This can also be observed by examining the taxa that were recorded from the site, where many more taxa displayed adaptations for swimming, such as members of the *Corixidae* (Water Boatmen) and the *Dytiscidae* (Diving Beetles), when compared to other sites (Table 3).

In addition to the aforementioned diversity indices, we also sought to quantify water quality by utilizing a macro-invertebrate biotic index (MBI). To accomplish this, these indices take into account the presence/absence and abundance of select taxa; quality is measured by considering the presence and proportion of 'sensitive' species (taxa like stoneflies, caddisflies, etc.) compared to taxa that are more tolerant of polluted environments (taxa like chironomid larvae, leeches, etc.) To allow for easier comparison, we elected to use an index created by the Illinois RiverWatch for our analyses. This index utilizes a standard metric, where MBI values can be quickly compared, values typically ranging from ~4-6, with lower values being indicative of better quality. All sites examined displayed MBI values ranging from 4.8 to 5.4, with corresponding ratings of mostly fair to good. Values remained similar even when pooled (Table 7). These results suggest a relatively healthy habitat, which is well illustrated by the number of taxa recovered here; however, it is worth noting that the ratings presented here may be skewed by our selection of MBI, which was developed to be general in scope. Different ratings might be recovered if these data were run through an index redesigned for taxa occurring in the Chihuahuan Desert.



A naucorid water bug (*Ambrysus* sp.) feeding on a caddisfly larva. Members of this genus often display high levels of endemicity.

Among the taxa collected, some of the most fascinating were the caddisflies. These insects of the order *Trichoptera* resemble moths as adults, but as larvae, they spend most of their lives in the water. Caddisflies are industrial insects, possessing the ability to construct a variety of structures using silk. Different caddisfly taxa are characterized by either building cases (structures made up of objects in the environment held together by silk, that the animal carries with it and uses for protection) or retreats (larger silk-laden structures that the animal can reside in and use to funnel/ collect food items) (Wiggins, 1996). In samples collected from Palomas Creek, we observed six families of caddisflies; of these, four were case-builders and two were taxa that utilized retreats. Perhaps unsurprisingly, retreat utilizing taxa (*Philopotamidae* / *Hydropsychidae*) were only observed in sites containing higher flow (Sites 2+4), while case-making taxa were present in all sites where caddisflies were observed.



Above: Silken treasure! A case made up of leaf segments built by a caddisfly (possibly a *calamoceratid*).

Below: Members of the family *Philopotamidae*, these animals construct a net-like mesh made of silk in flowing water to collect food items.



While a majority of the arthropods collected were insects, representatives of the *Crustacea* were present as well. These were mainly in the order *Amphipoda*, a group of small shrimp-like crustaceans that are actually more closely related to the terrestrial roly-polies than to true shrimp. Two species were present in and near Palomas Creek:

(I) *Gammarus lacustris,* a wide-ranging species that herein is reported for the first time from Sierra County and represents one of its southern-most occurrences;
(II) A member of the genus *Hyalella*, a poorly understood genus that is found throughout North and South America.



Above: A *lepidostomatid* caddisfly. Members of this family build cases using bits of organic material such as bark and leaves or grains of sand. These cases are often circular or rectangular and are carried around as observed here.

Below: A caddisfly of the genus *Helicopsyche*, an unusual genus that constructs cases that mimic snail shells.



Individuals of *G. lacustris* were present in the stream in moderate abundance but were notably absent from riffles and areas associated with the beaver meadow. In addition, *Hyalella* were only observed in a small spring run feeding Palomas Creek proper which lay outside of our selected sites. Genetic analyses of these determined that they are likely a new species, which is presumably endemic to the spring, likely occurring nowhere else in the world! Analyses of this population are ongoing.

Through our collection efforts, we shed some much-needed light on the unique aquatic invertebrate communities present in Palomas Creek. Here, an unexpected number of taxa were observed, including representatives of over 45 morphospecies which were identified to 39 unique families



Above: *Gammarus lacustris*, an amphipod, recorded for the first time in Sierra County.

(Tables 1-4). These included common taxa like *Physella* and baetid mayflies (taxa that enjoy distributions throughout the United States) but also included organisms of interest such as *Gammarus lacustris*, and several families of caddisflies. Our examination of various indices of biodiversity corroborates this, with most measures suggesting relatively high diversity in all sites examined (Table 5). Although we sampled several locations and included a set of habitat types, community similarity was not observed to vary much, with all sites displaying relatively similar values. The only notable exception to this was observed in site 3 which was visibly deeper and more well-vegetated than the other sites, allowing for a slightly different community to form. Furthermore, examinations of invertebrate communities as a proxy for water quality were suggestive of a relatively healthy system, where taxa intolerant of pollution were present in meaningful numbers (Table 6). In total, the results presented here not only highlight the diversity present within Palomas Creek but also spotlight the potential for biodiversity which can exist even in relatively unassuming systems like Palomas Creek.

Invertebrate taxa remain under-sampled in the Chihuahuan Desert, and the likelihood for novel taxa and/or new range records continues to be high. This trend is illustrated by examinations of numerous taxa such as amphipod crustaceans (Adams et al., 2018), hydrobiid gastropods (Czaja et al., 2022), and flatworms (Inoue et al., 2020), among others. Our results continue to follow this trend; while most taxa were not examined beyond family, those that were (*Gammarus*, *Hyalella*) were revealed to likely represent new species or new range records. In addition, we highlight the presence of several taxa that show a proclivity for endemicity, such as *Girardia* (Inoue et al., 2020) and *Ambrysus* (Reynoso-Velasco & Sites, 2016). Further research into Palomas Creek and other similar systems in the region has the potential to uncover additional hidden biodiversity and provide information on the ecology and behavior of the poorly known taxa which inhabit them. It's easy to discount what lies underfoot while splashing through systems like Palomas Creek and others that cross the landscape of the Chihuahuan Desert. However, a closer look can reveal these systems for what they truly are, habitats for animals that are just as enchanting and varied as those occupying the land surrounding them.

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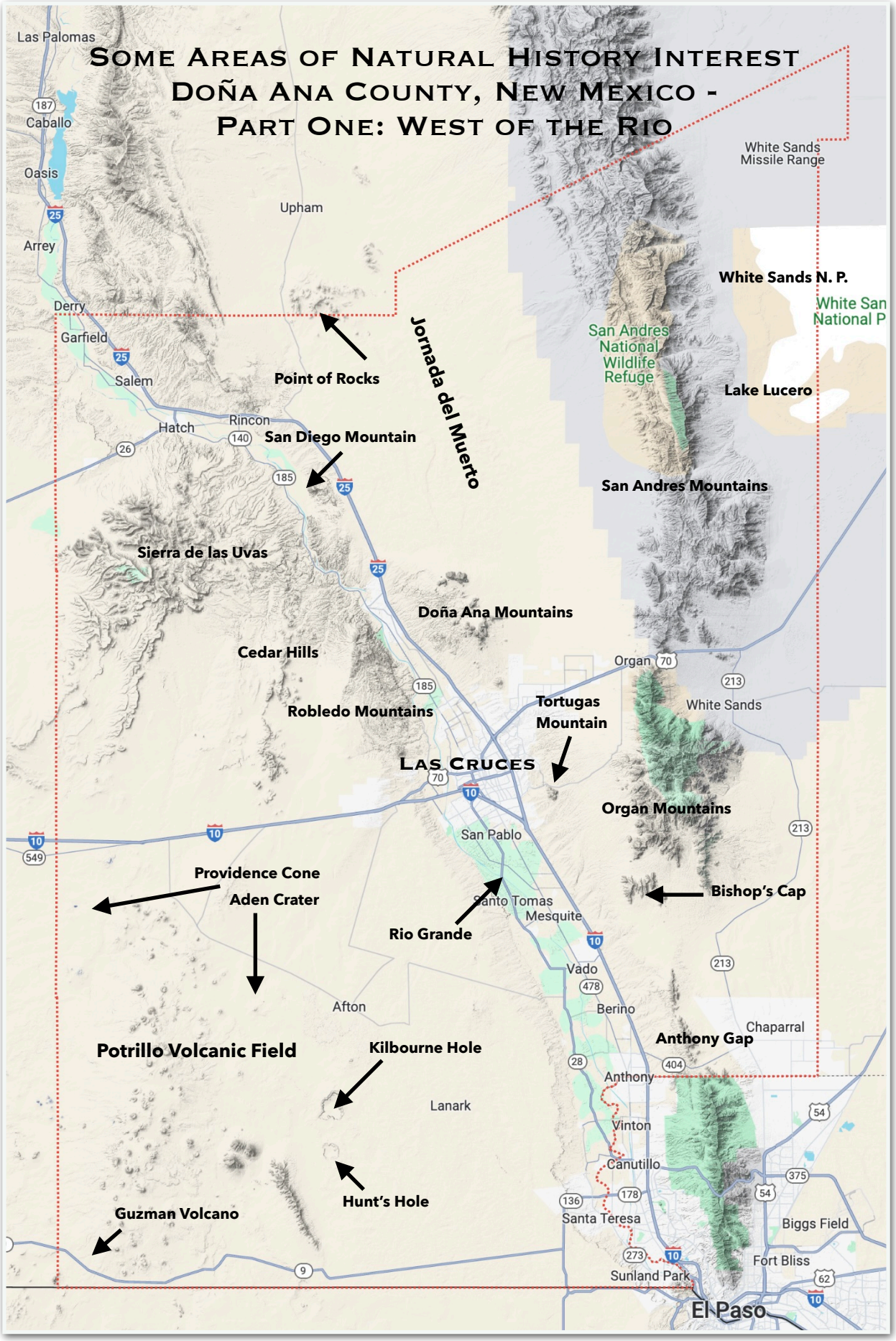
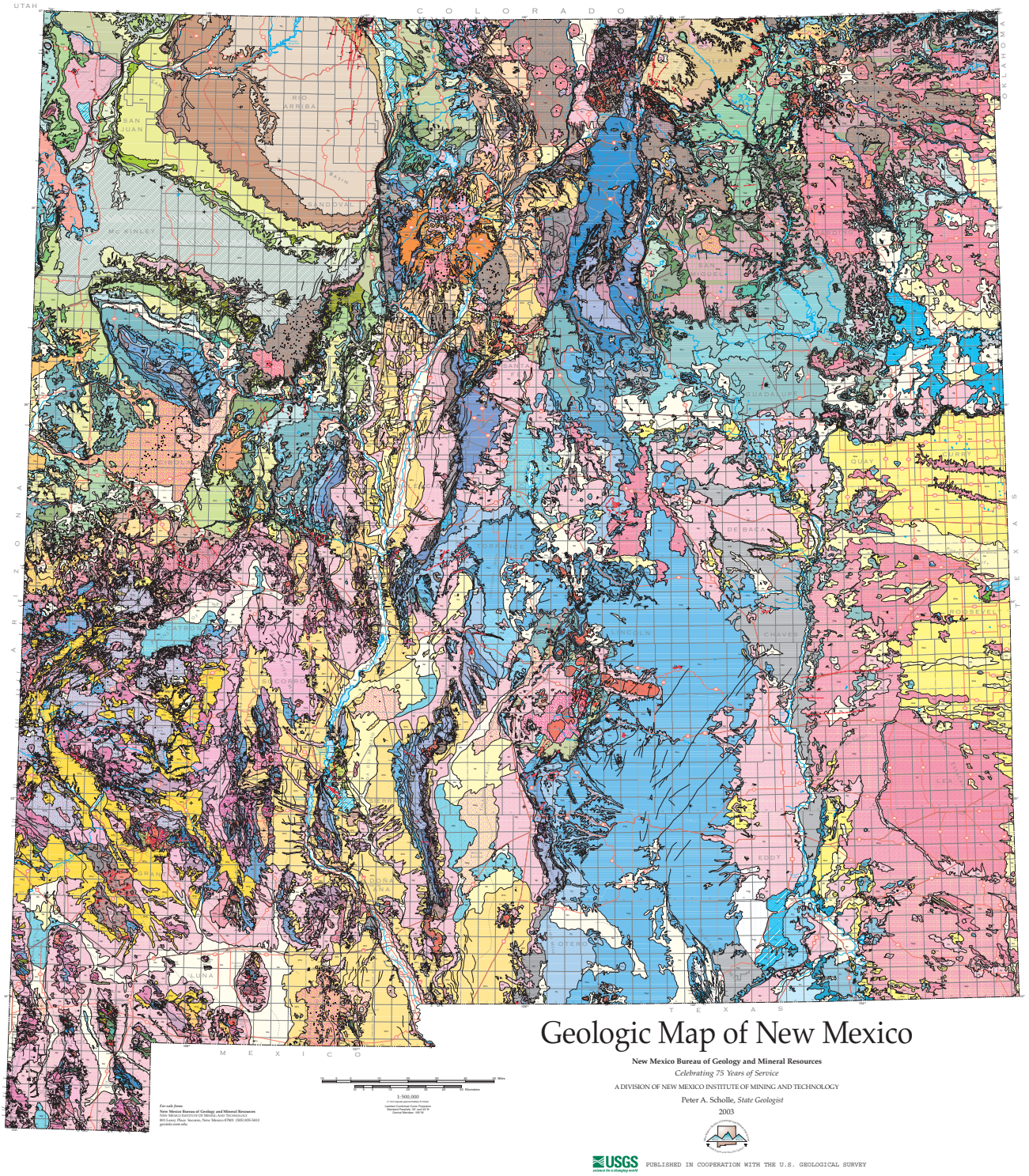

Some Areas of Natural History Interest
Doña Ana County, New Mexico -
Part One: West of the Rio
Las Palomas
Caballo
Oasis
Arrey
Upham
Derry
Garfield
Salem
Hatch
Rincon
Point of Rocks
Jornada del Muerto
San Diego Mountain
Sierra de las Uvas
Doña Ana Mountains
Cedar Hills
Robledo Mountains
Tortugas Mountain
Las Cruces
San Pablo
Organ Mountains
Bishop's Cap
Providence Cone
Aden Crater
Rio Grande
Santo Tomas
Mesquite
Vado
Berino
Afton
Potrillo Volcanic Field
Kilbourne Hole
Lanark
Hunt's Hole
Guzman Volcano
Anthony Gap
Chaparral
Anthony
Vinton
Canutillo
Santa Teresa
Biggs Field
Fort Bliss
Sunland Park
El Paso
White Sands Missile Range
White Sands N. P.
White San National P
San Andres National Wildlife Refuge
Lake Lucero
San Andres Mountains
Organ
White Sands



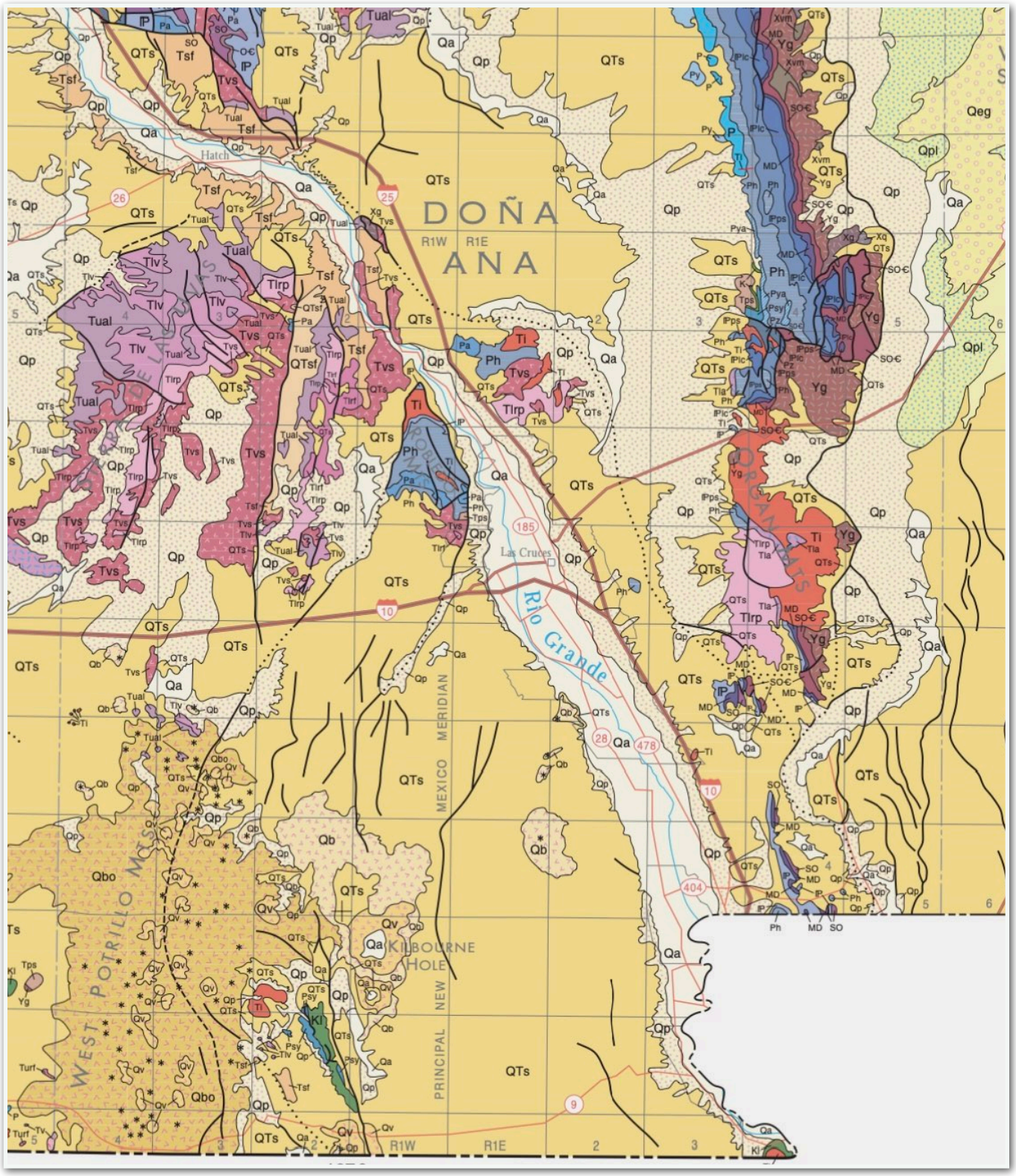
Doña Ana Geology

New Mexico is widely varied geologically. Doña Ana County includes varied geologic strata and forms, making it an excellent place to study this aspect of natural history. To provide context, we start with the Geologic Map of New Mexico (New Mexico Bureau of Geology and Mineral Resources, 2003, Scale 1:500,000) which is shown above and may be downloaded at this link. It is a pretty piece of art, and the significance of the art is enhanced by the Explanation for Geologic Map of New Mexico.

On the following page we have excerpted that portion of the state map which covers Doña Ana County. Readily apparent are three of the major geologic regions of the county: the Potrillo Volcanic Field at the lower left, the Sierra de las Uvas (and adjacent hills) at the upper left, and the San Andres and Organ Mountains at the right. But do not be fooled by some of the less busy areas on the map. The Rio Grande flood plain and the Jornada del Muerto are major geologic features which have significant effect on the flora and fauna of the region.

Although we start with the Potrillo Volcanic Field, the areas of interest are not presented in any particular order. Adjacent areas were often influenced significantly by the same geologic activity, but it is possible to gain insights from the study of each individual area. It is simply a question of where you want to draw the box. Is it a big box (state-wide or North America) or is it a much smaller area? Geology is a complex science, with large numbers of variables whose significance significance change over time. It is like looking into a front-loading washing machine and trying to figure out where that pair of jeans was five minutes ago.

At various places in this issue we provide links to technical papers which address the specifics of "jean placement" in much greater detail than is discussed here.



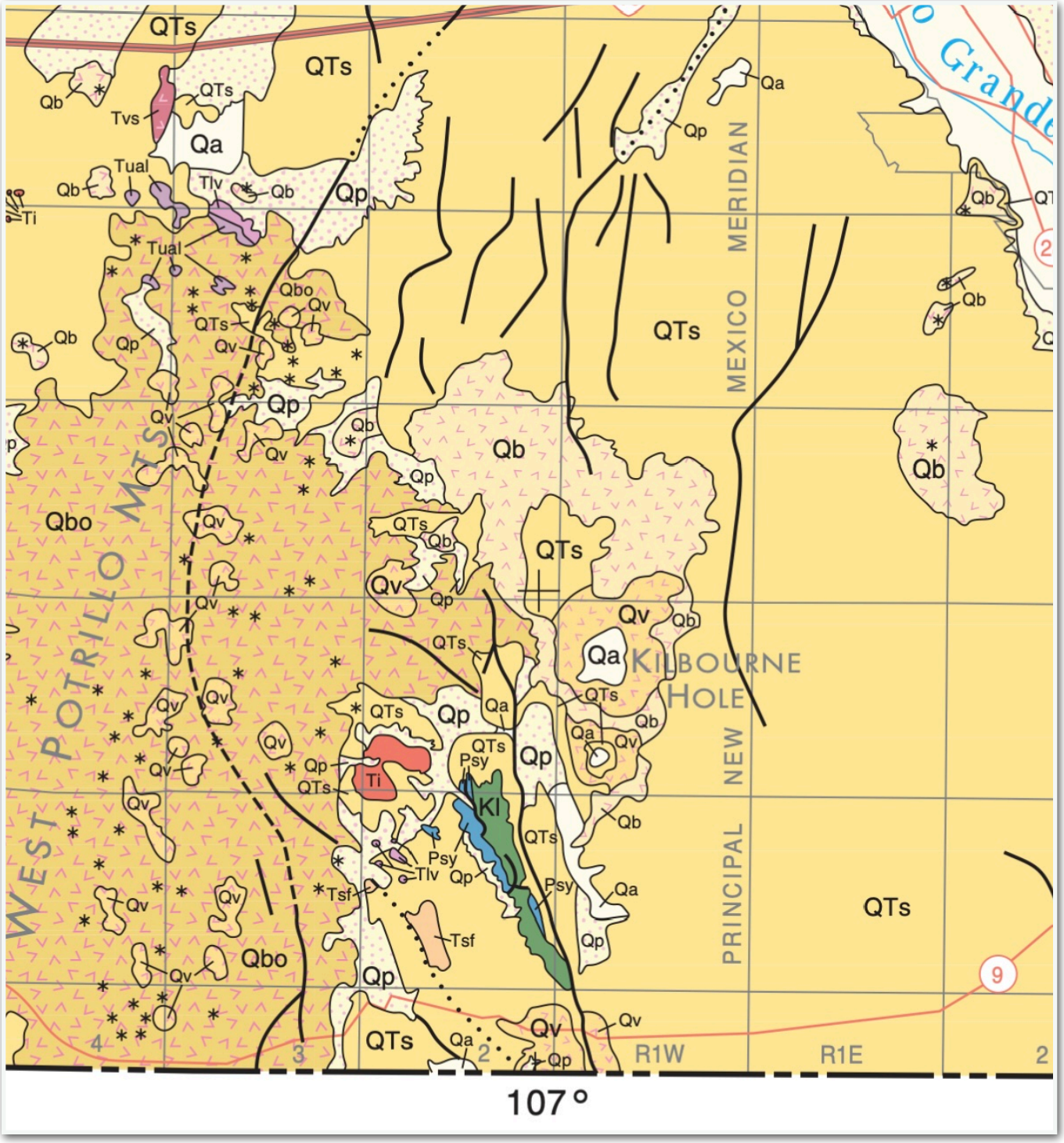
Potrillo Volcanic Field

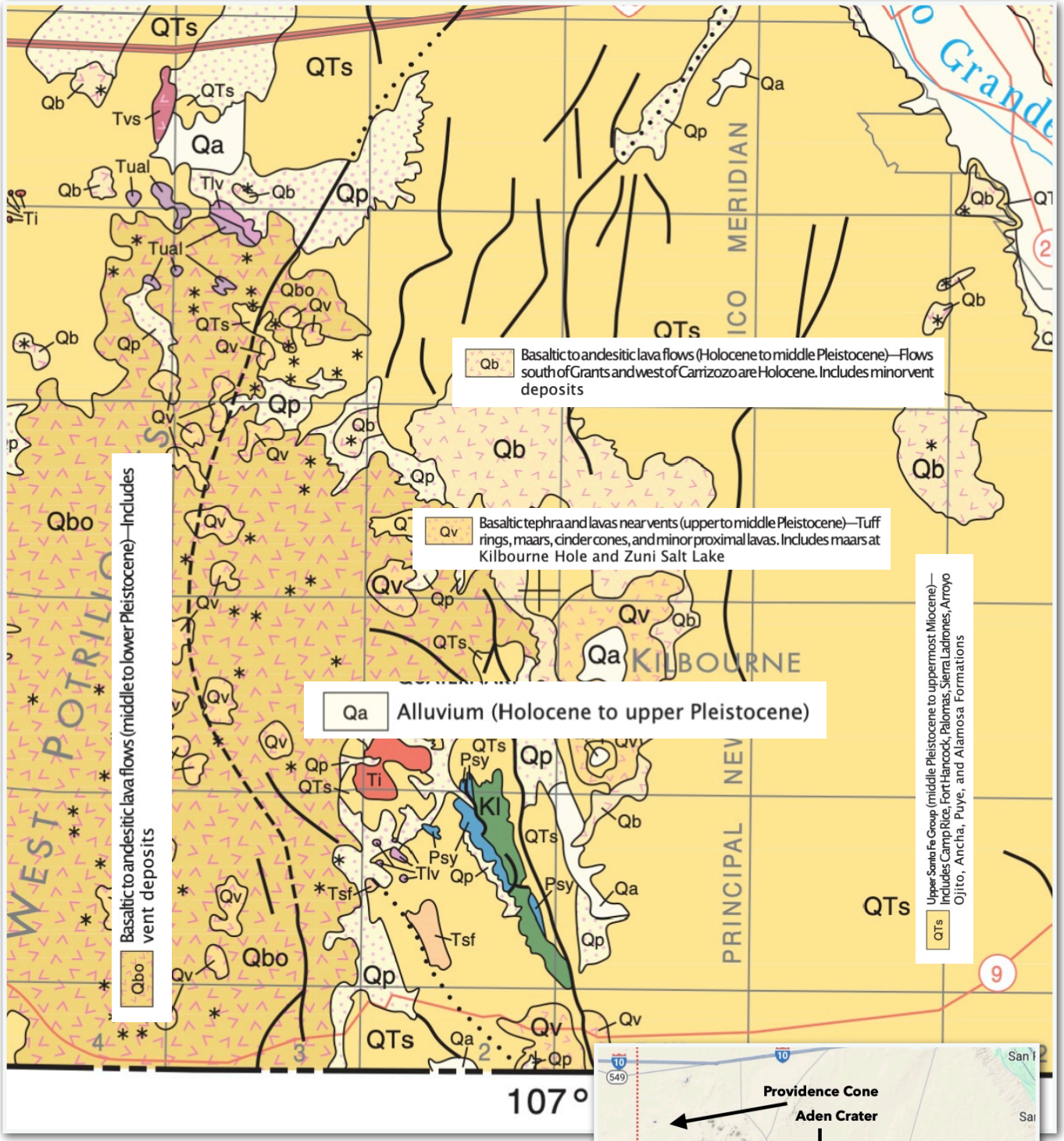
The Potrillo Volcanic Field is southwest of Las Cruces in the southern part of New Mexico. It is one of the most recently formed lava fields in New Mexico. The eastern portion, known as the Aden-Afton field, may be only 24,000 years old. Kilbourne Hole is thought to be about 80,000 years old, and the western portions of the field may be anywhere from 260,000 to 900,000 years old. As a result, there are several areas within the volcanic field which are of particular interest and are examples of varied volcanic activity.

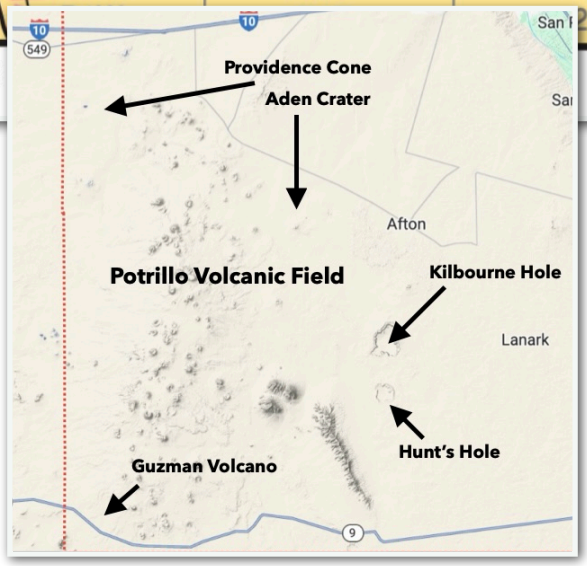
The detail below is from the Geologic Map of New Mexico and the Explanation for the Geologic Map (New Mexico Bureau of Geology and Mineral Resources, 2003, Scale 1:500,000). Some of the geologic unit descriptions are found on the following page (see the "Explanation" for a full range of descriptions).

Although this area was formed in the geologically recent past, it is rich in diversity, with some geologic formations which are rarely found in other areas. In this article we focus on just a few of the features found here, those noted at the bottom right of the next page.

A word of caution about directions in this area: Local ranchers and the U.S. Border Patrol make entry into the area very difficult at times. Some of the







directions given here are from several years ago and inquires should be made before relying on them.

Aden Crater

The following report is from Bob Barnes: In late August 2014, my brother Mike and I took a trip to Aden Crater in the Potrillo Volcanic Field about 30 miles east of Las Cruces, New Mexico. The Potrillo Volcanic Field is located in the Rio Grande Rift which extends from central Colorado, down the Rio Grande River, and into northern Chihuahua.

Aden Crater (photo at the top of the next page) is a small shield volcano which was most recently active about 16,000 years ago. A number of lava tubes are associated with the crater and



deep vents are reported at this location. Jerry Hoffer (*A note on the volcanic features of the Aden Crater area, southcentral New Mexico*, New Mexico Geological Society, 1975) posits that the current geologic feature started as a series of lava flows from one vent, building a shield cone over time. That activity was followed by more explosive eruptions which cast volcanic material outward forming a roughly circular rim around the vent. The formation of the rim was followed by more lava flows which were contained within the rim. The lava tubes, in the lava field within the walls of the crater, are collapsing and the areas along the rim are badly fractured (photo at right). As is often the case when the pressure beneath the surface ceases, the lava drained back into underground vents, and eventually the area above the vent collapsed, forming a large pit in the southeast corner of the crater. The west wall of this pit is pictured at the top of the following page.



The areas through which we walked to get to the crater, and the crater itself, were covered in grass and wildflowers, in addition to the cholla, yucca, ocotillo, and other plants that we expected. Everything was green, the plants were responding to recent rains. The photograph at the bottom of the next page was taken from the top of a small dome in the crater. It is a view of the interior of the crater (looking south). The crater floor is covered with grass and is bounded by the rim of the crater (dark mounds just below the skyline).

The crater is within a Wilderness Study Area. Vehicles are prohibited within such areas (we noted, however, that some people had illegally driven their vehicles into the crater).





We parked at the road and walked south toward an obvious lava cliff on the north wall of the crater (see photo at the top of page 13). The walk was across a lava field which was broken and shattered in places and smooth in others. There were small lava tubes along the way. We entered the crater area just west of the lava cliff mentioned above. (Additional photographs at this link.)

Directions: Take exit 116 on I-10 between Deming and Las Cruces. Travel east for two miles on Frontage Road 1028. This road reaches a dead end. Turn south on a dirt road at this point and travel 7 miles (initially the road heads south but then it intersects a railroad which it follows east on the north side of the railroad right-of-way). At this point, cross the railroad, and continue east on the County Roads which are parallel (and adjacent) to the railroad. At 14.2 miles from the end of the Frontage Road or 7.2 miles from the railroad crossing, turn south on a "one-lane track". Travel about four miles. The crater is visible for quite some time so where you begin your walk is dependent on parking along the road and your own desires. There are no marked trails. Our walk into the crater was roughly 4,000 feet each way.

Providence Cone

Providence Cone (additional photographs at this link) is best known as a site where there is evidence of Mastodons rubbing against the rocks. There are a handful of locales like this in the United States. Providence Cone is to the left in the photograph below, some of the Mastodon Rubbing Rocks are in the foreground. There are also petroglyphs and grinding holes in the area. The drive in to Providence Cone is shown in this video.

Ignoring the geographic constraints of this article for a moment - see "Fox Wells Petroglyph and Megafauna Rub Site, New Mexico" by Margaret Berrier for information about a site in Luna County, just a few miles away.

Kilbourne and Hunt's Holes

A report by Bob Barnes: On September 6, 2014 my brother Mike and I returned to the Potrillo volcanic field south of Interstate 10 between Las Cruces and Deming, New Mexico. Our point of entry for this trip was New Mexico State Road 9. In the map on the following page the US-Mexico border is at the bottom of the image, the starting point is at the red marker (NM-9). From NM-9 we traveled north on County Road-008 (also signed as CR-08 and CR-008). Roughly 3/4 of the way in we took a sharp turn to the right (east) on CR-14 (or CR-014). After a short distance we turned north again and stopped at Hunt's Hole. After our stop we traveled around the western rim of Hunt's Hole on A-013. At the "intersection" of A-013 and A-011 it is possible to travel northeast a bit to Kilbourne Hole (the end of this trip indicated by the green marker) - see the photograph at the upper right on the next page and additional photographs at the link. The small mountain range to the west of the route is the East Potrillo Mountains which are an example of "rift-flank uplift" along the western edge of the Rio Grande Rift.







The roads are dirt and, because of recent rains, mud was very deep in places.

We also visited Phillips Hole, which is east of Hunt's Hole. Phillips Hole and the Potrillo Maar (located roughly at the intersection of NM-9 and CR-008) are larger and have less defined features. Often they are not depicted on maps.

These three "Holes" are maar volcanic craters. A maar volcano is created by a steam explosion. Magma super heats water in the ground which is contained in some manner, in this case by a lava flow. At some point the pressure is so intense that the steam explodes upwards. Typically this does not create a volcanic cone, but instead the expelled material and the void left by the steam buildup causes the surface to collapse creating a "hole". In the case of Kilbourne Hole, roughly 500 million cubic yards of material were ejected by the explosion. The age of these maar volcanos is thought to be between 24,000 and 80,000 BP.

All three holes are roughly circular in shape. Kilbourne Hole is about a mile wide (E-W) and two miles long (S-N) and roughly 300' deep (see photos on the following two pages).

Basalt and pre-sandstone (composed of volcanic ash) cliffs make up the boundaries of Kilbourne and Hunt's Holes. The photos on page 18 show the cross-bedded volcanic surge material ("sandstone" cap) which covers the Camp Rice Formation (reddish material deposited by a south flowing river which emptied into a playa near El Paso) along the southeast rim of Hunt's Hole.

Basalt cliffs form the rim of most of Kilbourne Hole. This layer of basalt is what remains of the cap which contained the super-heated steam prior to the explosion (photo next page upper left).

Both Kilbourne Hole and Hunt's Hole are situated along the Fitzgerald Fault. Other faults in the area include the Robledo Fault which runs along the east side of the East Potrillo Mountains.

The cross-bedded volcanic surge material at Hunt's Hole is similar to the strata at Kilbourne Hole. The unconformity between the volcanic surge material and the Camp Rice Formation is dramatically displayed in places (photos above and on the next page).





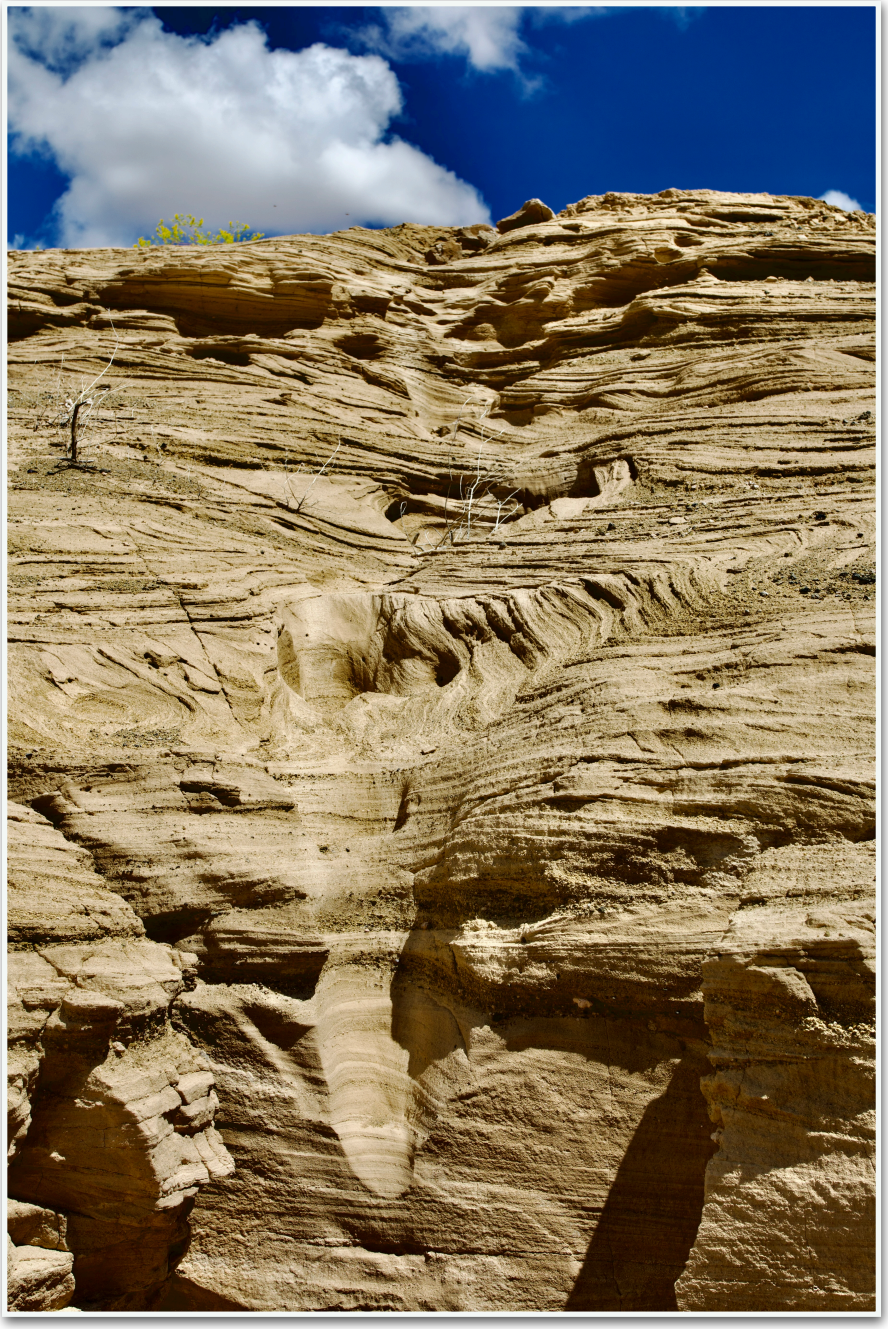
Kilbourne Hole





Hunt's Hole





Like many places in the Chihuahuan Desert, the beautifully convoluted strata of a site like Hunt's Hole (left) or a less defined site like Phillips Hole can be juxtaposed with markedly different flora and fauna when a bit of water is present. In the case of photographs below, that water comes from Hunt's Windmill at Phillips Hole. Overflow from the stock tank can form a tiny oasis amongst the mesquite. But this is a very ephemeral habitat. It can come and go with the wind or the number of cattle. Species which are well adapted to such fluctuations obviously have a distinct advantage - as do those which are mobile enough to find suitable, but geographically dispersed, habitat.

Evolved strategies for species survival include long periods of dormancy, the ability to translocate, varied methods of reproduction, physiological adaptations to mitigate (or accentuate) the effects of the environment, or a host of other things. Such places are wonderful sites to take a moment and ponder.





Common Green Darner to the left, a Familiar Bluet to the right.





Guzmans Lookout Mountain - Guzmans Volcano



Guzmans Lookout Mountain (photograph above) is located a couple of miles north of the U.S. - Mexico border on the western edge of Doña Ana County. The mountain is a 519 foot high cinder cone, reaching an elevation of 4,619 feet. Cinder cones are the most common geologic feature in the West Potrillo Mountains. As you can see in the photographs in the photo gallery and to the right, the southeastern portion of the mountain has been quarried for scoria. Scoria is a volcanic rock which is porous like pumice but slightly heavier; it does not float. It has a high strength to weight ratio and is, therefore, used in many construction applications. It is also used in landscaping. The deposit of scoria at Guzmans Lookout Mountain consists of well sorted cinder and is about 350 feet thick. The rock mined here was transported by truck south on County Road A002 to the town of Malpais, which was a water stop on the El Paso & South-western Railroad. It was also the point from which the rock was transported to other parts of the rail line where it was used as ballast for the bed of the railroad. All that remains of Malpais are a few foundations and assorted debris. This section of railroad line was completed in November of 1902 and abandoned on December 20, 1961. (When the railroad operated, trains passing through Malpais at 3:30 p.m. would arrive in El Paso at 5:10 p.m.

[West bound: leave El Paso at 8:30 a.m. and pass through Malpais at 10:01 a.m.], taking one hour and forty minutes to cover the 49.1 miles between the two points. Sleeping cars were available on some of the trains running between El Paso and Douglas, Arizona.)



Summary

Considering the shield volcanos, lava tubes, maars, and scoria cones – all found within a small area (all can be visited in one day) – this is one of the more fascinating geologic areas in the western United States. And we did not even discuss the Rio Grande uplift and rift valley.

Cedar Hills, Picacho Peak, and the Robledo Mountains

The July 2024 issue of *The Black Range Naturalist* describes a slot canyon which was created as water gouged out a fault line in the Cedar Hills to the west (and across the Rio Grande) from San Diego Mountain. This entire area is rich geologically with multiple examples of faulting, cinder cones, volcanic vents, and various manifestations of uplift associated with the Rio Grande Rift.

This area is, among other things, the site of Prehistoric Trackways National Monument. The tracks found in the monument date from about 280 mya (the Permian). The Las Cruces Museum of Nature and Science has an excellent example of tracks from the site on display.

A description of the site can be found at this link. Although it is fairly easy to find fossils at this site (see below), finding the iconic footprints is much more difficult. Flora is "desert diverse", and many good specimens can be found along the trail.

Jerry MacDonald recognized the importance of this site when he discovered it on June 6, 1987, and worked diligently to get it recognized.

A significant number of rock slabs, with footprints, have been quarried from this site and are housed at such places as the Smithsonian, the Carnegie Museum of Natural History, and the New Mexico Museum of Natural History and Science.





The Natural History of a Landmark - *Ferocactus wislizeni*

by Gordon Berman

Where Picacho Peak's wide, sandy arroyo met its steep, rocky, upward lift, a barrel cactus (*Ferocactus wislizeni*) mediated pathway and traveler. Having passed by it 50 times or more, marveling at its size, comparing its height to chin level, watching it cant in drought for 2 years, kneeling beside its collapse, the traveler wonders how long the barrel lived. Can we sort this out?

At the top left, below, on a flowering July 27, 2017, handy yardstick Peter Dorfman marks the barrel at about 5' tall - both erect and sturdy.

Beginning in 2022 during an ever extending drought, the barrel leaned at a perilous angle (photo top right).

The traveler hopes monsoon rainfall will reverse the tilt, but by January 16, 2024, the traveler knows gravity's descent will claim the barrel.

The barrel reached ground zero sometime after April 16 and before the bottom left photo date of May 25.

By June 9 (bottom right and top of following page), decomposition has cast a sickly yellow ring which will migrate tipward, then morph to black.













The barrel is hollowed out at its base beginning well before it toppled. Since there are no obvious annual rings to count, known barrel counterparts will serve to extrapolate. I have a barrel born in 2019 which now at age 5 stands about 3" above ground. From friends in 1981, I obtained a barrel already 24" tall. Now, 43 years later, it is 48" tall.

The fallen barrel measured 63" in length. Making the admittedly uncertain but nevertheless convenient assumption that barrel growth rates remain constant over time, I'm guessing the Picacho barrel lived to be 100 years of age or so.

If there are New Mexico State Records for tallest barrel cactus, I couldn't find them. So, maybe, perhaps - this was it.





Red Swamp Crayfish, *Procambarus clarkii* (Girard, 1852)
Photo and caption by James Von Loh

Left: Red Swamp Crayfish, an invasive species, is sometimes observed in flowing water of the Rio Grande, but more often following heavy, soaking rains that moisten the soil of their burrows located adjacent to the river; they emerge on the ground surface and crawl to the flowing water. Burrows are located adjacent to the confined river channel, up to ~10m distant within the overflow channel. As obligate omnivores, they eat plant material, animals (including insects of all life stages), detritus, and sediments.

The Color of a Crayfish

The common knowledge about color is that it evolves in animals for a very particular reason, to warn others that its body is poisonous, for instance. A different paradigm is presented for crayfish in "Correlated evolution of conspicuous colouration and burrowing in crayfish" by Zackary A. Graham and Dylan J. Padilla Perez (10 July 2024, *Proc. R. Soc. B* 291: 20240632).

From the article's Abstract: ". . . a lack of evidence for the adaptive value of conspicuous colours garners interest from biologists, such as when organisms that live underground and are rarely exposed to the surface are nevertheless colourful. Here, we use phylogenetic comparative methods to investigate colour evolution throughout freshwater crayfishes that vary in burrowing ability. Within the taxa we analysed, conspicuous colours have evolved independently over 50 times, and these colours are more common in semi-terrestrial crayfishes that construct extensive burrows. The intuitive but not evolutionarily justified assumption when presented with these results is to assume that these colours are adaptive. But contrary to this intuition, we discuss the hypothesis that colouration in crayfish is neutral. Supporting these ideas, the small population sizes and reduced gene flow within semi-terrestrial burrowing crayfishes may lead to the fixation of colour-phenotype mutations. Overall, our work brings into question the traditional view of animal colouration as a perfectly adapted phenotype."

Before diving into the particulars of this study, consider the species which we may encounter in/near the Black Range.

Procambarus clarkii, the Red Swamp Crayfish, is an invasive species in our area but not in New Mexico, per se, since its native range includes the very southeastern tip of the state. This was one of the study species in Graham and Padilla Perez's research and is shown as "h" in a later graphic.

The Virile Crayfish, *Faxonius virilis* (Hagen, 1870), is native to the northeastern part of the state (Upper Canadian River drainage) but invasive in most of New Mexico, including the Black Range. *Faxonius* replaced the genus designation for most of the species formerly in *Orconectes* in 2017. (See the iNaturalist observation referenced on the following page.)

Conchas Crayfish, *Faxonius deanae* (Reimer & Jester, 1975) is native to the Canadian River drainage but has been introduced into the middle Rio Grande, as evidenced by observations from north of Elephant Butte Reservoir. The type specimen is from Conchas Lake (see below).

The Western Plains Crayfish, *Faxonius causeyi* (Jester, 1967), is native to the Canadian River drainage but invasive in the Rio Grande system. Hobbs (1974) felt that this species could not be distinguished from *Faxonius virilis* and might not be a unique species. In his original description of this species, Douglas B. Jester noted that "The new species was first observed by the author when three specimens were collected in a gill net during a fishery investigation of Conchas Lake, New Mexico, on 15 January 1960. The specimens were sent to Dr. H. H. Hobbs, Jr., after the author was unable to identify the species. Dr. Hobbs duly advised that they represented a new species and offered his advice and assistance in preparation of a description." The type-location is Conchas Reservoir, 32 miles northwest of Tucumcari on State Route 104, San Miguel County, New Mexico. *Faxonius causeyi* is currently considered a valid species.



Left: The crayfish shown here may be a Western Plains Crayfish, *Faxonius causeyi* or a Virile Crayfish, *Faxonius virilis,* photographed on 7 June 2018 at the A-Spear Ranch (Palomas Creek) on the east slope of the Black Range.



The Virile Crayfish, *Faxonius virilis*, shown above was photographed at Animas Creek (Ladder Ranch Road) on May 25, 2024, and posted to iNaturalist by "Desert Max". This species is also known as the Northern Crayfish or Eastern Crayfish, indicators of its native range. Here it is invasive. Note the general cryptic color of the body and the bright blue chelae (pinchers).

Southern Plains Crayfish, *Procambarus simulans* (Faxon, 1884), is found in the Canadian and Pecos River drainages. The (invasive) status of this species in this area is unclear. The type locality for *P. s. simulans* is the Gallinas River at Las Vegas, New Mexico. In 1900, T.D.A. Cockerell (see *Early Naturalists of the Black Range*, p. 112) and Wilmatie Porter described a new species (*Cambarus gallinus*) in "A New Crayfish From New Mexico" (*Proceedings of the Academy of Natural Sciences of Philadelphia*, Vol. 52 [1900], pp. 434-435). *Cambarus gallinus* is now considered a synonym for *P. simulans* (that is, it was not a new species).

The Rusty Crayfish, *Faxonius rusticus* (Girard) ("g" in a later graphic) is native to the Ohio River Basin and invasive where it is found in New Mexico.

Except for the Red Swamp Crayfish in general and the claws of the Virile Crayfish, the species likely to be found in our area are not especially colorful. Why some crayfish species are quite colorful while others are not is the focus of the Graham/Padilla Perez study.

If you have a particular interest in crayfish, you may find the following useful: Hobbs, Horton Holcombe, Jr. 1989. *An Illustrated Checklist of the American Crayfishes (Decapoda: Astacidae, Cambaridae, Parastacidae)*. https://doi.org/10.5479/si.00810282.480 for a complete listing (note date of publication) of the crayfish in North America including drawings of distinguishing characteristics for each species.

It should be noted that the authors accept the adaptive function of coloration in many species. Their study was particular to crayfish - and possibly to some other animal groups. They note that "Despite recent theoretical and empirical studies demonstrating the evolutionary drivers of conspicuous colouration, biologists still struggle to explain the functional significance of colour in some animals." They support that assertion with numerous examples of brightly colored creatures which exist in habitats where that color is not obvious.

The authors argue that "although crayfish are most often associated with cryptic colours that aid in camouflage from their primarily visually oriented predators, with over 700 species, crayfish possess a range of conspicuous colours and colour patterns – with many species being blue, red, orange, purple. . . ." Most, but not all, of the species which may be found in or near the Black Range fall within the cryptic color pattern.

In their study, the authors control for variables like burrowing, nighttime (or daylight) foraging, and use of aquatic habitat.

The authors found "that conspicuous colouration in crayfish is evolutionarily correlated to a semi-terrestrial burrowing strategy. Therefore, the typical association between light environment and adaptive colouration lacks support based on the reclusive lifestyle of semi-terrestrial burrowing crayfishes because semi-terrestrial burrowing species are nocturnal and rarely interact with each other on the surface . . . We believe that recent developments

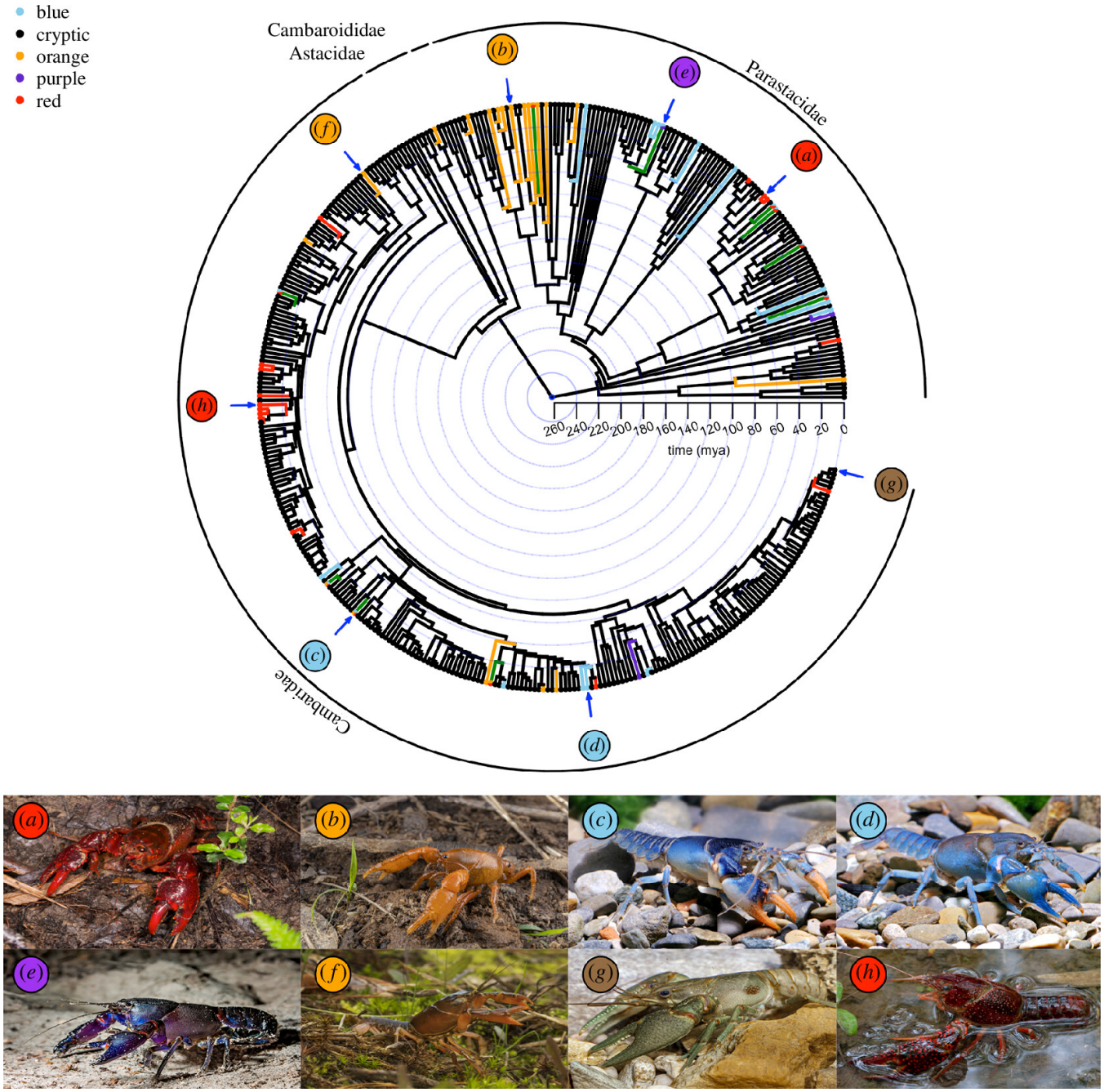


Figure 1. Evolution of colouration throughout 399 species of freshwater crayfish. Branch lengths and branch tips are coloured based on the species that exhibit cryptic and conspicuous colouration. Green branches represent polymorphic species. Photographs highlight the diversity of colours in crayfish species; (a) Euastacus australasiensis, (b) Engaeus cymus, (c) Cambarus dubius, (d) Cambarus harti, (e) Cherax robustus, (f) Distocambarus carlsoni, (g) Faxonius rusticus, (h) Procambarus clarkii. Photo credits: (a) Ciaran Nagle, (b) Ryan Francis, (c) and (d) Chris Lukhaup, (e) Narelle Power, (f) Zackary A. Graham, (g) Guenter A. Schuster, (h) fra298 on Flickr.

regarding the evolution of neutral colour phenotypes, that is, colour phenotypes that may be under little to no selective pressures" help explain the variety of colors found in crayfish. They note that "colour phenotype mutations in crayfish and other decapods appear to be relatively common" and that Mendelian inheritance studies indicate that the coloration resulting from those mutations may become dominant because, at least in part, the coloration does not have any negative consequences because of habitat usage and lifestyle.

The genetic tree shown above depicts the times that significant color variation has evolved in the various crayfish species and the general time-frame when it developed. The development of differing color patterns has occurred since about 120 mya and appears to be ongoing.

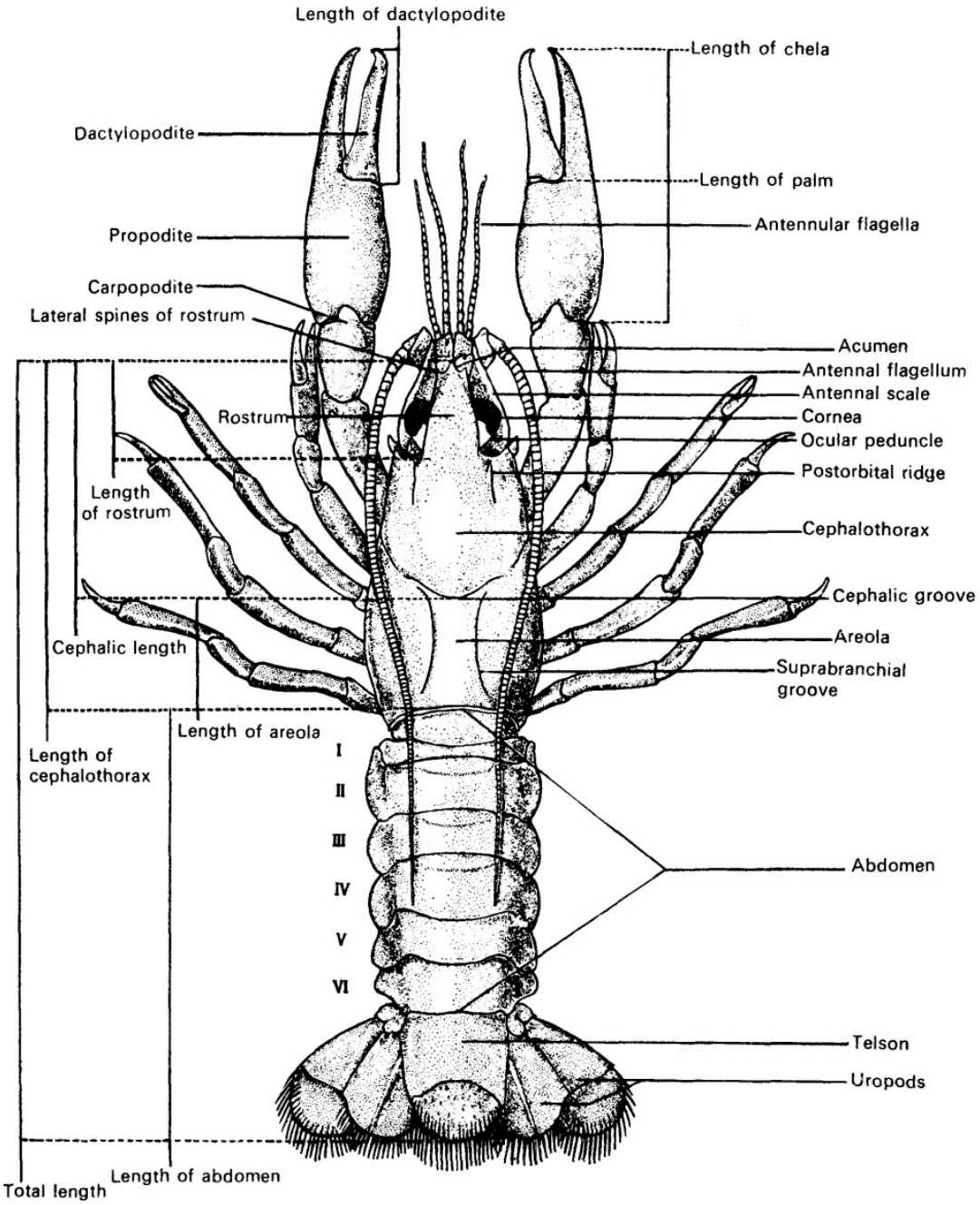
Among other things which they considered was the likelihood that coloration played a role in sexual selection. They found that the visual capabilities of crayfish are limited and apparently do not allow these crustaceans to recognize the full range of colors found in the various species.

This is a well structured study and the authors do not overstep by making claims with limited evidence. They note the complexity of the many possible variable interactions and they recognize that not all of those variables and the interactions between them are well understood.

The external parts of a crayfish are named in the graphic below by Alejandro Villalobos (Plate 2, *Crayfishes of Mexico [Crustacea: Decapoda]*, The National University of Mexico, 1955 - Published by the Smithsonian Institution and the National Science Foundation, 1983). This book provides a significant amount of information on these creatures, including many highly detailed diagrams.

The crayfish most likely to be found in the Black Range are cryptically colored, if you discount the blue chelae of *Faxonius virilis*. Despite that, they are one of the favorite prey species for the Common Black Hawks which nest along Palomas Creek on the east slope of the range.

Black Hawks are known to hunt extensively in wet areas, feeding on many aquatic creatures. The Great Black Hawk shown at the top of the following page has just caught a fish, for instance (photographed in the



Pantanal of Brazil on 3 August 2003). There is not much "wet" in the Black Range. But where there is, it sometimes attracts a Common Black Hawk, as shown at the middle right swooping in to snag one of its favorite foods - a crayfish - at the A-Spear Ranch (trailcam photograph administered by J. R. Absher).

However, the Common Black Hawks have not been the only challenge for the crayfish in the Palomas. The individual photographed on 7 June 2018 (see earlier) was found in a pool of clear water roughly 36 square feet and up to 3' deep at a natural spring along Palomas Creek. The photograph at middle right was taken roughly 40 meters from that spot. Sometime between the date of that photograph and April 2024 flooding in the area completely destroyed the spring area. Large flood events on the slopes of the Black Range are major factors in the occurrence and population of flora and fauna in this area.





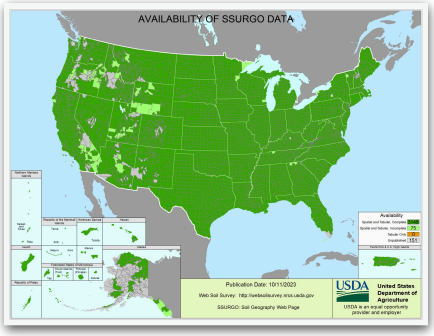
Black Range Soils

Soils are complex and variable. Those two facts should be kept in mind when you read the following, especially if you find yourself wishing to drill down into the data.

We accessed a number of different data sources while researching these data and relied heavily on the assistance of Jon Barnes (Aurora, Oregon) in our efforts to take large data bases and make the information they contained about the Black Range accessible and understandable.

SSURGO

The Soil Survey Geographic Database (SSURGO) is maintained by the USDA, Natural Resources Conservation Service (at least NCRS is the current name of the organization which maintains this database at this time - the names of these organizations seem to change with the political whims of whatever party is in power). The NCRS website (follow map link) describes the data base like this: "The SSURGO database contains information about soil as collected by



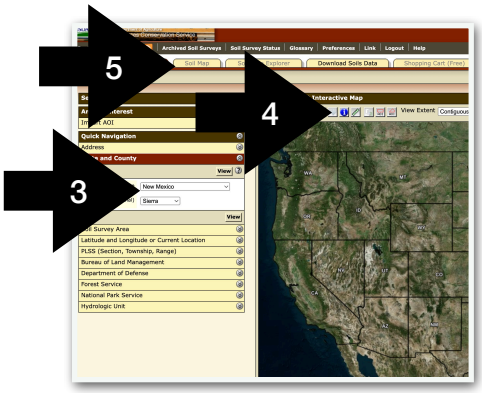
the National Cooperative Soil Survey over the course of a century. The information can be displayed in tables or as maps and is available for most areas in the United States and the Territories, Commonwealths, and Island Nations served by the USDA-NRCS. The information was gathered by walking over the land and observing the soil. Many soil samples were analyzed in laboratories. The maps outline areas called map units. The map units describe soils and other components that have unique properties, interpretations, and productivity. The information was collected at scales ranging from 1:12,000 to 1:63,360. More details were gathered at a scale of 1:12,000 than at a scale of 1:63,360. The mapping is intended for natural resource planning and management by landowners, townships, and counties. Some knowledge of soils data and map scale is necessary to avoid misunderstandings.

The maps are linked in the database to information about the component soils and their properties for each map unit. Each map unit may contain one to three major components and some minor components. The map units are typically named for the major components. Examples of information available from the database include available water capacity, soil reaction, electrical conductivity, and frequency of flooding; yields for cropland, woodland, rangeland, and pastureland; and limitations affecting recreational development, building site development, and other engineering uses."



To obtain specific soils information for your area following these steps:

1. **Follow the link to open the Web Soil Survey website page.**
2. **At the upper right of the webpage click "Start Web Soil Survey (WSS).**
3. **Make your selections. In this case "New Mexico" and "Sierra County" have been selected. Note that there are a number of other ways to sort and access data in the search feature.**
4. **Use the AOI (Area of Interest) polygon tool to identify a specific search area.**
5. **Click the "Soil Map" tab.**



The viewer will generate a map like that below. (It will correspond, of course, to the area you specified within your AOI.) The legend includes the Map Unit Symbol (the orangish numbers on the map detail to the right) and Map Unit Name. It also gives the acreage of that type of soil within the AOI.

This site provides access to a great deal of information and it is best viewed on a large computer screen. Jon Barnes created the map at the upper right, of part of the area shown below. It makes the map units more obvious.

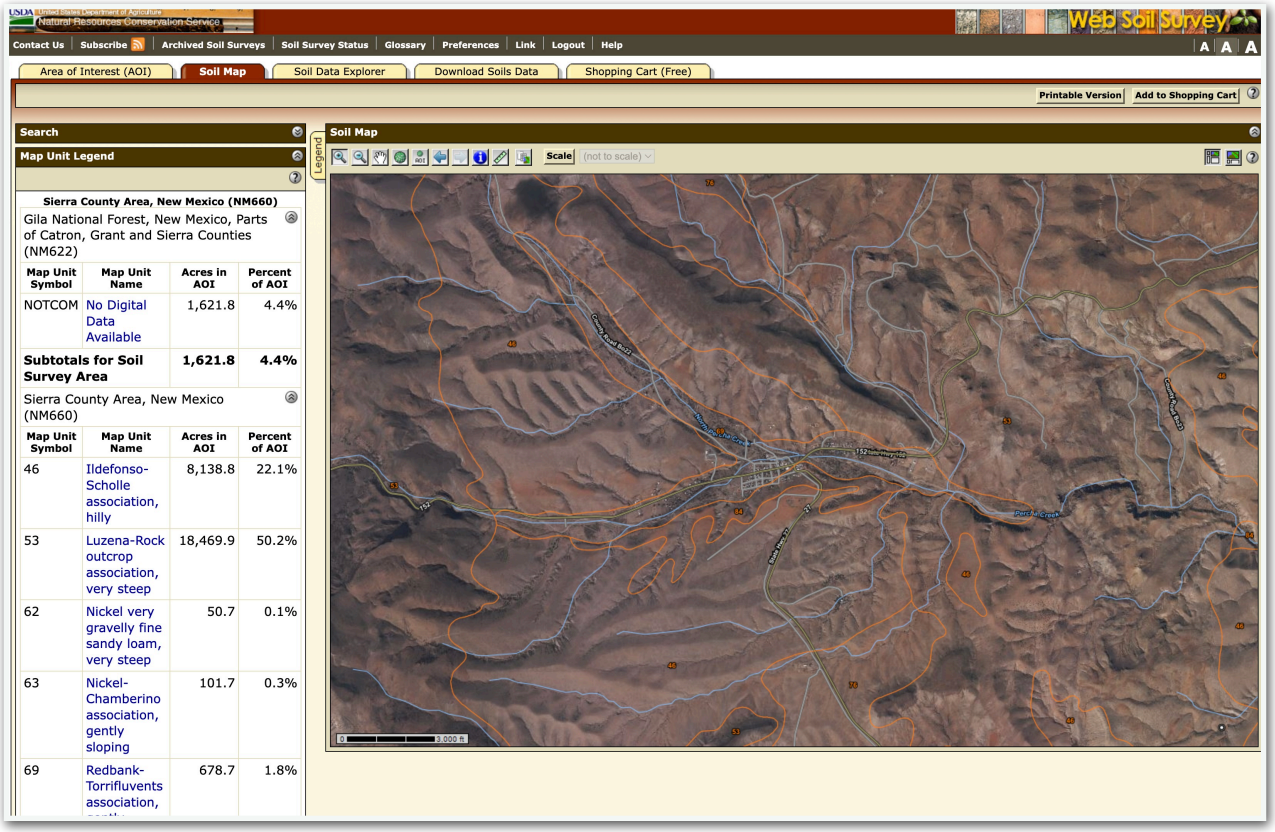
WHAT THE NUMBERS MEAN

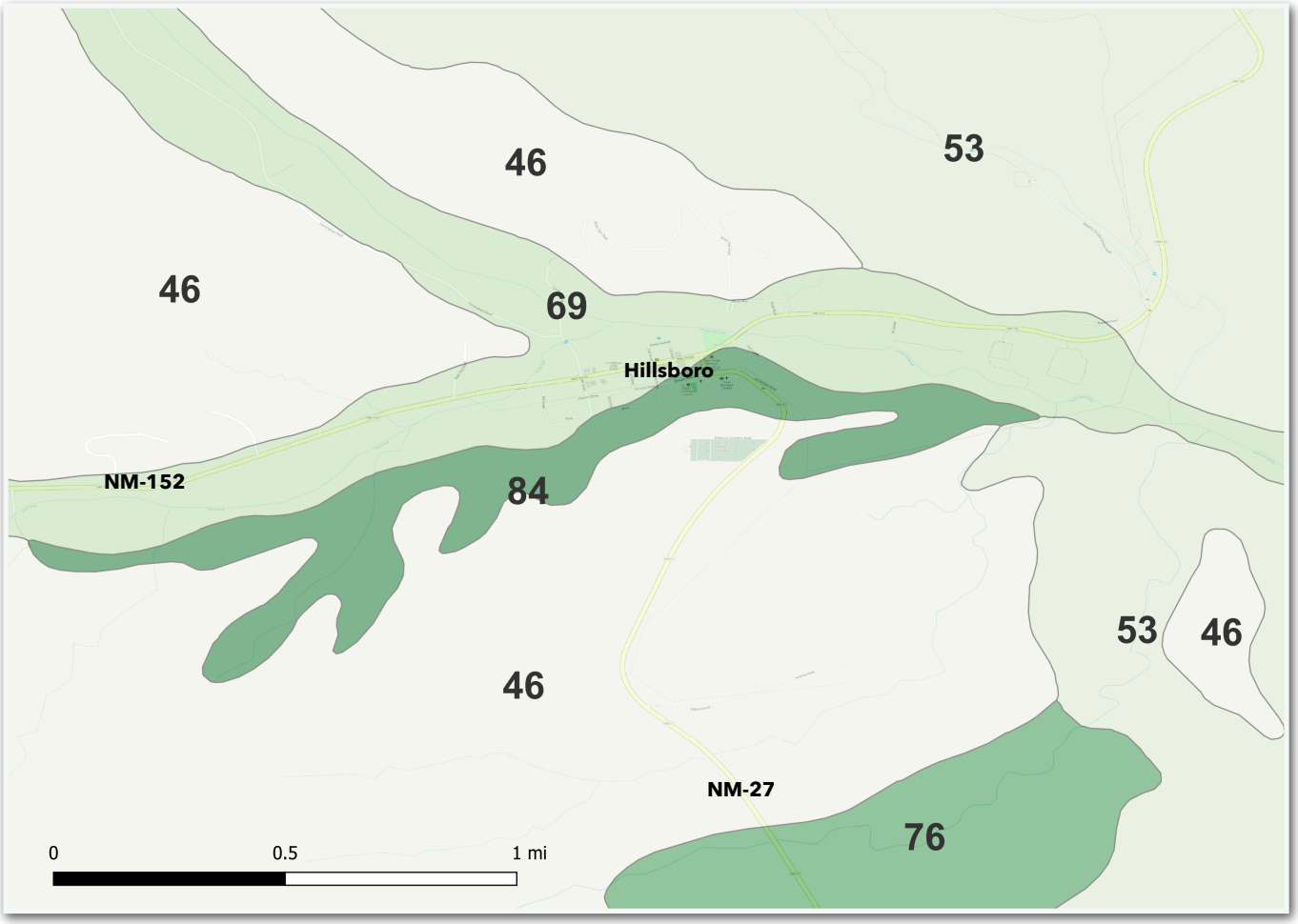
Here we provide the definitions of map unit names. For example, to be called "46", 45% of the unit must meet the definition. It does not mean that 45% of the AOI is composed of "46".



46: (Map Unit Name: Ildefonso-Scholle association, hilly/ Compname: Ildefonso).

The Ildefonso component makes up 45 percent of the map unit. Slopes are 1 to 35 percent. This component is on fan piedmonts. The parent material consists of mixed gravel alluvium. Depth to a root restrictive layer is greater than 60 inches. The





drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R038XB102NM Gravelly ecological site. Non-irrigated land capability classification is 7e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches typically does not exceed 28 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

53: (Map Unit Name: Luzena-Rock outcrop association, very steep/Compname: Luzena).

The Luzena component makes up 50 percent of the map unit. Slopes are 5 to 55 percent. This component is on low mountains or hills. The parent material consists of montmorillonitic clayey alluvium derived from igneous rock and/or colluvium derived from igneous rock. Depth to a root restrictive layer, bedrock lithic, is 8 to 20 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches (or the restricted depth) is very low. Shrink-swell potential is high. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This component is in R038XB103NM Hills ecological site. Non-irrigated land capability classification is 7e. This soil does not meet hydric criteria. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface. The Rock outcrop is a miscellaneous area.

69: (Map Unit Name: Redbank Torrifluve association, gently sloping/Compname: Redbank).

The Redbank component makes up 2 percent of the map unit. Slopes are 0 to 5 percent. This component is on alluvial flood plains or valleys. The parent material consists of mixed coarse-loamy alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is rarely flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R038XB106NM Bottomland ecological site. Non-irrigated land capability classification is 6e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 4 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ration of 1 within 30 inches of the soil surface.

69: (Map Unit Name: Redbank Torrifluve association, gently sloping/Compname: Torrifluvents).

The Torrifluvents component makes up 30 percent of the map unit. Slopes are 0 to 9 percent. This component is on flood plains, river valleys. The parent material consists of mixed alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is occasionally flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. This component is in the R042BB016NM Draw, Desert Shrub ecological site. Non-irrigated land capability classification is 7s. Irrigated land capability classification is 2s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 10 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 3 within 30 inches of the soil surface.

76: (Map Unit Name: Scholle-Ildefonso association, moderately rolling/Compname: Scholle).

The Scholle component makes up 40 percent of the map unit. Slopes are 1 to 15 percent. This component is on stable fan piedmonts on piedmonts. The parent material consists of mixed gravelly alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R038XB102NM Gravelly ecological site. Non-irrigated land capability classification is 6e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 23 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

76: (Map Unit Name: Scholle-Ildefonso association, moderately rolling/Compname: Ildefonso).

The Ildefonso component makes up 30 percent of the map unit. Slopes are 1 to 15 percent. This component is on fan piedmonts on piedmonts. The parent material consists of mixed gravelly alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low.



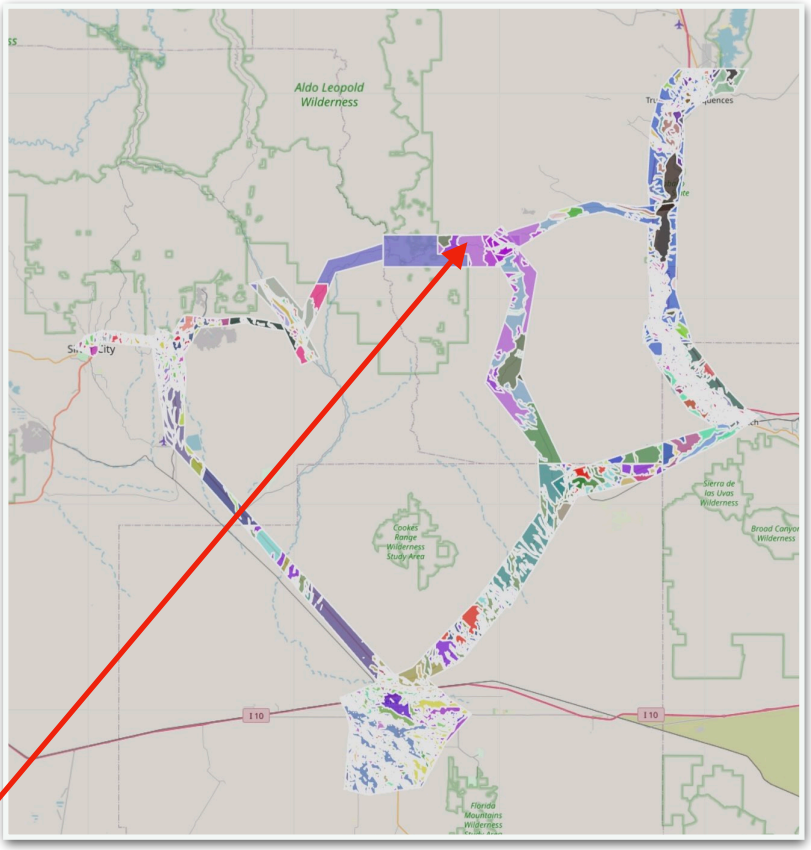
Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R038XB102NM Gravelly ecological site. Non-irrigated land capability classification is 7e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 28 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

84: (Map Unit Name: Ustorthents dissected-Ildefonso complex, Extremely steep/Compname: Ustorthents, dissected).

The Ustorthents, dissected component makes up 45 percent of the map unit. Slopes are 35 to 100 percent. This component is on alluvial fans on piedmonts. The parent material consists of mixed gravelly alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R038XB105NM Breaks ecological site. Non-irrigated land capability classification is 7s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 3 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

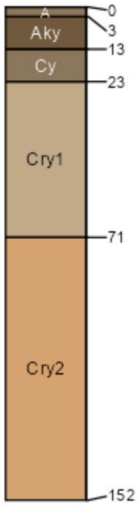
84: (Map Unit Name: Ustorthents dissected-Ildefonso complex, Extremely steep/Compname: Ildefonso).

The Ildefonso component makes up 25 percent of the map unit. Slopes are 35 to 75 percent. This component is on dissected fan piedmonts on piedmonts. The parent material consists of mixed gravelly alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R038XB105NM Breaks ecological site. Non-irrigated land capability classification is 7e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 25 percent. There are no saline horizons within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.



Holloman fine sandy loam, moderately undulating

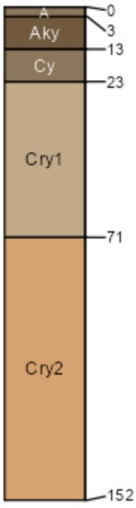
Holloman (80%)
Gyp Hills, Desert Shrub
Typic Torriorthents
Well drained
Hydric: No
PAWS: 4 cm



relict lakebeds

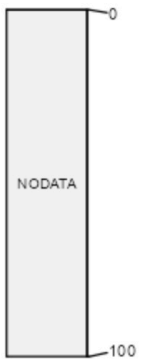
Holloman (10%)
Gyp Upland, Desert Shrub
Typic Torriorthents

Hydric: No
PAWS: 4 cm



Torriorthents (10%)
Gravelly, Desert Shrub

Hydric: No
PAWS: NA



SSA	Scale	Published	Export
nm660	1:48,000	1981	2023-09-07

MUKEY

Jon Barnes also furnished a soils map of the routes we most frequently travel in the Black Range. Deming is at the bottom center, TorC is at the top right, and Silver City is at the center left.

This data set linked the MUKEY index to different data tables which describe a Map Unit Symbol (see earlier).

The MUKEY number for the highlighted unit to the left is 56526. Because of the great variability in soils, MUKEY numbers can be quite elaborate (For instance, the large bluish block to the left of the highlighted unit is MUKEY 2813634.)

In the example to the left, Holloman is a fine sandy loam, moderately undulating with a set of mineral material listed at the left center. The .pdf description of "Holloman Gyp Hills, Desert Shrub" contains a wealth of information on vegetation, climate, soil characteristics, recreation opportunities, other references for the units, hydrologic functions etc. For example:

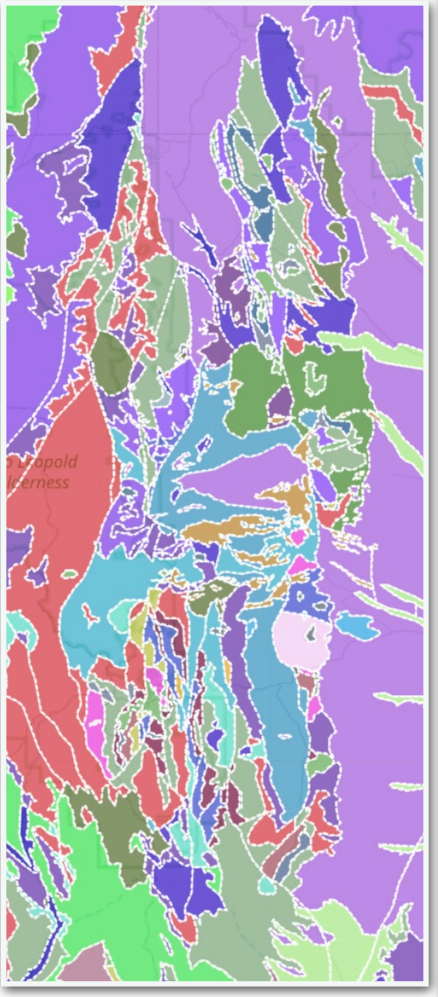
"Community 1.1 - Historic Climax Plant Community - Table 5. Annual production by plant type. The general aspect of this site is that of a rough, broken badlands, sparsely vegetated and highly dissected. There is more of the surface area comprised of bare ground and rock than that which is vegetated. The map delineations of this site are in actuality a complex of bare ground, rock outcrop, a few deep soil pockets in cracks and fissures of the bed rock and areas of very shallow soils. The vegetation on the very shallow soil areas is dominated by rhizomatous and stoloniferous short grasses and forbs. Shrubs and half shrubs are apparent and rather unevenly distributed. The potential plant community varies somewhat with depth of soil, exposure and slope. Large bare areas with only surface lichens are common. Where there is little or no soil over the gypsum material only rough coldenia may be present".

MUKEY organizes information from diverse distributed data sources into a comprehensive description of a specific soil unit - or if you wish (because it is so comprehensive) a specific geographical area.

Mapping Natural History Features Associated With Soils

Jon Barnes furnished us with two other maps which describe the natural history of the Black Range and are associated with soils.

In the past, we have described the geology and geologic features of the Black Range in a number of articles.





Even so, much is to be learned by the map (above) showing the geologic units in the Black Range. It is a detail from the map to the right which delineates the geologic units in south-western New Mexico.

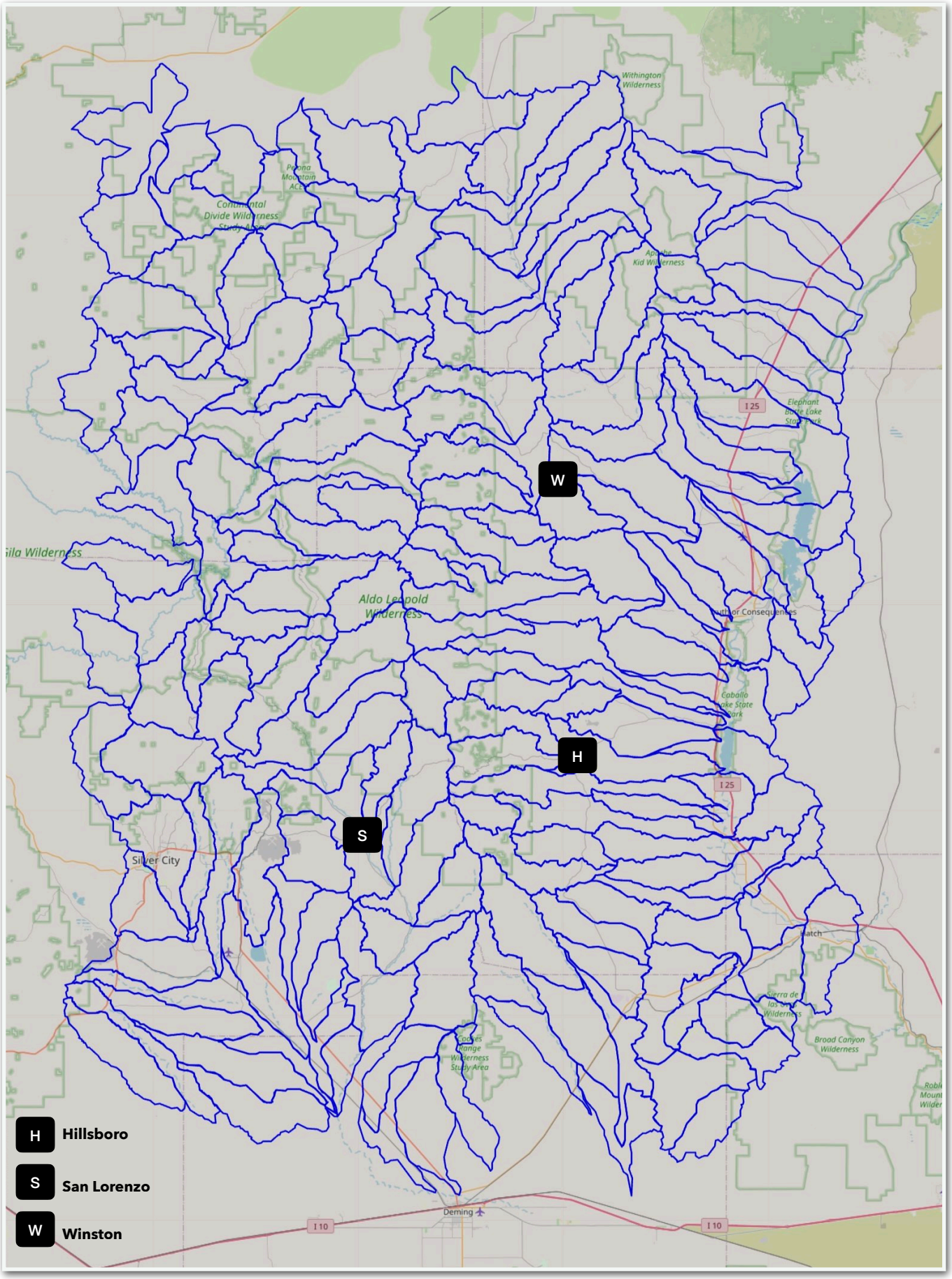
John Wesley Powell saw the West for what it was and made several proposals about how it could be effectively developed. His ideas were dismissed because they ran contrary to the greed which political forces enable. An 1889 portrait of Powell, by Edmund Clarence Messer, is shown at the bottom right.

Many people know Powell as the explorer of the Grand Canyon. He was the chief of the U.S. Geological Survey in 1890 when he testified before the Senate Select Committee on Irrigation and Reclamation of Arid Lands (the political forces of greed).





The Committee wanted to hear about the wealth to be garnered from irrigation and exploitation. Instead, Powell proposed a vision of managing the West based on watersheds. He provided the map above as part of his testimony. This map shows the major watersheds of the west and was part of a proposal that government bodies be based on natural features and in particular watersheds. Fruitless.



All of that to reinforce the idea that watersheds are important. Not only are they foundational to the understanding of the natural history of an area, when incorporated into political subdivisions they enable

better governance. We need both more protections for watersheds and better governance. (Jon Barnes' map of Level 12 watersheds in this area is shown on the previous page.)

All of the maps developed by Barnes may be viewed as interactive web maps at this link. Meaning that you can click on a colored unit and see an interactive label which defines it and drill down from there.

Granularity

At the scale shown in this article, maps provide a lot of detail. They also leave out a lot. That is the nature of mapping - to see all of the detail you need a full-scale (or greater - a map that is larger than what it "maps") map. A scale like that simply does not work. But an example of the complexity of soils in rolling, geologically complex, landscapes is shown by this series of photographs.

Forget about the map which shows wide areas of one type of soil, with a standard set of characteristics including "average depth" and composition.

The hillsides just east of Hillsboro are rocky with little soil, bedrock is at the surface or only shallowly concealed (photo upper right).

Over thousands of years the bits of soil which originate on those slopes (chemical and physical decomposition of the rock) is swept down into the small valleys between the hills where it can form deep deposits (center photo at right - backpack for scale). These deposits of soil can be cut deeply when rainwater flows downhill unchecked. In the central photo the wash is more than 6' deep and has yet to reach the bottom of the deposit.

At times bits of root, broken limbs, or rock form obstructions in the washes. Water flow is slowed by these obstructions and the water drops its load of soil upstream of the obstruction. In the bottom right photo a few roots and broken limbs have formed one of these obstructions and the area upstream of the obstruction has filled with soil.





The indigenous peoples of this area understood this process well and built check dams in many areas of the Black Range. Rich soil built up behind the check dams, villages were built at the sites, corn and other crops were planted in the soil, designs were carved into the rock, the bedrock was worn away by the grinding of corn and nuts, forming grinding holes. All because when something gets in the way of running water it slows the water down and the water drops the material it holds in suspension.

In the recent past, Bill Zeedyk, his proteges, and others have championed the concept of checking the flow of water to conserve the soil at locations where it is deemed desirable. See his excellent "*An introduction to Induced Meandering*" for the particulars of his methodology.



Follow-ups and Tidbits

Bird Nests

In the July 2023 issue (Vol. 6, No. 3) we included a survey of the nests of a few bird species found in the Black Range. In this issue, we add three additional species to our listing and enhance other listings.

The nests of cavity nesters are not obviously elaborate, just a hole in something. In the case of the White-breasted Nuthatch, *Sitta carolinensis nelsoni*, shown to the right, a rather small hole. If we were able to see inside, it would be quite elaborate. These images were taken on May 7, 2024, in Railroad Canyon on the west slope of the Black Range. Video was also recorded at that time.

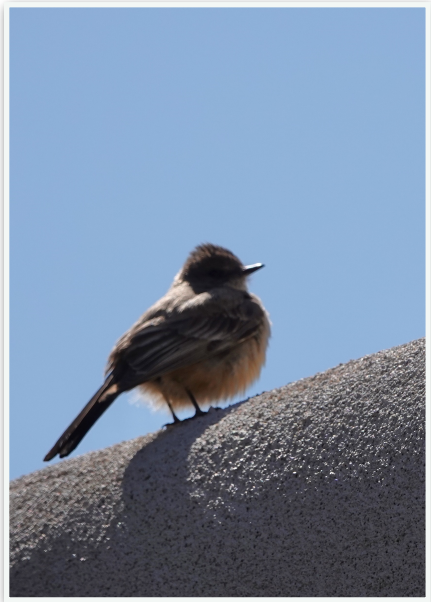




The Say's Phoebe, *Sayornis saya*, photographs were taken on April 21, 2024.

The Ladder-backed Woodpecker, *Picoides scalarus*, is the most common woodpecker in our area, and the nesting of this species was included in the July 2023 issue of this journal. During the first part of May 2024 we monitored one of the species' nests in Hillsboro. The photographs shown on the following page and the video found at this link were taken on May 15-16, 2024. As the video shows, in addition to the adult male and female woodpeckers, fledglings of both











sexes were also using the nest and coming and going at will. The fledglings still had short brown tufts of down near the bill (the general area of the lores). At that time, the fledglings were strong fliers and it did not appear that they were being fed by the adults.

On May 28 and June 3, 2024, we recorded video of Common Raven nestlings on a nest in Wick's Gulch east of Hillsboro. Mortality of nestlings in the Corvid family tends to be very high (estimates to 70%). In this case, three nestlings were present on May 28 while only one remained on June 3. Images shown here are frame grabs from the video, which may be viewed at this link. The nest is shown in two images at the bottom of this page. The image of a nestling was recorded on June 3. Additional images from this observation may be viewed at this Black Range photo gallery.

Debora Nicoll provided the photographs on the following three pages. She lives a few miles south of Hillsboro and has a "number of Scott's and Hooded at the feeders and flitting around". In Hillsboro, Hooded and Bullock's are common enough but Scott's is not.

Hooded Oriole Nests In Unusual Setting

by Debora Nicoll

Our home with plentiful fruit trees, vegetable garden, hummingbird feeders, red yucca, and a cat who might well have been named Chauncey Gardiner has become a favorite haunt for a number of flying creatures. We've even had Scott's orioles building a nest on our front patio for several years. The clever fellows took advantage of a pair







of shades hanging from the ceiling to begin their construction. The nests then hung between the two shades (top three photographs in the center column). Of course, that meant no lowering and raising of shades through the hottest months but as foster parents to orioles you do what you gotta do.

In addition to birds, wasps have come to think of our home as their own private oasis. The last few years have seen more and more nests being built in the canales from our roof. While small numbers of them can be tolerated, the dense population that required multiple summer trips to the roof to eradicate their homes was a bit much. But, how to reduce the wasp population without killing or making sick all the other flyers? Traps and swatters are effective on a small scale but what we really wanted was to keep them away in the first place. A web search showed a number of wasp deterrents that look like hornet nests. Although there does not seem to be any scientific proof they keep wasps away, we thought we'd give them a try anyway and purchased not one, not two, but a half dozen







artificial hornet nests to decorate the exterior of our house and garden.

Late in May this year, we were in our porch enjoying our adult beverages when we both saw movement in the direction of a wasp deterrent. We looked at each other and both said, "did an oriole just come out of that?" Yes, patient waiting caught more glimpses of the bird(s), hooded orioles (photo bottom left). By June 9, construction was well under way with frequent trips carrying strands of yucca fibers and much pounding into the deterrent fabric.

By June 21, the nest appeared to be quite well along to completion when viewed from the bottom of the deterrent (photo bottom right).

On July 3, I braved upsetting the parent hooded orioles to take a glimpse inside the nest. Four beautiful brown speckled eggs in a softly lined nest were a sight to see (photographs on the following page). Momma bird seemed to tolerate my presence so I decided to make weekly chick progress checks.

Around the week of July 18, a male hooded oriole seemed to be more interested in the nest and was frequently in a desert willow nearby. His role seemed primarily to be









chasing other orioles and birds away. We never saw him enter the nest but his presence was notable.

At the same time, we saw that a second nest was being built in another deterrent. Whether it was the same female, or a second female either copying the first or just drawn to a good nesting site we can't say. However, that nest has since been abandoned with a quartet of eggs snuggled down in the bottom.

By July 11, chicks had hatched from the eggs (photo at center of page) and by the 18th the bill and feather structure was well developed on those which remained (photo at center bottom).

By July 24, there was a lot of activity both by the nestlings and adults outside. I decided to take a peek in to see what was going on. One last nestling was trying to figure out how to get through the hole in the top of the deterrent. Evidently, it was the least bright of 4 and didn't observe its nest mates. Or, it was waiting for me to tip the nest to take a photo so it could sneak out of the bottom hole. At any rate down it went and landed on the ground before shaking off the shock of freedom and fluttering off with Mom close behind. Fortunately Chauncey Gardiner was not nearby. She certainly would have been roused out her laziness to give chase to easy game.

Within about a week or two of fledging all orioles seem to have disappeared from around here. We have two nests in deterrents. One has quite the collection of fecal droppings and the other four quiet eggs. We will leave them through the winter and see if any other birds take up residence and hope that the other deterrents will be home to orioles next year.

Oh, and the wasps? Whether because of the deterrents or the vagaries of New Mexico insect populations, we did have a reprieve from wasps this year. Only one wasp nest needed to be cleared from the canales compared to dozens each summer of the last few years. Our home will definitely be sporting wasp deterrents in the summers to come.





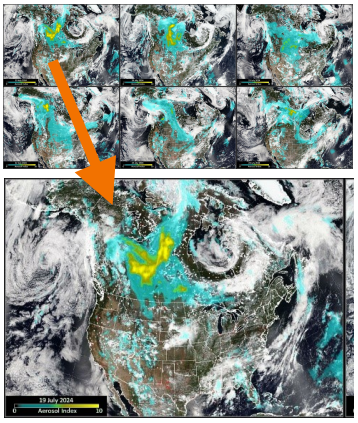


Pyrocumulonimbus Clouds

In the April 3, 2024, issue of this journal (Vol. 7, No. 2) we reported on the pyrocumulo-nimbus clouds created during the Silver Fire in June 2013. The Silver Fire was one of two major fire events in the Black Range during the last twelve years. Pyrocumulonimbus clouds can be created by the intense heat of forest fires and rise to over 30,000' in height. The swiftly rising air carries smoke and other particulates into the upper atmosphere where they are dispersed widely.

On July 20, 2024, Jennifer Brennan, reporting for NASA, noted the large number and intensity of such clouds in western Canada during July of 2024 ("Canadian Wildfires and Recent PyroCb Events - Pyrocumulonimbus (pyroCb) events (fire thunderstorms) caused by wildfires in western Canada were detected by the Ozone Mapping and Profiler Suite (OMPS) instrument July 19-24, 2024").

The images below are from the Ozone Mapping and Profiler Suite (OMPS) of instruments on board the NOAA-21 satellite. The sequence of photographs (July 19-24 daily record) shows how widely and quickly the material from these fires spread across the northern part of the Americas. The daily record for July 19 (bottom) shows the significant levels of aerosols (yellow colors) which were pumped into the air at the time these pyrocumulonimbus clouds occurred. Much more significant events than that reported from the Black Range in Vol. 7, No. 2.



Acmaeodera rubronotata (Laporte & Gory, 1835) - Yellow-marked or Spotted Flower Buprestids

During a walk up Railroad Canyon on August 7, 2024, we found several (what are probably) *Acmaeodera rubronotata*. Although this particular species is pretty distinctive, there are more than 150 species in this genus north of the US-Mexico border and the area of greatest species diversity is in the southwest, so - probably. (rubronotata = red marked). Its range extends southward well into Central America.

Adults in this genus are generally seen on flowers while the larvae of this species use oak (*Quercus*) as host species. This is one of the wood-boring species.

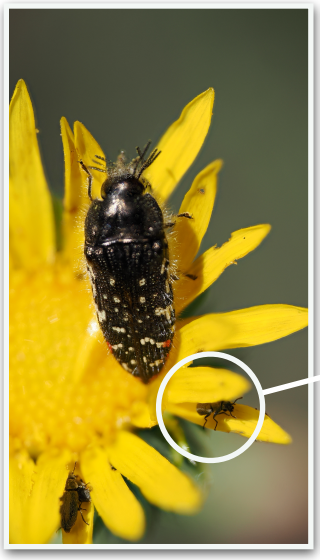
In 1878, George Henry Horn described an individual of this species as *A. sparsa*. The specimen Horn used to describe (what he thought was a new species) is maintained at Harvard.

See: *Laporte, F.L. de L. (Comte de Castelnau) & Gory, H.L. 1835. "Monographie des Bupres-tides", Histoire naturelle et iconographie des insectes coléoptéres, vol. 1. Duméril, Paris.*











Unobserved at the time the beetle on the previous page was being photographed was the small click beetle shown at the top center. The *A. rubronotata* is roughly 10 mm long.

We have identified two other *Acmaeodera* beetles to species in the Black Range. *A. amabilis* is shown directly below and *A. bowditchi* is shown at the bottom. First impressions can be deceiving. These black beetles with yellow spotting actually do not look much alike. The patterns run the gambit, from small spots, to larger blotches, to stripes.

Having said that, and given the number of *Acmaeodera* species in the Southwest, we need to apologize for any misidentification, which is possible, since they all look alike.





Nicrophorus guttula - Yellow-bellied Burying Beetle

On August 5, 2024, what were probably Yellow-bellied Burying Beetles, *Nicrophorus guttula* (shown below), were found in dung (probably Coyote) in Railroad Canyon, not far from where the *A. rubronotata* was found two days later.

N. guttula may not be distinguishable from two other species, *N. marginatus* and *N. obscurus*, based on general appearance. *N. guttula* is more common in the western U. S. than *N. marginatus* which may also be present. *N. obscurus* is a species of the northern plains and Rockies of the U. S. and not known from this area.

There were two, possibly three, individuals in the dung and when disturbed they quickly buried themselves in the dung. When uncovered they either pretended to be dead or another (dead) beetle was in the group. The beetles were roughly 20 mm long.





As of August 14, 2024, the few sightings in the Black Range which have been reported on iNaturalist have been identified only to genus. See Matt Becker's observation, for instance. These individuals may also have been *N. mexicanus*.





Road Closures

In May 2024, NM-152 was closed for almost two weeks so that chip seal could be placed on sections of the road across the range. The closure created hardship for those who used the Black Range - Silver City corridor but it also created an opportunity to photograph from the road, directly into the canopy of the trees down-slope, without having to dodge the traffic. The photographs at the top, of a Grace's Warbler, were taken during that closure, on May 15.

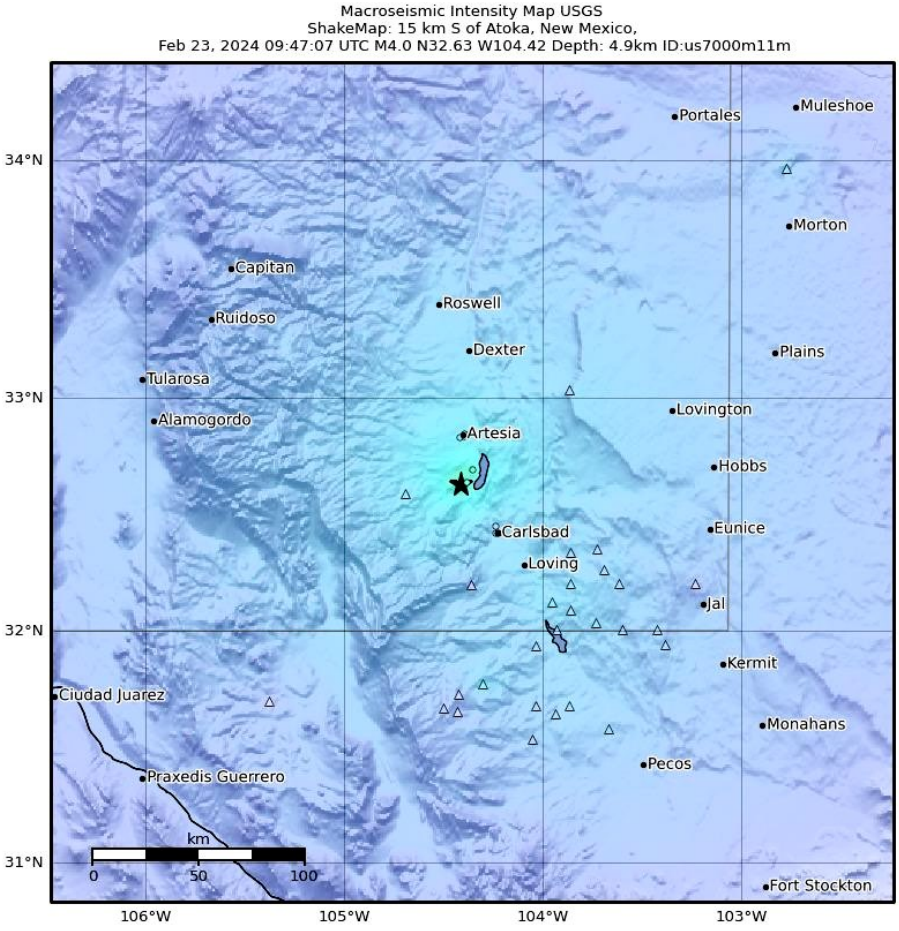
See the New Mexico Bird Conservation Plan - Grace's Warbler (*Setophaga graciae*) Species Account for additional information about this species.

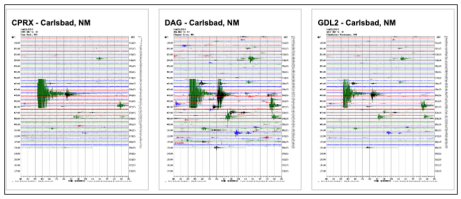
Earthquakes

In our July 2024 issue (Volume 7, Number 3) we reported that the US National Seismic Hazard Model has been updated, affirming our general lack of risk.

That risk is contextual, however. A few months earlier a 4.49 magnitude earthquake occurred near Carlsbad (not exactly in our backyard, but on the map). The helicorder plots of that event are shown below.

The macroseismic intensity map (USGS) is shown below. The earthquake occurred at a depth of 4.9 km and was described as light with no damage.





SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.00663	0.0795	0.954	4.99	8.76	15.4	27	47.4	>83.2
PGV(cm/s)	<0.0028	0.0383	0.524	3.03	6.48	13.9	29.6	63.4	>136
INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based on Atkinson and Kaka (2007) Version 8: Processed 2024-03-19T10:32:26Z
△ Seismic Instrument ○ Reported Intensity ★ Epicenter

Mistletoe

In our July 2024 (Vol. 7, No. 3) issue of this journal we featured the natural history of the Broadleaf Mistletoe, *Phoradendron macrophyllum*. Along NM-152, west of Kingston, the mistletoe regularly found in the oaks of our area (*Phoradendron villosum* [Nuttall] Nuttall ex Engelmann subsp. *coryae* [Trelease] Wiens) is regularly seen. Commonly called the Oak Mistletoe or Cory's Mistletoe, this species was seen in many Gambel's Oaks during May 2024 (example, photo right).



Elk

Spring can be a good time for Elk, *Cervus canadensis*, in the foothills of the eastern Black Range. The Elk found here are of the subspecies *Cervus canadensis nelsoni*, Rocky Mountain Elk. Taxonomic classifications are disputed, but most authorities describe six subspecies in North America (two of which are extinct). As can be seen in the map below, the range of Elk is greatly reduced (dark green is the current range, lime green + dark green is the historical range). The photographs on this page were taken on May 19, 2024, in the eastern foothills of the Black Range.

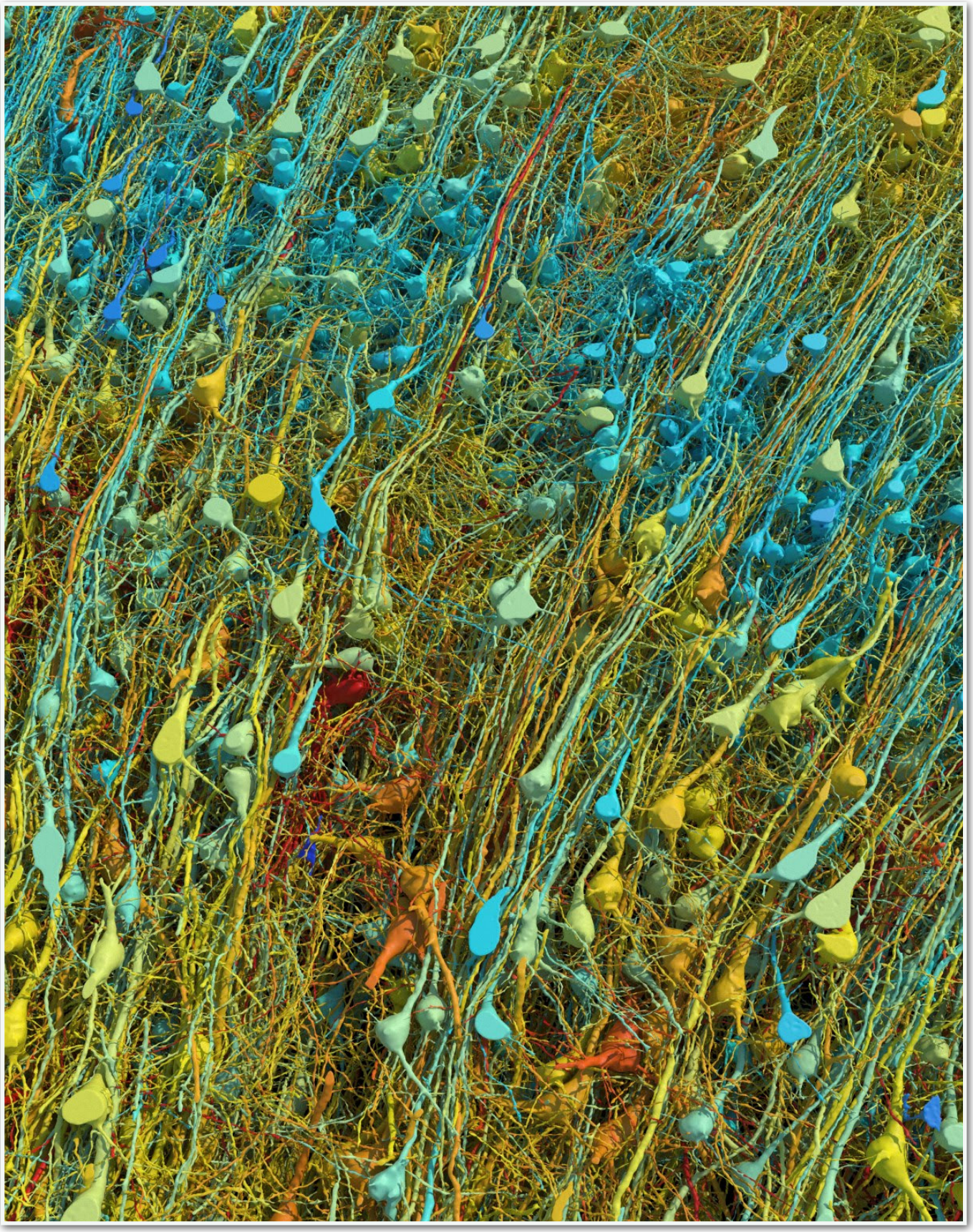




False Colors

In our last issue we discussed the use of false colors to make the information in images more understandable ("Tools of the Trade - Presentations"). A stunning example of the usefulness of such techniques came out of the work associated with a paper in *Science*, Volume 384, Issue 6696, by Alexander Shapson-Coe et al. "A petavoxel fragment of human cerebral cortex reconstructed at nanoscale resolution" May 10, 2024. The image on the following page was created by D. Berger, one of the authors of the cited study. The false colors in the image were used to highlight size and tissue function. This is an image of one cubic millimeter of human brain tissue. It was made using an electron microscope to image 5000 slices of the tissue. The raw data for this image is 1.4 petabytes (or if you wish 1,400 terabytes) in size. The cubic millimeter of tissue contained 57,000 cells and 150 million synapses.

A crystal of table salt is a cube about .3 mm on a side, so 1 cubic mm would contain 27 cubes of salt.



Ants Have Probably Sensed Pheromones for 100 Million Years

Common Knowledge: 1) Ants communicate with each other, they lay out scent trails, recognize intruders, etc. - all by applying and detecting pheromones; 2) All sorts of bugs get caught in tree sap and when that happened a long time ago, and the sap hardened into amber, there are beautiful creatures in little golden jewels; and 3) microscopes magnify things a great deal and are used to make incredible images.

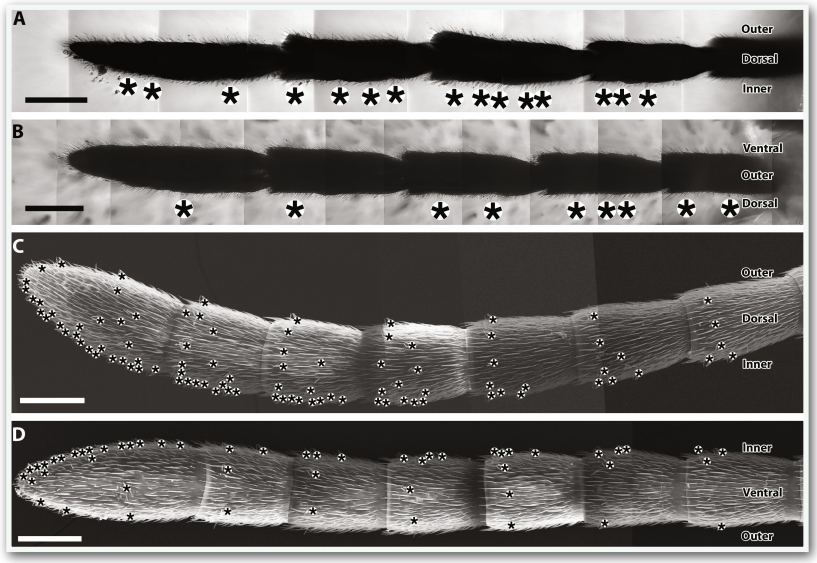
Less Commonly Known Things: 1) At the very least, ants use the sensilla (little hair-like structures) on their antennae to detect pheromones; 2) All ants are eusocial (where a single female or caste produces all of the young and nonreproductive individuals care for the young) and have probably been so since ants split from the more solitary wasps about 100 million years ago; and 3) Most of the ants preserved in amber have been found in France and Myanmar.

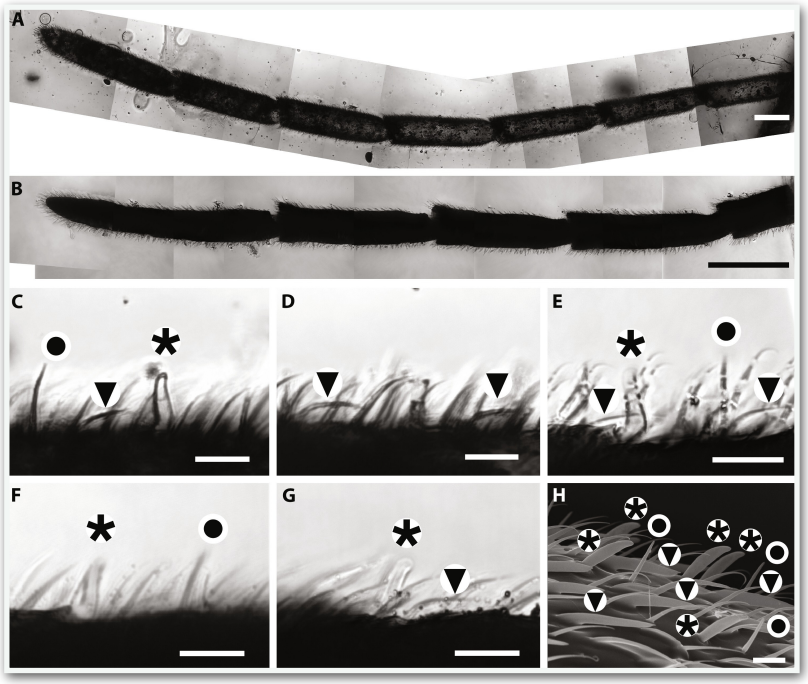
Ryo Taniguchi *et al.* report in "Sensory Evidence for Complex Communication and Advanced Sociality in Early Ants.", *Science Advances,* Vol. 10, No. 24 DOI:10.1126/sciadv.adp3623 that they were able to photograph sensilla of an ant (*Gerontoformica gracilis*) encased in amber 100 million years ago.

Taniguchi and team were able to photograph the ant at top right in great detail. (See the study for several other images.) In the center group of images A & B are images of the fossilized ant's antenna. C & D are the antenna of a species which lives today, *Camponotus quadrinotatus*. In the bottom group of images the sensilla of the fossil specimen (images C - G) are compared to the extant species *Formica sanguinea* (H).

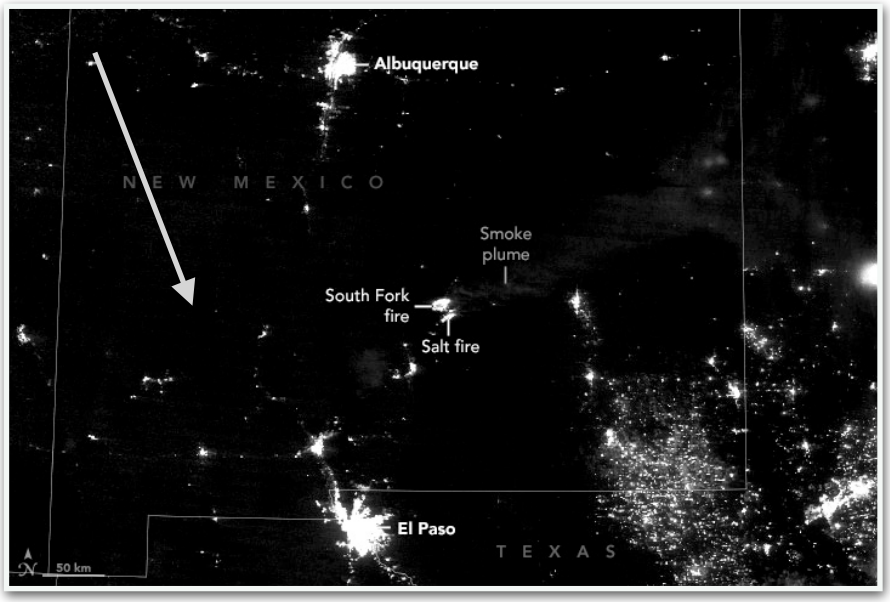
Extant species of ant have eight types of sensilla. Taniguchi et al. were able to identify at least four types of sensilla in the fossil specimen. Each type of sensilla has a different capability and/or function. Sensilla in the fossil specimen are associated with the detection of alarm pheromones and another set of sensilla is associated with the ability to identify other members of the colony. The authors conclude, "The presence on the antennae of *Gerontoformica* of abundant sensilla trichodea curvata and the concentration of sensilla basiconica on dorsal and inner surfaces indicate that these early, stem-group ants were adapted for social chemical communication via pheromones, as in modern ants. As such, this provides compelling, independent support for hypotheses that ants from the mid Cretaceous were eusocial."







Dark Sky and Fire



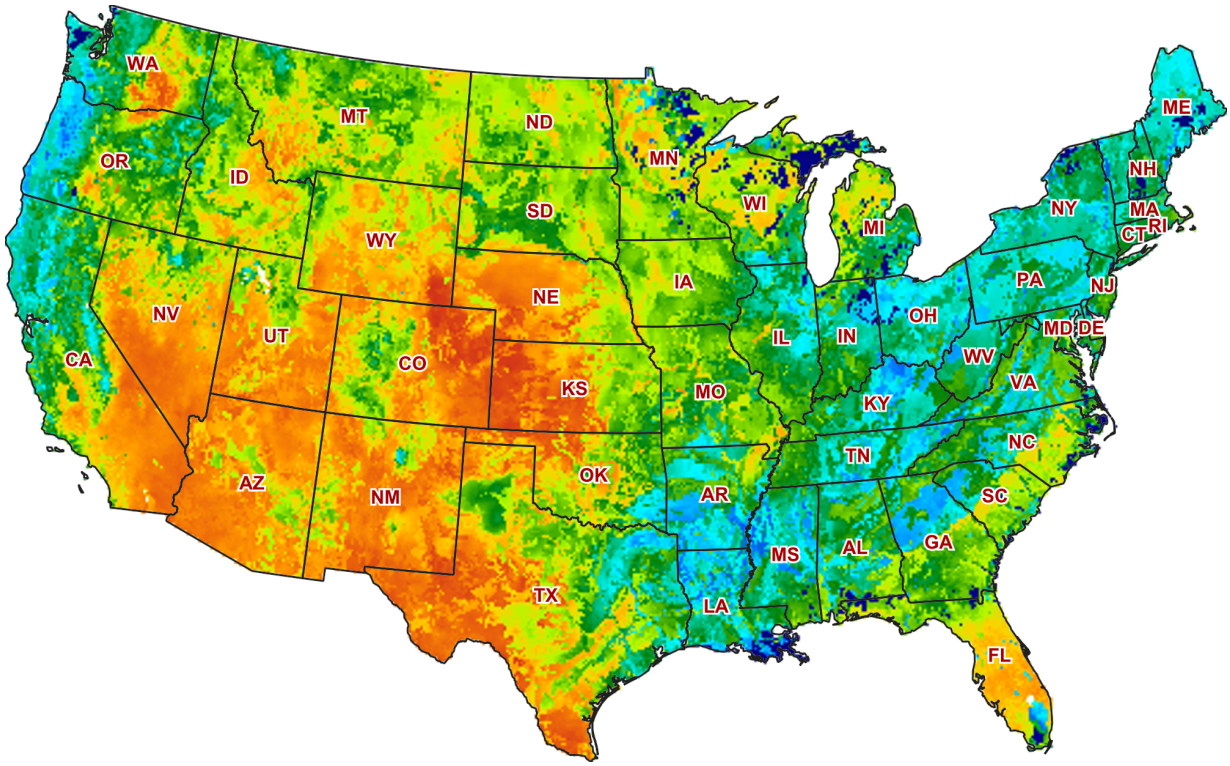
During our night of June 18, 2024, the Suomi NPP Satellite acquired the image to the right. At that time the South fork and Salt Fires were burning in the Sacramentos. On the image, they are as brilliant as the metropolitan areas and the oilfields in southeastern New Mexico. They are larger than many of the "metro areas". As interesting as that it is, that is not why we show the image here. We have added a large arrow to point at a large dark spot. That large dark spot is where we live, and in a world where humanity is actively destroying everything natural we can hold on to this gem for a while. Most of humanity is not able to look up at night and see the Milky Way. We can. Let us rejoice.

Ground Water & Ephemeral Streams

The U. S. Supreme Court recently rejected the Rio Grande Compact agreement reached by Texas, Colorado, and New Mexico. The settlement reached by the states effectively ignored the reality of water in this area. Legal allocation systems in New Mexico and other states focus on the individual "rights" of current water allotment holders rather than the availability of water or the "rights" of society, generally. In particular, New Mexico's willingness to allow (for all intents and purposes) the unlimited pumping of ground water in the Rio Grande basin prevents the intent of the Compact from being achieved. A system of law which continues to ignore reality is not beneficial to anyone in the long run and benefits only the few in the short term.

"NASA, the U.S. Department of Agriculture, and George Mason University created the Crop Condition and Soil Moisture Analytics (Crop-CASMA) application to create high resolution maps showing changes in soil moisture and vegetation health. The . . . map (below) of the U.S. shows Volumetric Soil Moisture data from NASA's Soil Moisture Active Passive (SMAP) mission (yellow/red = lower soil moisture; green/blue = higher soil moisture) for April 13, 2024. Credit: NASA, USDA, George Mason University." (See link for article.)

In "Ephemeral stream water contributions to United States drainage networks", Craig B. Brinkerhoff et al. (*Science* 384, 1476-1482 (2024) DOI:10.1126/science.adg9430) the authors



presented their findings from a massive study of watersheds in the United States. All quotes are from the article.

"Ephemeral streams are short-lived water bodies that flow only after precipitation has fallen. . . . Brinkerhoff et al. modeled the contributions of such streams to over 20 million more-permanent water bodies in the contiguous US, finding that ephemeral streams contributed about 55% of the total discharge from drainage areas. . . . This work illustrates how important ephemeral streams are as pathways for the transport of water and pollution into perennial water bodies." In the Rio Grande-Elephant Butte drainage they found that the contribution was roughly 80%.

It is nonsensical to ignore the role of ephemeral streams in our water supply. "The issue was addressed once again by the Supreme Court in the 2023 case of *Sackett* v. *Environmental Protection Agency* (EPA), where a majority of the Court narrowly defined WOTUS as encompassing 'only those relatively permanent, standing or continuously flowing bodies of water forming geographical features that are described in ordinary parlance as streams, oceans, rivers, and lakes.'"

Pretending that a problem does not exist does not solve it.

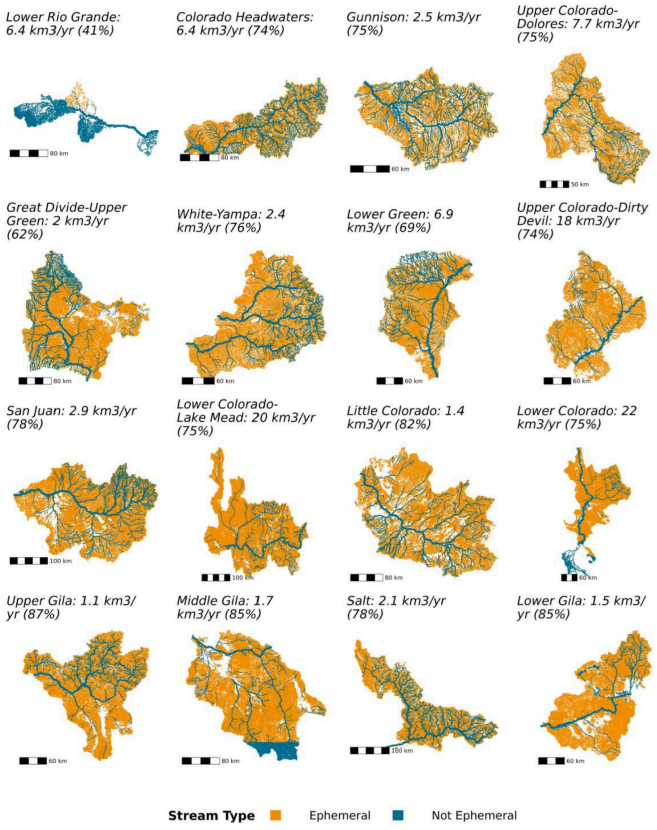
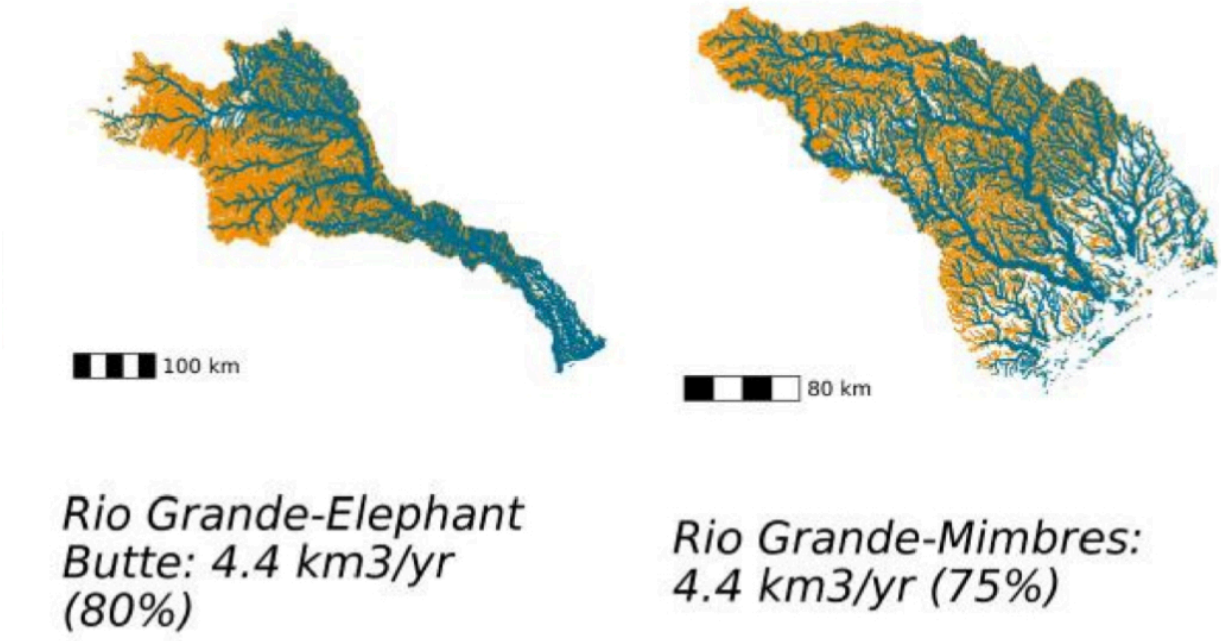


Figure S26: *Drainage network hydrographies 161-176 of 205. Sub-plot titles refer to the relative and absolute values of discharge exported from drainage networks that is ephemerally sourced (equation S1). Reach width corresponds to the size of the river (specifically, the logarithmic bins of discharge relative to map scale). Note that foreign streams are mapped as 'not ephemeral' in these plots for visualization's sake.*



Directly Above: Supplementary Information from Brinkerhoff et al., two of many drainage and water content diagrams in the study, figure S25. The drainage network hydrographies are shown on pp. 145-160. Sub-plot titles refer to the relative and absolute values of discharge exported from drainage networks that is ephemerally sourced (equation S1). Reach width corresponds to the size of the river (specifically, the logarithmic bins of discharge relative to map scale). Note that foreign streams are mapped as 'not ephemeral' in these plots for visualization's sake.
Upper Right: Figure S26, page 38 of the supplementary material for the study.

Ground Cone and Western Boxelder Bug

While making a stop at Iron Creek Campground on the west slope of the Black Range (June 3, 2024) we recorded a nymph of the Western Boxelder Bug (video link), *Boisea rubrolineata* (Barber 1956), on a stand of Ground Cone (also Alpine Cancer-Root), *Conopholis alpina* (Leibman).

At one time the population of *Conopholis* found here was described as *Conopholis alpina* (Liebman) var. *mexicana* (A. Gray ex S. Watson) Haynes, known commonly as the Mexican Cancer-Root. As noted below, that taxonomy is generally not accepted at this time. (But note that as of June 9, 2024, USDA, iNaturalist, and Wikipedia list the subspecies.) Photographs from this outing are shown to the right and on other pages in this article. Other photographs of this species from the Black Range may be viewed at this link.

Ground Cone erupts from the earth in clumps of several stems, typically under Ponderosa Pine in the Black Range. This may not indicate that they use the pine as a host plant. Most authorities indicate that oak trees are used as host plants.

Vascular Plants (see link above) indicates that the individual stems are generally no taller than six or seven inches (other sources, Lady Bird Johnson, indicate that they may grow to a foot tall). We do not know if the plants in the Black Range are "stunted" or if taller ones simply have not been found here. A clump may be wider than the individual plants are tall. The flowers of this species (protruding from all sides of the cone-shaped structure) are cream colored, while the bracts (visible beneath the flowers) are brown.

***Conopholis alpina* is a root-parasitic plant (a holoparasite which lacks chlorophyll and relies on its host for all of its fixed carbon). All parasitic plants connect with their hosts with an organ (haustorium) which penetrates the host, allowing them to extract material. The development of haustoria (or because haustoria existed?) reduced the need for a variety of morphological adaptations in *Conopholis*. (This is generally true of all parasitic plants: the morphological adaptations found in many other plants are not required by plants that use other plants to furnish their carbon, nutrient, and water needs.) Because of the reduced number of morphological adaptations, identifying the features which can be used in making taxonomic determinations to species and/or subspecies can be difficult. This has led to the lumping and splitting of the genus and this specific species since it was first described.**

Botanical references like the Lady Bird Johnson Wildflower Center website state that this species is "parasitic on the roots of oak trees".







Flora of North America (FNA) gives "oak woodlands, mixed montane forests" as the habitat and notes that this species grows between the elevations of 1500 and 2800 meters. "*Flora*" does not recognize subspecies of this plant, citing A. G. Rodrigues et al. (2013). This reference notes that the seeds of this species are part of the diet of Mexican Black Bears and that, as a result, one of its common names is Bear Corn (citing B. R. McKinney and J. D. Villalobos (2014).

Rodrigues et al. (see cite below) note that the genus is an oak obligate and that *Conopholis alpina* generally uses oaks in oak woodlands and mixed montane forests.

The Native Plant Society of New Mexico Wildflowers of New Mexico lists information for this species which is consistent with our experience. It notes that it uses pines as host plants along with hardwoods.

All sites where we have found this species in the Black Range have been beneath Ponderosa Pine but there have been Gambel's Oaks nearby and their roots certainly extend into the area where the Ground Cones are present. We, however, have not dug into the ground and followed the roots to the host trunk. All populations we have found have been at elevations at the higher end of that indicated in FNA. These observations have not been comprehensive, however, and indicate only that our populations are found at higher elevations - not necessarily that they are not found at lower elevations.

There is some evidence that indigenous peoples used this species as an anti-tuberculosis treatment (effectiveness unknown). SEINet reports that "an infusion of the plant was used as a strengthener for weakened tuberculosis patients, and the dried plant was used to rub the ground before a race to make runners more swift footed." For many years, it was assumed that Europeans brought tuberculosis with them when they came to the Americas and infected the native peoples. All of that is true, but there is a significant caveat to the second part of the statement. In "Pre-Columbian mycobacterial genomes reveal seals as a source of New World human tuberculosis" Bos et al. present evidence that a strain of the disease was actually introduced to the Americas long before the Europeans showed up and that the vectors were most likely seals. (Nature, 514, 494-497, 2014) Given that finding, it is conceivable that indigenous peoples might have had time to identify this treatment strategy.

The specimen shown to the right was collected by O. B. Metcalfe on July 2, 1904, along Iron Creek in the Black Range. It would be very romantic to muse that this specimen may have been collected from the very population we recorded on 6/3/2024.

Note that the identification of this specimen was verified by Robert R. Haynes in 1968. We do not know if this specimen was used by Haynes in his original description (or analysis) of the subspecies. We do not know if S. Shaya and A. Rodrigues used this specimen in their study which removed the subspecies designation, of this specimen, on September 21, 2013. Their findings, that this species is not appropriately divided into subspecies, were outlined in "Morphometric Analyses and Taxonomic Revision of the North American Holoparasitic Genus Conopholis (Orobanchaceae)"; Anuar Rodrigues, Shana Shaya, Timothy A. Dickinson, and Saša Stefanovic´; *Systematic Botany* (2013), 38(3): pp. 795-804. A schematic of their findings is shown at the top of the following page.



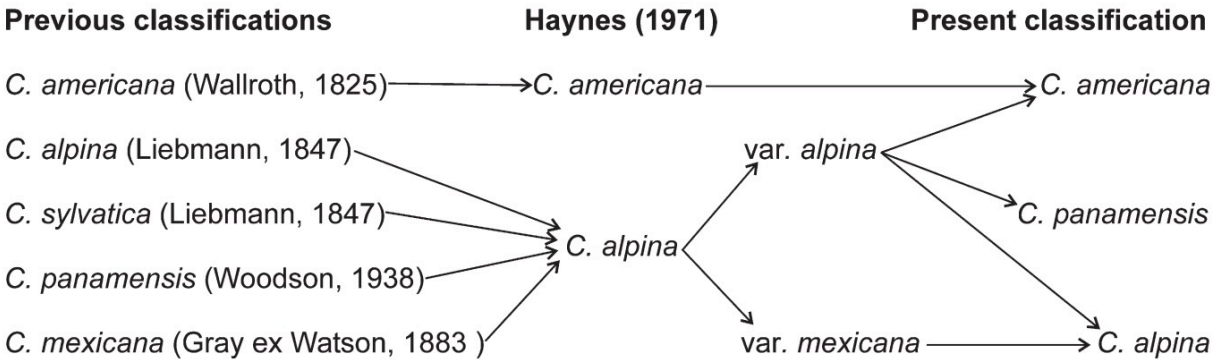
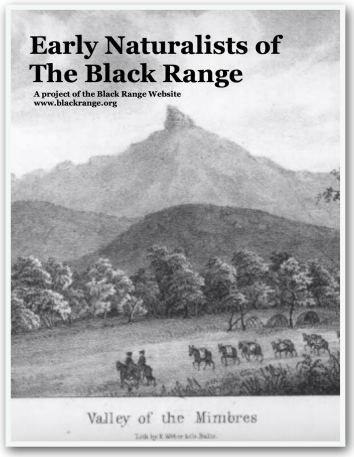


FIG. 1. A summary of the relationships between the various names applied to taxa in the genus *Conopholis* according to the various authors before 1971, by Haynes in his monograph in 1971, and by our revised classification following this morphometric study.

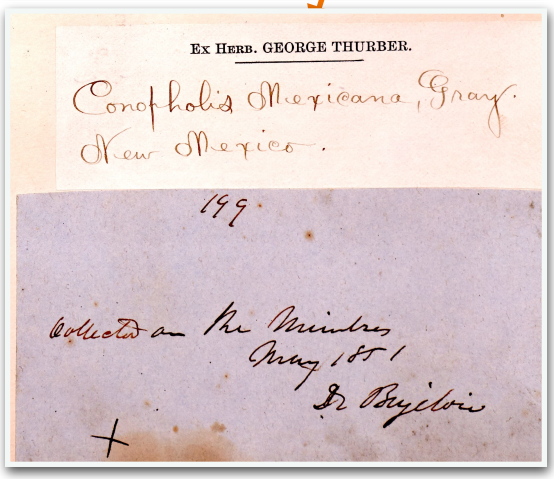
The specimen shown at the right was collected by John Milton Bigelow in May 1851 on the Mimbres. The Harvard University Herbaria erroneously lists the collection site as "Mintres" - looking at the specimen label it is possible to see how that mistake could have happened.

***Early Naturalists of the Black Range* (see below) has more information about O. B. Metcalfe (pp. 116-117), George Thurber (p. 61), and John Milton Bigelow (pp. 67-72).**



The USDA range map shown at the top right (download 6/9/2024) does not indicate that the species is found in Sierra County. Photos in our photo gallery include images from both sides of the Black Range (Sierra and Grant Counties). The range map shown on the Wildflowers of New Mexico page (see earlier) is more accurate.







What about the other life form we found at this site, *Boisea rubrolineata*, the Western Boxelder Bug? The nymph shown in the video link and in the top two images at the beginning of the article may be a member of one of the several broods which occur every season. Most Western Boxelder Bugs overwinter as adults or late stage nymphs (there are five nymph stages). Although we did not see adults at this site, it is not uncommon to see populations with multiple life stages present at the same time. Nymphs resemble the adults, but the wing pads do not become apparent until the third instar stage. Wings are not functional until the bug reaches the adult stage. Even as adults these bugs rarely fly. NMSU has produced a nice flyer on this species.

The individuals we observed may have been gathering sap from the Ground Cone. In general, however, Boxelders, Maples, and Soapberry trees serve as hosts for this species - but when it comes to eating they are quite cosmopolitan.



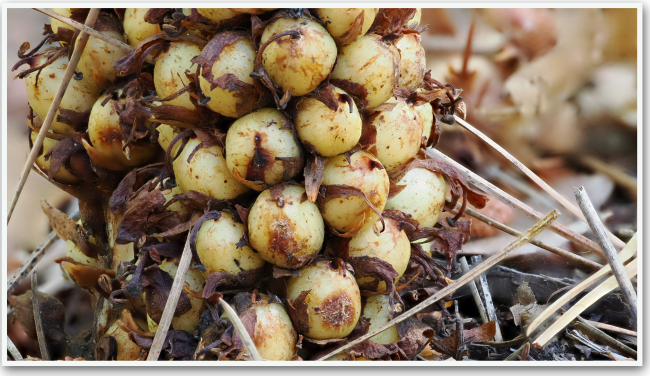




Ground Cone (also Alpine Cancer-Root), *Conopholis alpina* (Leibman), Iron Creek Campground, west slope of the Black Range. June 3, 2024.









By July 11, 2024, the plants had gone to fruit.





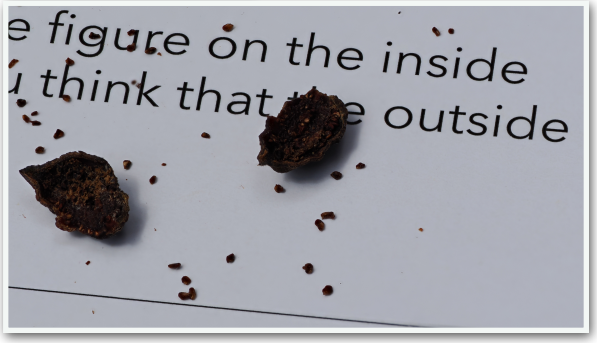




Mindy Gage (Nampa, Idaho) took the photo above, of the stand of Ground Cone at Iron Creek, on July 20, 2024.

On that same day, we completed our survey of this colony of Ground Cone, noting the size of each seed capsule and the large number of seeds in each. The photo at the bottom right depicts a desiccated pod and seeds.





The Black Range: Thoughts from a Visitor

by Jon Hoffman

There was fog lying prostrate in the canyons; my windshield wipers were twitching with anticipation at lone droplets that dripped from the overhanging ponderosa branches as I wound my way up NM-152 over Emory Pass. I stopped to usher a black-tailed rattlesnake (*Crotalus molossus*) off the road – she sounded out in disapproval, ambivalent that I was playing god.

After 10 days in the Chiricahuas, I was Kingston-bound. Then, back to Bozeman to return my car to my dad – his Chrysler Pacifica a far cry from the Rocinante of either Quixote or Steinbeck. From there, a flight back to New York City was waiting to tuck me away between the alley-less streets: my one-bedroom apartment in the bottom floor of a rowhouse.

On my journey southbound from Montana, I stopped one night in Salt Lake City to commune with my brother and sister over burgers and beers. After a quick night's stay, I put the Wasatch Range in the rearview.

The next stop was a day in Flagstaff to conduct some of my research – the point of my journey. I was on an expedition to catch lizards, specifically skinks in the genus *Plestiodon* for my doctoral thesis back at the American Museum of Natural History. Over my four-year stay in NYC, I am tasked with piecing together the evolutionary history of this group.

As a kid growing up in the water-logged state of Michigan, I pictured Arizona as the polar opposite: an empty desert. Although I had known differently for quite some time now, I was still surprised as I peeled past the North Rim into Coconino National Forest and was swallowed whole by an astounding array of ponderosa pine forest. I spent most of the day wandering in the green meadows between the red trunks. With the San Francisco peaks looming in the distance, I managed to scrounge up some beautiful individuals of the many-lined skink (*Plestiodon multivirgatus*); their elegantly long tails writhed at my touch. Only mostly prepared for collection, I had to condemn one to an empty Cheez-Itz box. In the enclosed darkness, the skink was also ambivalent that I would have to play god.

Although collecting a skink pains me each time, there will be no waste: each individual included in my research will have its genome sequenced and uploaded to public databases; their bodies will be fixed in formalin to be stored in ethanol for an eternity, creating a resource that will be able to support a plethora of future research while recording a snapshot of current genetic diversity.

Continuing southbound, I forged ahead to the American Museum of Natural History's Southwest Research Station in Portal, AZ to embark on a pleasureful teaching assistantship for a course geared towards teaching field techniques and the herpetofauna of the desert southwest. Over nine days we hiked scree fields; summited mountains; waded in cattle ponds; walked the desert in the heat of the day, cherishing our water; and walked in the desert in the relief of the night, cherishing our headlamps and the cool winds. We found fifty-five species of reptiles and amphibians. An elegant trogon perched on a branch above me. I learned that a coyote's howl still sounds the same.



From there, I drove on towards the Black Range.

I had planned my route back to Bozeman through the Black Range to celebrate the centennial of the Gila Wilderness – the first nationally designated wilderness and a product of the conservation efforts of Aldo Leopold, who started his career as a Forest Service worker assigned to District 3 in Arizona and New Mexico. Working in the area from 1909-24, Leopold was a student of the landscape and played a crucial role in the first inclusive management plan for the Grand Canyon and spear-headed the creation of the Gila Wilderness. After his start in the desert southwest, Leopold transferred to Wisconsin, where he would live for the remainder of his life. Eventually becoming the first game management professor at the University of Wisconsin, Leopold would earn the title of 'father of modern conservation biology'. Steeped in environmental ethics, Leopold is most well-known for his book *A Sand County Almanac* (1949) – an inescapable text for any aspiring ecologist. The portrait of the complete landscape that Leopold portrays of his Wisconsin farm is reminiscent of my experiences in the sandy forests, prairies, and wetlands of my home in West Michigan. His seminal essay, "The Land Ethic", places humans back into the ecosphere as members of the environment, challenging the traditional dominion over nature instilled by Western Religion and permeated in Euro-American culture. Expanding upon this idea of within rather than above, Leopold emphasized that ethics should be extended to humans' relationship with the land, defined as the ecosystem and broader environment. Leopold argued that land has the intrinsic right to exist, and it is morally wrong to degrade it. With the works of John Muir, George Grinnell, and Theodore Roosevelt, Aldo Leopold's ideals set the foundation of the North American model for wildlife conservation – a model that holds wildlife and public land resources in a public trust, managed scientifically and democratically. Arguably the premier wildlife management model in the world, the North American model is the basis for creating opportunities for the public on

immense tracks of protected land, and in turn, funding for conservation. This protected wilderness started with a large section of the Black Range – the Gila Wilderness – a century ago.

Reading Leopold's work always gives me a sense of wonder, nostalgia, and encouragement to pursue a career in biology and writing. I felt drawn to extend my fieldwork in Arizona to experience the ecosystems of the Black Range one hundred years later.

To make the most of my short time in the area, I wanted to meet people with a deep connection to the land. In my search for expertise, I decided to reach out to local naturalists via the iNaturalist app – a citizen science initiative to identify and upload geotagged observations of any organism imaginable. Through this, I connected with Jan Richmond – a resident of Hillsboro and an Ontario native who became entranced with the Black Range, just as so many residents of Hillsboro have. Early in our email conversation, Jan looped in Bob Barnes as an "excellent naturalist". Upon further correspondence, I was thrilled to learn of Bob's magazine and his dedication to the flora, fauna, and history of the area. Once together, he would mention that he only started the publication "to keep him off the streets" – a believable notion as it is hard to be on the streets when you spend all your time in the woods (unless you count fire roads). Soon after, in sincerity, Bob confided in me the true reason: when he was moving to the area from the Pacific Northwest, he was disappointed with the unavailability of information regarding the region's natural wonders, thus, *The Black Range Naturalist* was born.

I pulled into the Black Range Lodge and parked beneath a plum tree. I had an afternoon to kill before meeting Jan and Bob early the next morning. After getting situated in my room, I laced up my boots and drove to a drainage just below Hillsboro to look for the *Plestiodon obsoletus* – the Great Plains skink. After rummaging through rocks and discarded lumber, hiking up smaller offshoots of the drainage, and looking in every crevice imaginable, I heard rustling below a small cliff band. Something serpentine and sleek was





Except as noted, all photographs in this article are by the author.

Top Right Previous Page: Warm Springs Wash, east of Hillsboro.

Bottom Right Previous Page: A *Plestiodon obsoletus*, Great Plains Skink, from Soledad Canyon, Organ Mountains, photograph by James Von Loh.

Right: Juvenile Great Plains Skink, photograph by Debora Nicoll, Lake Valley, NM

See *The Black Range Naturalist, Volume 6, Number 1*, pp. 71 - 74, for more on this species.



moving softly across the rocks and beneath branches, its golden sides patched with rust. I knew immediately that this was the quarry I was after. I carefully crept towards the animal, trying to get a better view and hopefully catch the skink to admire it closely, as I had never seen one prior.

This was to the satisfaction of the first objective of this outing: to locate and observe. The second objective now loomed: acquisition. I crept as quietly as I could up the bank, placing my steps on bare rock to avoid the rustle of vegetation and the crunch of stray branches. Once I was close enough to grab the skink, it darted under a rock – I assumed I had the creature cornered. I flipped the rock and watched its tail disappear into a hole beneath. I dug relentlessly. I dug and I dug. I stayed to survey the area until dusk. Dust-ridden I walked back to the car and drove away, empty-handed.

I have never been upset at this form of failure. The skink that eluded me, like other wildlife in the U.S., belongs to the people – but it also belongs to the land and the ecosystem, maintaining the intrinsic right to exist unbothered. In the absence of subsidence and science, the land and its inhabitants should not be subject to external stressors.

A quarter after seven in the morning, I started up the meandering coils of NM-152 back up over Emory Pass. Cresting over and winding down, I followed the curving pavement into Railroad Canyon where I was met by two friendly figures toting hiking equipment and such a range of optics that I had no choice but to assume it was Jan and Bob. Stepping out of my car I greeted the two of them and we began our way into the canyon. Almost instantly I was amazed by the surroundings – the mountains rose on either side in a slope just shallowing enough to harbor a sea of ponderosa pine, some of which were barren, victim to the Silver wildfire that raged through 140,000 acres of the Black Range in 2013, and the Black fire which claimed another 330,000 acres in 2022. In the center of the canyon was a small stream that flowed gently across the rocks, thriving with plant life that shifted from willows to Arizona Walnut to Gamble Oak as you moved away from the banks. Bob and Jan celebrated the water above the creek bed, mentioning that it had been dry for the season up until now. Meadows sprawled beneath the deciduous canopy and made way for a myriad of wildflowers – I could have sworn we stopped to look at every single one – partly by my own volition to learn as much as possible while in the presence of such experts. We admired the bergamot (*Monarda fistulosa var. menthifolia*) clumped in bushels along the path, the light dappled across their purple flowers. The sweet four o'clock (*Mirabilis longiflora*) hid in plain sight as we continued to walk.



There is such austere beauty hidden in the folds of the Black Range. The verdant pulses of undergrowth that climb out of the moisture-laden rivulets spread far towards the peaks until they surrender to barren talus or cliff bands of the igneous bedrock, the backbone of the landscape. In the green hollow of the Railroad rivulet, surrounded by primrose (*Oenothera neomexicana*) and mustard (*Hesperidanthus linearifolius*), there is more hidden beauty: Bob hunches over a pile of coyote scat, sorting through it with a stick. As Jan and I leaned over to see the aim of Bob's macro lens, the carrion beetles (sp?) tucked themselves back under the folds of excrement. On we walked.

Previous Page, Bottom: Water flows in Railroad Canyon.

Right: Bob Barnes admires a pile of …

Bottom Right: Or perhaps a carrion beetle, *Nicrophorus guttula/N. mexicanus* (Yellow-bellied Burrowing Beetle) living up to its name. Photo by Bob Barnes.





Reaching the second junction of trails, it was time to begin the trek back to the parking lot. The sun was growing higher into the sky and the temperature was warming. Following the trickling of the creek, we meandered once again through the canyon. Although railroad canyon is likely too high for the Great Plains skink that prefers the aridity of the land beneath Hillsboro, I was able to catch a crevice spiny lizard (*Sceloporus poinsettii*) and prove to Jan and Bob that I am a functional herpetologist. Although not very similar in appearance or ecology, spiny lizards (*Sceloporus*) are close relatives to an icon of the American deserts – horned lizards (*Phrynosoma*). Both groups, joined by earless lizards (*Cophosaurus* and *Holbrookia*), rock lizards (*Petrosaurus*), fringe-toed lizards (*Uma*), tree and brush lizards (*Urosaurus*), and side-blotched lizards (*Uta*) make up the family *Phrynosomatidae* and share a common ancestor approximately 50 million years ago. This family of lizards is fascinating and is a great place to start when seeking to understand the reptile communities of the southwest United States. I was glad to have caught the *Sceloporus poinsettia* as it basked against the warming landscape because a week earlier, I tried to evict one from a crack in a boulder for half an hour. Once these lizards find their way into a tight spot, they'll wedge themselves into a fissure and let their spines do the work of keeping them in place, earning them the common name 'crevice spiny lizard'. I released the lizard onto the rock to warm in the morning sun; she ran quickly towards a crag lily (*Echeandia flavescens*). All too soon we arrived back to the gravel and sun of the trailhead, the mountain parsley (*Cymopterus lemmonii*) and cinquefoil (*Potentilla thurberi thurberi*) left behind. Brought with me out of the valley, a taste of the biodiversity of the area and an appetite for further exploration. I took off my boots and slipped into a pair of rubber clogs. In parting with Bob and Jan I expressed my gratitude for the companionship and openness in joining me – I felt as if I had been let in on a well-kept secret. Before leaving, Jan offered Bob and

me 'cowboy cookies'. I would suggest adding the following to the recipe: best served warmed up on the dashboard of a car climbing Emory Pass. They were delicious.

As I set back north towards Bozeman, I thought back on my time in the Black Range and earlier in the day. I was surprised at the familiarity of the morning. I have traveled all over the country in search of skinks and otherwise, communing with the people and landscapes from hemi-boreal forests to deserts – I have never felt a more immediate connection to a place stronger than the Black Range. This is surely a result of the biodiversity and geography creating points of curiosity around every corner. As Bob mentioned on our walk, the Black Range is a "meeting of biomes"; it is a four-way intersection where life crashes together in the middle. Not only is this the result of the long-worked processes of geology and climate, but also the more recent efforts that have protected this landscape: the vision of Aldo Leopold and other early conservationists' recognition of the need for wilderness and their actions to protect vast swaths of the range one hundred years ago. I'm sure that the inhospitality of the desert and general isolation that has allowed the area to fly under the radar for all this time has helped some, too. The amalgamation of time, effort, and stochasticity has produced a rich landscape many facets of which are unsullied and unblemished by crowds and the anthropological detritus that always follows. Beyond wilderness, I have come to greatly admire those who choose to call this area home – I was treated with such kindness by the locals and my presence was received with grace. No, this is not because I am used to the rushed interactions of New York City – it is because the people of the Black Range hold the same authenticity and generosity of the surroundings: if you are willing to give the effort of appreciation, it will be returned two-fold. I will be back sooner rather than later.







Top: Jan Richmond

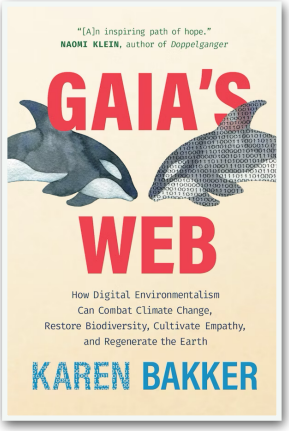
Center: Railroad Canyon

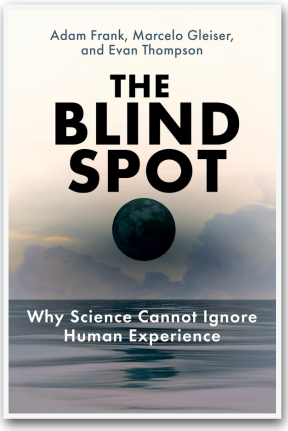
Lizard Photos by Bob Barnes:

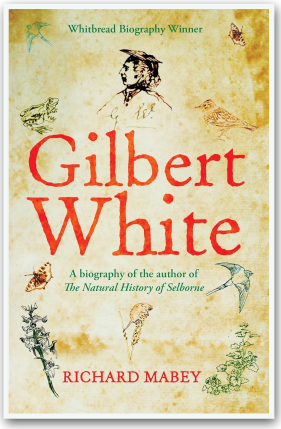
Above: *Sceloporus poinsettii*, Crevice Spiny Lizard seen earlier in the year in Railroad Canyon.

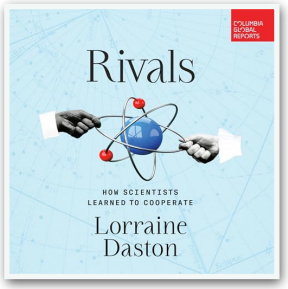
Right: Texas Horned Lizard, *Phrynosoma cornutum*, photographed in Hillsboro.

What People Are Reading and Listening To

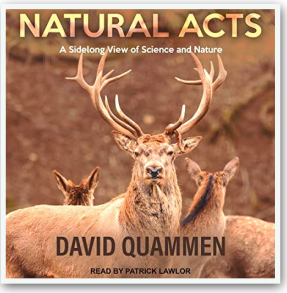












Gaia's Web

A full review of this book can be read at this link - from the 4 April 2024 issue of *Science*. An example of Bakker's study of the potentials (and pitfalls) of new technologies when it comes to the study of natural history is illustrated by her discussion of Wildbook (from wildme.org). This project utilizes a variety of machine learning algorithms to study natural history, including the identification of individual animals from images (trailcams, video feeds, etc.) - not the identification to species, the identification of the individual.

The Blind Spot - Why Science Cannot Ignore Human Experience

The Authors (Frank, Gleiser, and Thompson) argue for the inclusion of the human experience within the construct of science. Michael Pollan states that they "call for a revolutionary scientific worldview, where science includes – rather than ignores or tries not to see – humanity's lived experience as an inescapable part of our search for objective truth. The authors present science not as discovering an absolute reality but rather as a highly refined, constantly evolving form of human experience."

Gilbert White

Want to know what Gilbert, the famed naturalist who made in-depth studies of specific locales a thing, spent that shilling on last Thursday? This is the book for you. - R. A. Barnes

Rivals - How Scientists Learned to Cooperate

I don't buy it and would not buy it again. All too often people who are trying to make a point take an extreme position to justify the effort. For my two cents, scientists are humans and act like members of that species. Accept that fact and get on with life. - R. A. Barnes

Weavers, Scribes, and Kings

Amanda Podany has produced a work of art. She uses cuneiform inscriptions to tell the history of the ancient Near East. With an engaging sense of perspective, in-depth topical knowledge, and a deep sense of history she weaves a story which is engaging, sometimes repetitive (history often is), and enlightening.

Natural Acts

This is a 2009 revision of a book which first appeared in 1985. After 15 years some of the information is a bit dated, but Quammen is an excellent essayist and this collection of short reads is easy to pick up and start at any point in the book. A nice turn of phrase greets you on every page, and a global perspective often leaves the reader wondering as much as the author.

Journeys of a Pure Naturalist

When I started this book I had as a goal the understanding of what a "pure naturalist" was. By the end I was affirmed in an understanding of a lifestyle I am very familiar with and impressed with Joe "JB" Billings' ability and motivation to explore the natural history of Arizona, Sonora, Baja California, and Baja California Sur on his own terms.

Billings is described on his website in these words: "A lifelong, naturalist-at-large and 21st century cave man – has extensively explored, studied, written about, and photographed the wildlands of SE Arizona, along with other areas of the west and Mexico. Whether on an all-day long bushwhack hike and botanical expedition in the remotest corner of the Santa Catalina Mountains, rowing a primitive watercraft made from reeds out into the Sea of Cortez, fashioning stone spearpoints and primitive weaponry, as a self-taught flintknapper, or stalking and tagging thousands of beautiful monarch butterflies as MonarchQuestAZ, he is equally at home in the outdoors, all year round . . . JB tagged over 6,000 butterflies during six field seasons as MonarchQuestAZ, while tracking down at least 100 tagged monarchs from all tagging programs along the California coast and in the Mexican monarch preserves, including a dozen of his own tags . . ."

Truth be told, this self-description covers the topical subjects of his book fairly well because it describes his life, his ramblings, his insights, as a "pure naturalist". My understanding of what he means by that term began early in the reading of the book and continued to be reinforced and augmented as I read along. Billings might take issue with my description, but I would say that by a "pure naturalist"

he means that he is one who ventures into the natural world without a pack full of gizmos. He seeks not just to know the world he travels through, but to understand it.

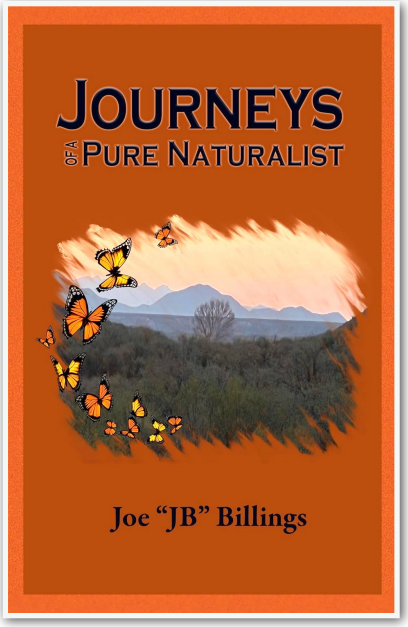
Billings describes a life many of us can relate to, and have cherished, but have never committed to the page. The fact that someone has put that way of knowing nature to the page benefits all of us.

His explorations of the (mostly) dry areas of the southwestern U. S. and northwestern Mexico were sometimes trying but never diminishing. Billings took on every challenge with an attitude of "I can make this work".

The book begins with several chapters describing his rambles in southeastern Arizona - multi-day walks into some of the most challenging topography the area has to offer. Most of these treks were in the 1970s and 1980s. Consider them "period pieces", the "what we did and the way we did it back in the day". Many of us started our explorations of the natural world on a shoestring but lost that way of understanding our natural setting somewhere along the way. J. B. never did. And we should make no excuses for ourselves. After all, those aging muscles and bones can get sore after a night on the ground, but those early days of sleeping on a tarp in a wash gave us an insight that an RV will never deliver.

Billings used (uses) the same "personal touch" when it came to understanding the ways of the indigenous peoples. His chapters on





flint napping, the making of a compound atlatl, and the construction of a reed boat to travel the Sea of Cortez are about a visceral understanding of the world. Not one to be gained from reading the print on this page, or any other. His efforts are about research and time, but mostly about time, because it is knowing the time that it takes to make these things which is important. I do not wish to diminish his efforts to search out the materials those peoples used but rather to emphasize the understanding and appreciation of the sophistication of their efforts which he gained in the process.

He ends the book with a description of his work on Long-tailed Tadpole Shrimp, Fairy Shrimp, and his various butterfly survey and tagging efforts*.

Journeys of a Pure Naturalist is a book about a way of life, a way of experiencing and understanding the world. We come to understand Billings' use of the term "pure" through his experiences.

This book is available on the Amazon website, in print at this link, or as a Kindle edition at this one.

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*"Opening a Window on Southwestern Monarchs: Fall Migrant Monarch Butterflies, *Danaus plexippus* (L), Tagged Synchronously in Southwestern Arizona Migrate to Overwintering Regions in Either Southern California or Central Mexico", Joe Billings, *Journal of the Lepidopterists' Society*, Volume 73, Number 4, pp. 257-267, 2019.

Monarchs

Migrations seem to fascinate people. In the world of the *Lepidoptera* it is the migration of the Monarch which has proven to be most interesting to the North American public.

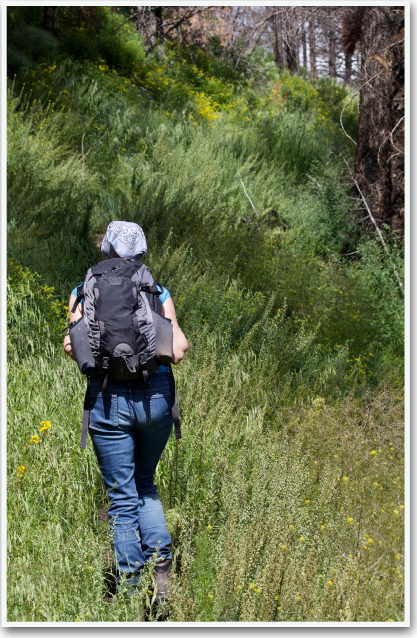
As we learn more about the migration patterns of Monarchs our fascination seems to grow. See, for example, pp. 114-118 of Volume 5, Number 2, of this journal, *Butterflies and Moths of the Black Range and Doña Ana County* (a publication of the Black Range Website).

Research into their migration patterns (for example, J. Billings in the previous book review and David James & Linda Kappen, Feb. 2021, "Further Insights on the Migration Biology of Monarch Butterflies, Danaus plexippus (Lepidoptera: Nymphalidae) from the Pacific Northwest", (*Insects*. 12. 161. 10.3390/insects12020161) has added layers of complexity to the understanding of their multi-year, multi-generational migration patterns. It is now clear that the east coast and west coast populations migrate differently and to two different winter population centers. It has also become clear, through the work of Billings, Silver City school kids, and others, that individuals in the population found in the southwestern United States may migrate to either the middle and southern coastal reaches of California *or* to the Mexican highlands. Additional research is needed to clarify the whys, wheres, and whens of this phenomenon.

Saying that additional research is needed is one thing. To understand the hands-on manner in which such research is conducted, is another. I refer you to Joe Billing's book - *The Journeys of a Pure Naturalist*. (Here is a hint: when your response to a swarm of cater-pillars is to open your house to them so that their metamorphosis can be studied more closely, you are deeply into the research mindset.)

Sawyer Peak Trail to Grandview Saddle











Occasionally we are asked if we intend to update the four-volume Walks in The Black Range (2nd Edition). Rather than simply saying "no", it is probably more appropriate to invite our readers to submit updates on their favorite trails and we will work on a 3rd edition as time allows, using that material. The trails of the Black Range change with every fire season and the winds of every spring - not to mention the gating of traditional use access points. As a result, trails fall into disuse or are abandoned, hikers and hunters in their frustration take to the game trails, etc. So there is a reason for periodic updates. Sometimes the changes are dramatic, sometimes not. For example, the photograph at the upper right was taken shortly after the 2013 Silver Fire, along the lower section of this trail. Most of the grass is now gone.

The photographs from June 30, 2019, of Convergent Lady Beetles, *Hippodamia convergens* (center) and Rocky Mountain Iris, *Iris missouriensis* (Nuttall) in seed (center right) were included in the 2nd edition of Volume 4 of *Walks in the Black Range*.

On June 2, 2024, we took a walk up the Sawyer Peak Trail, from Emory Pass to the Grandview Saddle, for the express purpose of seeing if the Iris were in bloom. The round trip was about 5.25 miles with a net elevation gain of about 1300 feet. We found the trail in good condition, better on the west slope of the crest, less well maintained on the east slope where the trail was uneven and sections of blowdown were present.

The route map shown above is copied from Volume 4 of the second edition.

It can seem strange to be walking along the crest of the Black Range and find evidence of human technology (ignoring the trails for a moment and the grazing allotment fencing) like that shown at the bottom, from the Grandview Saddle. But if you are watchful such evidence is fairly common.

True to form, the iris were in bloom at the saddle (see following two pages). They are generally also found in the upper reaches of the Grandview trail if they have not been destroyed by cattle. We did not check on this occasion, however, and cannot report on their continued existence at that location.

Since the iris prefer a fair amount of water, we assume that the drainage in this area flows down from the crest on both sides of the saddle and then downslope along the old Grandview Trail. There is typically seepage along the upper reaches of the trail.

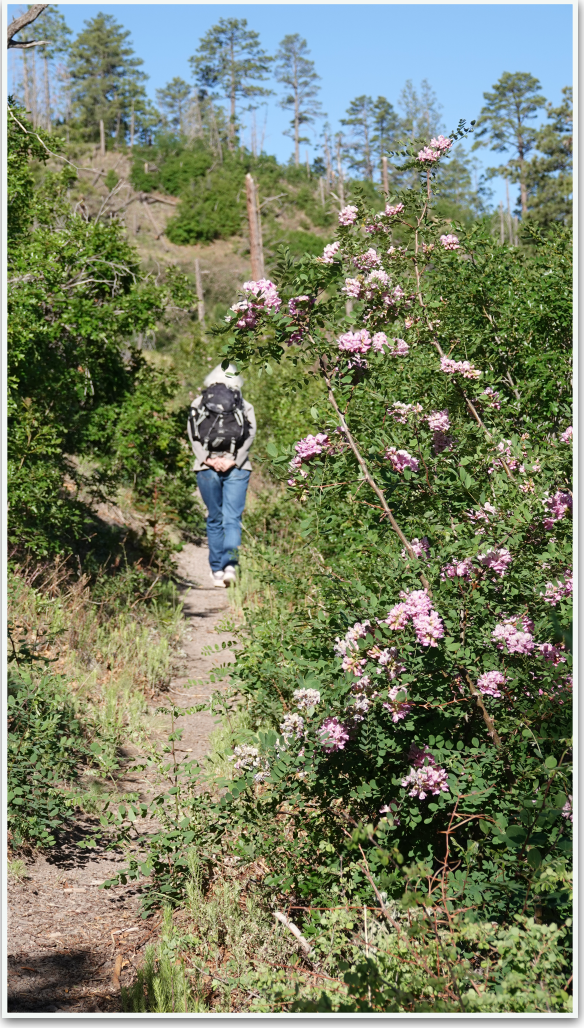


















New Mexico Locust, shown here with an iris, are doing well along the lower reaches of the trail.

Iris missouriensis **(Nuttall), Rocky Mountain Iris (also Western Blue Flag Iris) is found throughout the western United States. Ingestion of parts of this plant will induce vomiting and it is documented as used for that purpose by the Navajo.**

Robinia neomexicana **(Gray) var. *rusbyi* ([Wooton & Standley] Martin & Hutchins ex Peabody), New Mexico Locust or Rusby's Locust, is a plant of the middle elevations in the Black Range. The stems of new growth are reddish in hue, turning to brown as they age. Swallowtails are known to pollinate this species. The Apache, Jemez, and others ate the seed pods of this species, either raw, dried, or cooked.**

Rubus idaeus **(Linnaeus) var. *strigosus*** **([Michaux] Maximowicz), Red Raspberry grows in places along the trail (see right). "The stems have nearly straight prickles and are stipitate glandular." (Vascular Plants of the Gila)**

The ethnobotany of *Symphoricarpos rotundifolius* **(Gray), Roundleaf Snowberry (lower right), is described well by Wikipedia.**

Bird life, including this Western Wood-Pewee, was very vocal during this outing.







Gallinas Canyon Trail from the Railroad Canyon Campground to Gallinas Canyon

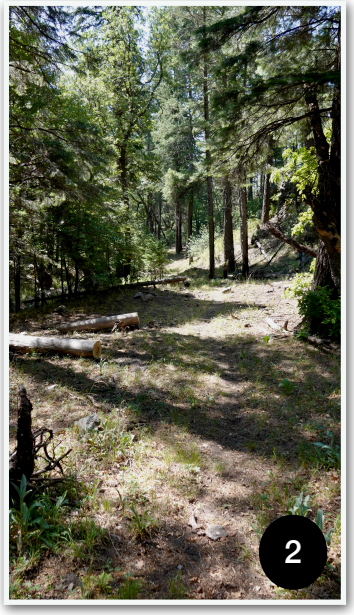
This entry updates the trail description which appears in Walks in the Black Range, Volume 3. Trail 14 in that volume describes the walk from the Railroad Canyon Campground to Holden Prong Saddle. The walk described here starts at the Railroad Canyon Campground and heads upstream for approximately one mile. This section of trail is properly called the Gallinas Canyon Trail. At about one mile the Gallinas Canyon Trail turns west (obscured trail on your left) up a steep section of trail. The Railroad Canyon Trail starts at this point. It is the more obvious trail following the stream, on your right as you make the stream crossing here.

The Gallinas Canyon Trail tops the steep hill following the trail fork (where the Railroad Canyon Trail begins) and continues up a valley to a saddle. In the last decade (since the Silver Fire) the next section of trail has been overgrown, lots of blowdown, and washed out - mostly bush whacking. On June 12, 2024, we found the trail in excellent condition, however. A substantial amount of trail maintenance has been done and we walked along without incident to the spring roughly two miles above the trail fork. This walk is 5.8 miles (RT) with a net elevation gain of just over 900'.

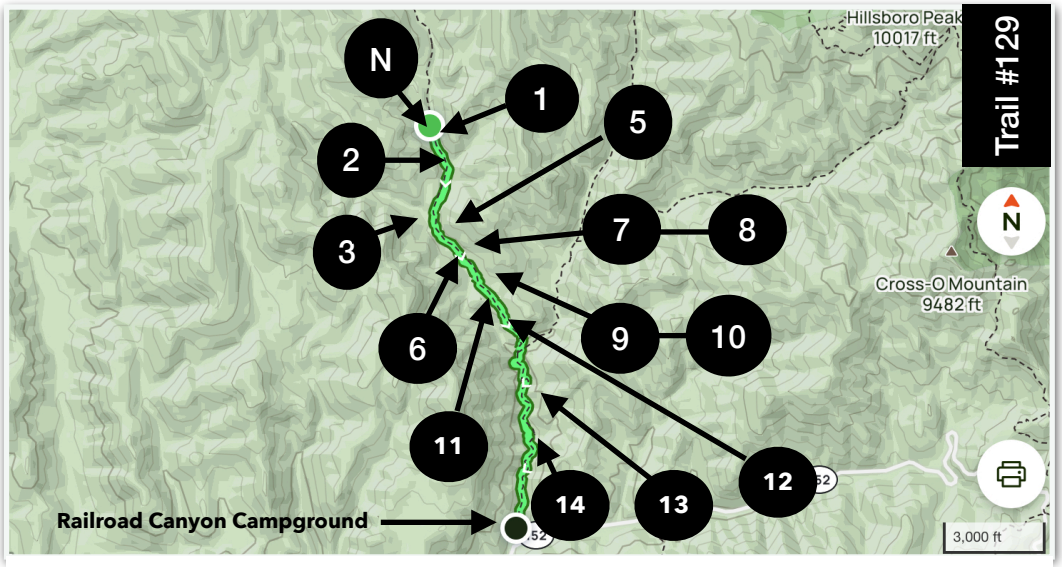
The most significant thing about this hike, on this day, was that the creek was basically dry. There were a few pools of water here and there and a little trickle in places, but dry. Only in the upper reaches of Gallinas Canyon did we find a steady (but small) flow of water in the creek. As a result, we found few flowers in bloom. It was quite hot.

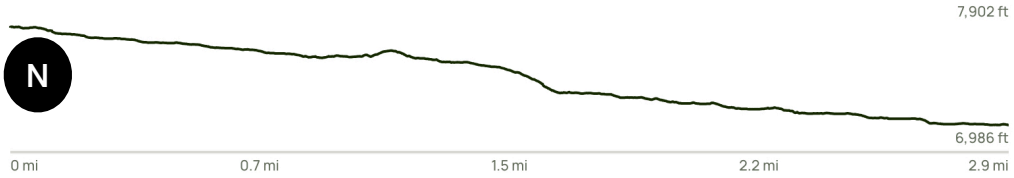
1. The spring is not "maintained" at this point. The pipe from the seep to the trough is gone and the trough has not had water in it for quite some time. There was a small pool of water, from the seep, at the base of the trough.



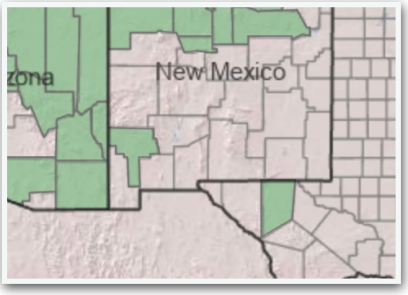








There were several specimens of *Frasera spiciosa* ([Douglas] Griseb.) (photo right), at the spring site. English common names for this species include Monument Plant, Elkweed, Showy Elkweed, and Green Gentian (this species is in the Gentian Family, *Gentianaceae*). There are at least 10 latin binomial synonyms for this species.



The USDA range map (above, download of 6/14/24) indicates the species is found in Grant but not Sierra County. These plants in Gallinas Canyon are about a mile from the crest of the Black Range (and thus in Grant County). Geographic features, like a mountain range, often serve as barriers to the distribution of a species. If this is an example of such a geographic limitation, it is quite dramatic.

2. Trail section just south of the spring.

3. This is a very pretty trail, often meandering along just above the creek. It is especially beautiful when there is some water about, less so when it is dry.

4. One of the rules the editor (in this case, me) often rails about is the need to have something in an image which provides scale, when you are providing scientific observation. Too bad I can't follow my own advice. This massive fungal growth was on a downed Ponderosa Pine and was just over a foot long. I am not able to determine the species, or genus, of this growth.



5. The aptly named Blue Fungus Beetle, *Gibbifer californicus* (*Cypherotylus californicus* [Lacordaire, 1842] in some sources), was present on this fungus. The range map for this species (directly above) is from the Global Biodiversity Information Facility.











Why do we use the Global Biodiversity Information Facility for range maps? There are two primary reasons: the maps are based on observational points and they are not restricted to political boundaries. If you were to read many US website descriptions of the range of this species it would be something like "native to Colorado and parts of Wyoming, Kansas, Arizona and New Mexico". That is a factual statement but it is not an accurate description of the species' range.

The "background" color of the elytra (the hardshell wing covers of beetles) is light blue here but in other parts of its range it may be anything from grey to purple. Always with black dots, however. The background color is created by a pigment, as you might guess since the other option is structure, as in many bird feathers. As pigments often fade with time, you are likely to enjoy the beauty of these beetles only when they are alive.

As their common name indicates, this species feeds on bracket fungi as well as pollen and nectar. The beetles lay their eggs and overwinter near these fungal growths.

6. *Athyrium filix-femina* ([Linnaeus] Roth ex Mertens) var. *californicum* (Butters), the Southwestern Lady Fern, was growing in scattered clumps along the trail.









7. Some of the Gambel Oak trees along the trail appeared to be infested with powdery mildew. This is a manifestation of several types of ascomycete fungi. Although it is reported to have little effect on the oaks, no definitive studies exist.



8. Growing in the same area were a few young trees which I took to be *Picea engelmannii* ([Parry] ex Engelmann) var. *engelmannii*, Engelmann's Spruce.



9. *Hymenoxys hoopesii* ([A. Gray] Bierner), Orange Sneezeweed, was the most common large wildflower along sections of the trail. See also the top of the next page.





10. There were occasional clumps of *Houstonia wrightii* (Gray), Pygmy Bluets or Wright's Bluets, along this section of trail.

11. *Lupinus argenteus* (Pursh), Silvery Lupine was in various stages of bloom and seed, generally in areas where there would have been water during a "normal" year.











12. There was a small *Quercus hypoleucoides* (A. Camus), Silverleaf Oak, growing at the top of the steep section of trail above the fork with the Railroad Canyon Trail.

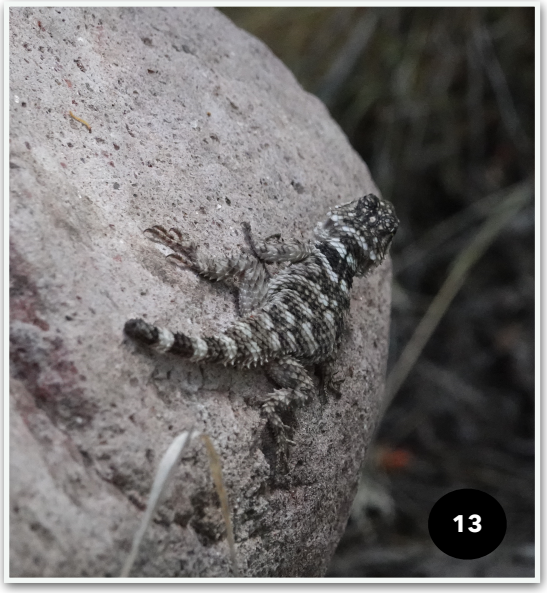
13. South of the fork with the Railroad Canyon Trail (on June 20, 2024) we found a very cooperative *Sceloporus p. poinsettii,* Crevice Spiny Lizard (photographs on the following page).

14. On June 20, 2024, we found a Gray Buckeye, *Junonia grisea* beside the trail (photograph on the following page).

And this brought us back to the Railroad Canyon Campground where, on June 20, 2024, a tree came crashing down in a very light wind as we picnicked.




13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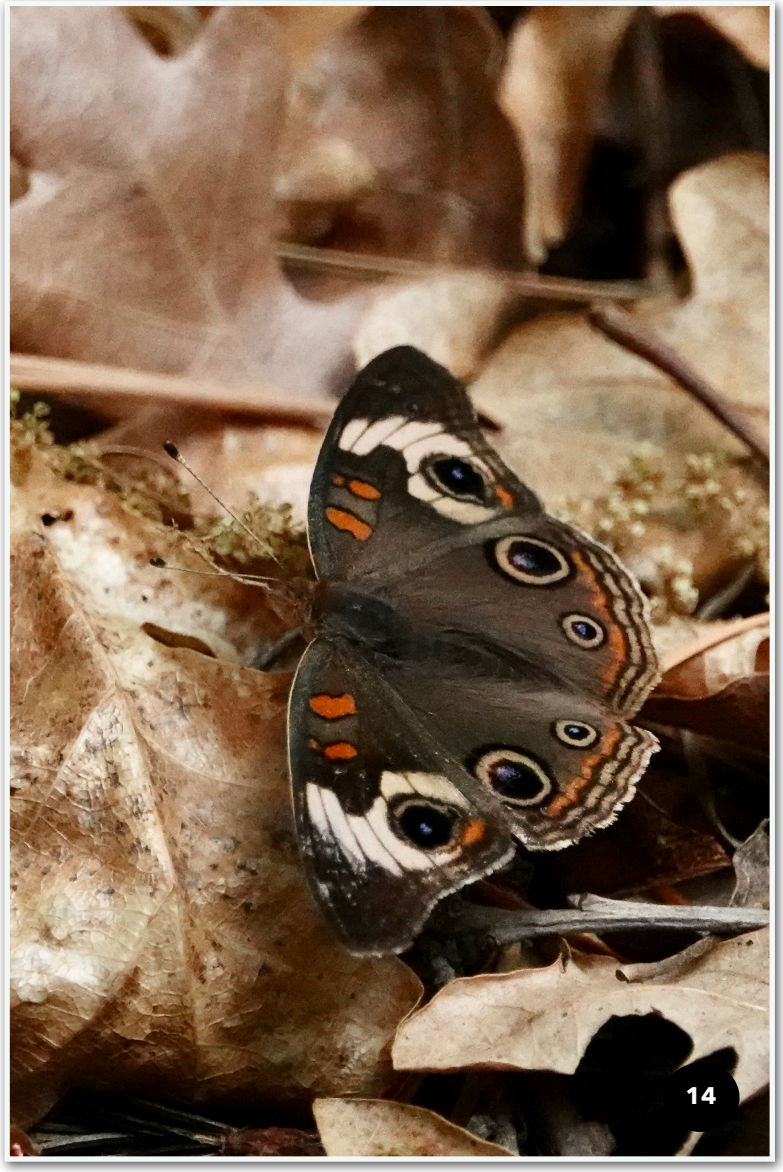

14

Desert Cottontail Gait - One of Many

Before we begin, we should emphasize the "one of many" comment in the title. Most (all?) mammals move in a variety of manners, depending on the habitat they are in, the opportunities or risks they face, and even how they feel at the moment.

There is nothing particularly new or exciting about the series of images which follow. The variety of gaits which animals utilize has been studied widely. The only comment I would make about those studies is that they have a tendency to want to put things in boxes. Animals often exhibit transitional movements between the various gait styles. This cline of movement styles has not been extensively studied as far as we can discern. And true to the literature, we do not explore it here.

On June 3, 2024, while the editor was recording Common Raven nestling behavior (see earlier in this issue), a Desert Cottontail wandered by the blind (or hide, if you are a Brit - a much more descriptive term than blind) presenting an opportunity for some quick (and what turned out to be rather poor) video. The video did not make the cut and does not appear in our Vimeo collection of mammal videos. Desert Cottontail video from 2017, in Hillsboro, is part of the collection.

If the raven video had been going well, if I had not been tired, if I had not been bored, I would not have recorded the rabbit video. But I did, and before discarding it as useless I noted that there was a short clip which depicted one of the gaits used by Desert Cottontails. A few framegrabs later and the original video was trashed, leaving us with the following.

1. **Desert Cottontail, *Sylvilagus audubonii* (Baird, 1858) at attentive rest.**
2. **Subject turns to face the direction of movement, raises its front legs and rises above its hind legs.**
3. **Subject springs forward and front legs begin extension.**
4. **Front legs make contact with ground, hips are raised (allowing the legs to swing forward under the body), hind legs no longer have contact with the ground.**
5. **Front legs are forming a pivot point and are centered under the rabbit's body. Hind legs are swinging forward on the outside of the front legs.**
6. **Hind legs have made contact with the ground, front legs have come off the ground, repetition of 2-5 begins.**

Nothing new, nothing exciting, just a bit of natural history enabled by being tired, bored, and having a semi-cooperative rabbit in the vicinity.















The Way I See It

by Bob Barnes

Long before I read Ed Yong's *An Immense World* (see our book review in Vol. 6, No. 2 of this journal) I was fascinated with the capabilities of non-human life to perceive the world differently from the way that humans perceive it. And, in particular, the incredible insight that capability gave those life forms and conversely what perspective and insight we lack because of our different abilities.





In various past issues we have discussed the tools and technologies which we use to gain perspective and insight which our human bodies deny us. The use of false colors is one of the most frequently used tools which can be used to gain a different perspective. Most photo processing programs (Adobe Photoshop, Lightroom, Affinity, etc.) have filters which can be applied to images to change a color image to black and white or to change the temperature of colors in an image so that the colors "change", for instance. Generally these filters are non-destructive, that is, the original image is stored in the program and can be recalled.

Jon Barnes has developed a set of image manipulation programs which modify the color of images as part of his continuing exploration of LLM (large language models) and other "AI" programs. These programs are not available publicly, but I have been able to use them to explore how different color profiles affect our understanding. The image of a Tarantula Wasp, *Pepsis sp.*, on this issue's cover and on this and the preceding page was modified with a variety of filters to gain perspective. The unfiltered image is found on the cover. At the top of page 74, that image has had the entire color spectrum modified to basically the inverse of what we normally perceive. Several features become more apparent, but there are also some limitations. Note for instance that the very end of the abdomen appears white - but this is just an artifact of the photograph, that part of the original image being "shadowed". In the image below, the temperature of the colors is increased and the blue cast, which is prominent in these species, is highlighted even more with this color range.

Even changing the image to a black and white photograph makes some of the features of this individual more apparent, and with varying degrees of contrast the features which become more obvious vary. The image at the right ("boundary test") is useful for some applications - the simpler the image, the more useful the results.

And lastly, removing the background can produce dramatic results, but I was intrigued by the changed perspective which results from simply changing the direction the individual is facing.

And the programs which enabled these changes were all written by an LLM model which Jon wrote. For most of us the development of such tools remains beyond our technical capabilities. We have to rely on commercial programs or the kindness of model developers.

The use of AI models will result in the proliferation of increasingly more nuanced tools which will enable us to see the world in dramatically different ways - bounded only by our imaginations.





Chagas

The degree to which Chagas is present in the United States is generally not understood. Local medical practitioners are seemingly ill equipped to diagnose or treat the disease. This situation is driven in part by a belief that Chagas is a tropical disease and not present in our locale. The Centers for Disease Control and Prevention (CDC) provides an online course which describes the epidemiology of the disease and its treatment.

The vectors of Chagas are generally known as kissing bugs, mostly in the genus *Triatoma*.

Triatoma gerstaeckeri is thought to be found no closer to the Black Range than southeastern New Mexico. The range map and images to the right are from "Chagas Disease in a Domestic Transmission Cycle in Southern Texas, USA" by Beard et al. (Volume 9, Number 1, January 2003), *Emerging Infectious Diseases*. This study followed the death of several dogs in south Texas from Chagas cardio-myopathy. Chagas is caused by a protozoan called *Trypanosoma cruzi,* which is transmitted to its host when a kissing bug bites the host and then defecates at the bite site. The protozoan is in the fecal matter and enters the blood stream when the host scratches the bite, smearing the fecal matter into the wound.

The CDC has published information on species of *Triatomine* Bugs in the United States, including some information on how to identify the bugs. They list the following species from New Mexico: *Triatoma rubida, Triatoma protracta, Triatoma lecticularia, Triatoma indictiva, Triatoma gerstaeckeri,* and *Paratriatoma hirsuta*. The "Kissing Bugs & Chagas Disease in the United States" community science program administered by Texas A&M University has a wealth of information about the bugs and the disease. The graphic at the top of the following page is from the Texas A&M site (arrows added to show those species found in New Mexico).

A few other species are found nearby in Arizona and Texas. Included at the Texas A&M site is this page, which depicts some bugs commonly confused with Triatomine bugs. To this list we might add *Apateticus marginventris*, various species in *Brochymena*, and *Chelinidea vittiger*.

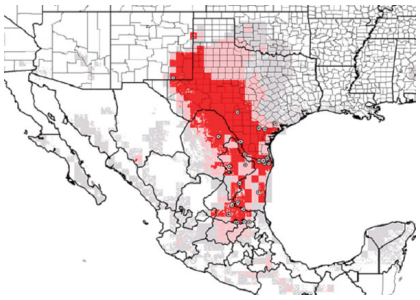
Santos et al. estimated that roughly 6 million people have Chagas (300,000 in the United States). Their study (at link) found that "Although the risk of vector-borne transmission to humans in the United States is potentially low, mounting evidence from bloodmeal analyses indicates that human-kissing bug interactions may be more common than previously thought. This includes, for example, an autochthonous (locally-acquired) case of Chagas disease reported in Missouri in 2018. Across Texas, bloodmeal analysis of kissing bugs in one study revealed that 40 (65%) of the collected insects had fed on humans. In Arizona, human blood was found among all of 8 randomly selected free-roaming kissing bugs at a popular outdoor attraction."

The iNaturalist library includes specific observations from our area of species known to carry Chagas. Two species predominate: *Triatoma rubida*, from Williamsburg, the Floridas, and Las Cruces; and *Triatoma protracta* from the Mimbres Valley and the Gila.



Above: Sighting of *Triatoma rubida* by Ilja Fescenko from the Floridas.





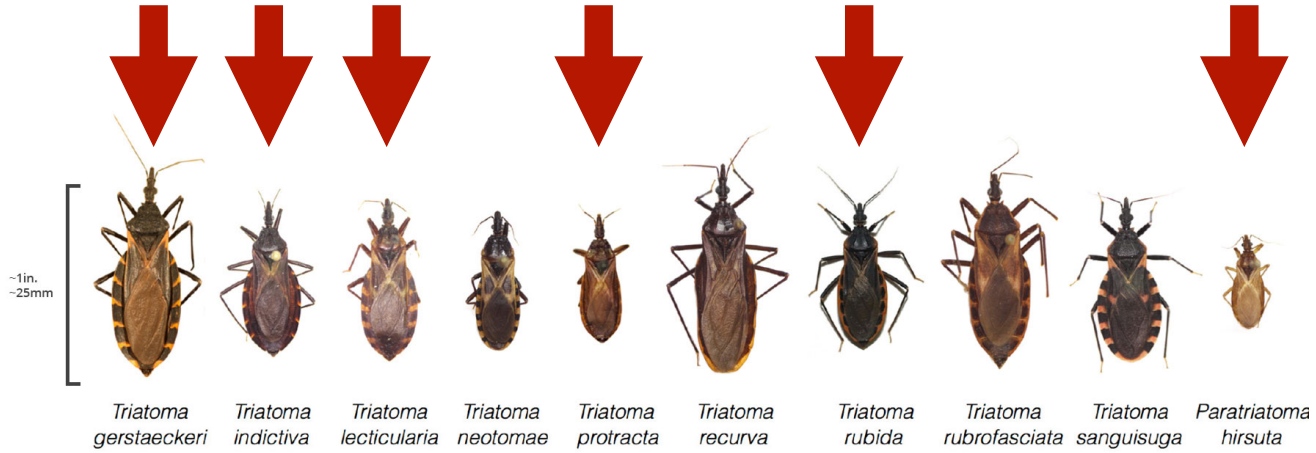
Above: "Figure 5. Genetic Algorithm for Rule-set Prediction-generated ecologic niche model, predicting distribution of *Triatoma gerstaeckeri*. Small circles show actual collection sites. Area in dark red is where high certainty exists for the specific niche of the species. The area in light red is the zone of moderate certainty, and the area in gray is for low certainty."

Directly Below: "*Trypanosoma cruzi* parasites in hindgut of a field-collected *triatomine* bug."





Left: Sighting of *Triatoma protracta* by Emily Pollom in the Mimbres Valley area during June 2021.



Valley Fever

Per the Mayo Clinic: "Valley fever is caused by a person inhaling spores of certain fungi. The fungi that cause valley fever – *Coccidioides immitis* or *Coccidioides posadasii* – live in the soil in parts of Arizona, Nevada, Utah, New Mexico, California, Texas and Washington. It's named after the San Joaquin Valley in California. The fungi can also often be found in northern Mexico and Central and South America.

Like many other fungi, *coccidioides* species have a complex life cycle. In the soil, they grow as a mold with long filaments that break off into airborne spores when the soil is disturbed. A person can then inhale the spores.

The spores are extremely small and can be carried far by the wind. Once inside the lungs, the spores reproduce, continuing the disease cycle."

A new study highlights the role of seasonal wet/dry periods in the growth pattern of the fungi and resulting rates of infection in humans. In "Coccidioidomycosis seasonality in California: a longitudinal surveillance study of the climate determinants and spatiotemporal variability of seasonal dynamics, 2000-2021" Alexandra K. Heaney et al. (*The Lancet Regional Health – Americas*, Volume 38, 100864) report their findings that the end of the dry season is a particularly problematic period for those concerned about infection.

In their conclusions they state: "California's increasing drought risk, driven by global climate change, is expected to worsen with more frequent droughts and potential megadroughts. Our findings, combined with recent research on drought's impact on coccidioidomycosis incidence, suggest that these changing climate patterns will affect both disease rates and seasonal patterns. Future droughts are likely to decrease annual incidence rates and suppress seasonal peaks during drought periods, resulting in lower but sustained cases year-round. Conversely, incidence rates and seasonality are expected to rise after droughts, leading to concentrated cases during specific months. The compounding effect of drought followed by heavy rainfall, a pattern projected to increase, along with the geographic expansion of coccidioidomycosis, will continuously elevate disease risk for Californians. Further research is essential to understand the mechanistic connections between extreme climate events and coccidioidomycosis transmission to inform accurate disease prediction systems and mitigate future disease burden."

We note here that for purposes of causal factors of infection, New Mexicans and Californians are in the same boat.

The Perception of Risk

The May 2024 issue of EOS (Vol. 105, No. 5) included several articles about how people perceive risk (their risk profiles) and how that affects our ability to communicate with them on technical, and often complex, issues.

Risk is an inherent part of the human fabric. Every human experiences the emotions associated with our perception of risk. Those emotions are part of our animal experience. Like many other factors, these emotions affect how we interact with the rest of nature. Here, we use the reactions of the people in the Black Range in the late 1800's to the availability of smallpox vaccinations as a case study in risk perception.

People died of smallpox in the Black Range in the late 1800's. Why?

Smallpox has plagued humanity for a long time. Evidence has been found that it existed 2300 years ago in Egypt, 1600 years ago in China, and 1300 years ago in India. These records treat the disease as an existing condition. There is little doubt that the disease was present before those dates. Since the sixth century there has been clear evidence that the disease spread along routes of trade and conquest (from China/Korea into Japan in the 6th century and from Europe into the Americas in the 16th and 17th centuries). Smallpox had a mortality rate of about 30%, not as virulent as ebola or the black plague, but high enough to cause widespread fear and panic when it occurred and higher than the mortality rate for COVID-19 (note, however, that the mortality rate for COVID-19 is measured in an environment where there is often a full regime of medicines and medical services available to the infected.

It would be much higher if the practices and medicines used at the time when the black plague or smallpox were prevalent had been in use during the COVID-19 pandemic).

Opioid Deaths vs. COVID Deaths

Between 1999 and 2022, 760,000 people in the United States died of opioid overdoses. Between Jan 1, 2020 and July 30, 2022, at least a million (probably more like 1.2M) people in the United states died from covid. (Proc. Natl. Acad. Sci. USA 119, e2115714119, 2022, T. Y. Lim et al.) The perceived risk represented by Opioid addiction and the COVID pandemic differs significantly.

Risk is not a simple concept, our perception of risk is affected by many factors: our comfort with an issue, our knowledge of an issue, our impressions of responsibility, how we deal with fear (which will vary with time, stimulus, and situation), etc.

The earliest efforts to protect people from smallpox are thought to have originated in Africa and China where variolation was practiced. Variolation, also called insufflation and inoculation, is the introduction of material from (smallpox) pustules into the arms of otherwise healthy people or the inhalation of the material through the nose. This practice was effective if the person being exposed had a healthy immune system. The first clear evidence of variolation is from China (1549) but widespread use there did not occur until later in that century. Variolation could cause a person to develop a serious case of smallpox, and roughly 2% of those who were treated died of smallpox. By the late 17th century variolation was being used extensively in Turkey, Persia, and Africa. Knowledge of variolation techniques reached England in 1700, and they were being practiced in the English colonies by the middle of that century.

In the 1700 and 1800s, if you caught smallpox you had a 30% chance of dying. If you received a variolation you had a 2% chance of dying (after developing smallpox). These statistics do not track similar risk profiles, however. In the first case, you had to catch smallpox. Smallpox is very contagious, and in some settings it was very likely that you would catch it. But you might never be exposed to the disease. In the case of variolation you might catch smallpox through knowing action on your part.

In 1796 Edward Jenner made his initial observations about the link between cowpox and smallpox and published his findings in 1801. Smallpox vaccination, a practice which eventually resulted in the eradication of the disease (except in various military/research stockpiles) began shortly after Jenner's experiments became known.

For the purposes of this article, it should be noted that the first use of smallpox vaccine in the Americas happened in 1798, in Newfoundland. "The Republic of Letters" fostered the spread of information; in this case Jenner's work was known in many circles before he published his paper.

So how is it that on the Mimbres side of the range there was a smallpox epidemic in the San Lorenzo area in 1877 and (all spelling and punctuation as in the original newspaper reports):

- On December 29, 1882, it was reported that "John Thomas over on the north Perche five miles from here has had the small pox but is now well. Dr. Guthrie attended him in his own tent. There are several cases at Kingston and several have proved fatal. Dr. Guthrie has been called to take charge of the pest house there" (*The Black Range* - a Chloride newspaper);

- On January 26, 1883 *The Black Range* reported that (in the Perchas) "small-pox is a thing of the past in this section. The last case being discharged from the pest house today";

- "According to The Tribune, Kingston is now free from small-pox." - *The Black Range*, February 2, 1883;

- "The small-pox scare has completely died out - both at Silver City and Deming." - *Deming Headlight*, January 25, 1890;

- On October 8, 1897, the *Sierra County Advocate* noted a "small-pox scare" started when a wagon load of Mexicans whose children had smeared their faces to ward off mosquitoes were thought to have smallpox";

- The *Silver City Eagle* reported (January 5, 1898) that "it appears that all efforts to check the spread of smallpox in the valley of the Rio Grande have proved futile. Since the appearance of the first case in October the spread of the disease has been gradual, and now there are cases all along the river from Val Verde for a hundred miles up. For weeks after the development of the first case reports that small-pox existed were denied in the papers and the denials were repeated until there was no longer any use in denying what was known to be a fact. There have been many deaths among the Mexicans and several Americans have succumbed to the disease which, it is said, is of the most malignant type. For the past few weeks (numerous) efforts have been made to check the spread of the disease, but in spite of all the precautions taken, it has been gaining ground.";

- "Now comes Alexander Maxwell and presents the following accounts and requests the Board to approve them, being for expense incurred in guarding smallpox patients in Precinct No. 4..." - minutes of Sierra County Board of Supervisors - *Sierra County Advocate*, June 17, 1898

- "Three cases of smallpox among the Mexican residents are reported in existence at the Hillsboro gold placers. Later - They have been moved away ... One of the Mexican children who had the smallpox out at Picket Springs, died last Sunday." - *Sierra County Advocate*, July 8, 1898; and

- "Frederick Munroe Williams, aged 21 years, of San Angelo, Texas, died on July 28 at the ranch of John Rabb, near Central, this county, of smallpox." *The Deming Headlight*, August 12, 1899

Unfortunately, this listing results from only a cursory review of the local papers of the time. There are many other examples.

What are we to make of the people of the Black Range during the late 1800's? Smallpox vaccinations were widely known to be effective and were generally available, yet enough people chose not to be vaccinated that outbreaks of the disease were relatively common and deadly. For instance, the *Albuquerque Daily Citizen* ran a column length article about the efficacy of the smallpox vaccination on August 30, 1898. After a summary of findings from around the world it notes that "vaccination is a wonderful preventative of smallpox; even where it does not entirely obviate the possibility of attack, it reduces the death rate to a very small percentage…". Is it that our forebears were superb examples of late adopters? Just what was wrong with them?

First of all, let's dispel any belief that the early settlers in this area were different from the American polity generally. Smallpox outbreaks were constantly mentioned in the newspapers from this era, from throughout North America.

In some cases, people were simply ignorant. Cases like - "Mrs. McKaughan, of Silver City, is ill with variolord. The health officers are using proper precautions to prevent an outbreak of smallpox." - *Sierra County Advocate*, May 7, 1889. Old techniques were still being used. Variolation was a technique used decades before; vaccination was the technique used in most of the world by this time. On the other hand, it is entirely possible that the reporter/newspaper were ill informed about the method of inoculation.

In many cases, access was an issue, as was the cost of treatment. But in other instances, cost was not a significant factor. On November 2, 1883, *The Black Range Newspaper* of Chloride noted that "Silver City has established a pest house for smallpox patients and $50 has been appropriated by the city council to provide vaccine matter for the free use of the people…."

Although compulsory vaccination laws had been adopted in Europe by the middle of the 1800s, such requirements were slow to take hold in the United States and especially in the West. So it is especially noteworthy that the situation was so bad that "Silver City has passed a compulsory vaccination ordinance. They have no smallpox cases as yet, but desire to be upon the safe side." - *Sierra County Advocate*, December 31, 1897.

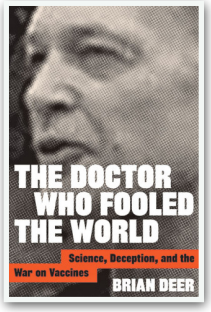
In 1905 the U.S. Supreme Court ruled (Jacobson v. Massachusetts) that states could enforce compulsory vaccination laws. The court found (7-2) that there are instances where the freedom of the individual (especially the freedom of the individual to harm others by not taking particular actions) should be subordinated to the common welfare of the American people. Of course, there are still people who believe that they should not be held accountable for their actions when those actions cause harm to others. At the time of the court decision there were a lot of people who believed their individual "rights" trumped everything.

When we look around at places like Pakistan and the Democratic Republic of the Congo where people distrust, even kill, health officials who are attempting to eradicate ebola and polio, we should be a little less willing to rush to judgement.

Misinformation (both intended and unintended) shapes that risk profile of individuals. Humans being what they are, there are always bad actors to be sorted. They complicate major efforts by spreading misinformation, sometimes with malicious intent.

Scientists and doctors are people. They often have credentials of some sort. Sometimes the fact that they hold credentials clouds the fact that they are human. That is to say that not all doctors and scientists are noble, high minded, diligent, or work for the betterment of the general public or their patients. In the case of anti-vaxxers and anti-maskers, this was readily apparent in the various flu pandemics (the flu of 1918 and others), smallpox "outbreaks", and the COVID pandemic of the first part part of the 2020s.

Misinformation is often the fodder of talk shows where the goal is "listener count" not the spread of accurate information. It is about greed and ad revenue.



The well documented case of Andrew Wakefield has been explored throughly by Brian Deer in *The Doctor Who Fooled The World*. A review of the book, in *Science*, notes that Wakefield's research was funded by legal teams who were suing the makers of measles-mumps-rubella (MMR) vaccine. In fact, they paid Wakefield the equivalent of $846,000 in current funds to build a case for them. That he did. The fraud that he committed in doing so has caused much harm and suffering in the world. To quote Wikipedia, Wakefield "*is a British fraudster, discredited academic, anti-vaccine activist, and former physician.*" Former physician because his license was revoked.

The best current estimate ("The Impact of Vaccines and Behavior on US Cumulative Deaths from COVID-19") is that behavior change (masking and social distance) and vaccines saved as many as 800,000 Americans from death (at the height of the pandemic, as many as 60,000 a day) and that as many as 273,000 Americans died as a result of the slow uptake of vaccines later in the pandemic.

But the antics of bad actors is nothing new. The Europeans who came to the Americas in the 1500 and 1600s were directly responsible for the deaths of

millions of the indigenous people. There is no evidence, however, that they were knowingly responsible for the spread of diseases, like smallpox, in the Americas. The truth probably lies between "not directly responsible" and "not knowingly responsible". It is clear that the protocols typically used to quarantine ships in Europe when the diseases were present were not adhered to by the early conquerors. At the very least, that makes them culpable.

Is there evidence that the Europeans knowingly used smallpox and other diseases as weapons? The clearest case during the revolutionary period is that of Sir Jeffery Amherst, who commanded British forces in North America during the early 1760s, his subordinates Col. Henry Bouquet, Capt. Simeon Ecuyer (who commanded the European forces at Fort Pitt), and Capt. William Trent, who intentionally tried to infect the Indian Tribes at Fort Pitt. Although they successfully completed their plot, it is not clear what effect it had. Smallpox was already ravaging the Europeans and indigenous peoples in the area.

During the First Civil War (aka the Revolutionary War) the British apparently attempted to use smallpox against the colonial forces by intentionally sending infected people into their midst.

The stories of "smallpox blankets" being distributed to indigenous people is clouded by people like Ward Churchill, who claimed that the US Army knowingly distributed smallpox blankets to the Mandan people in 1837. Numerous authors, including Thomas Brown, have concluded that Churchill fabricated much of his source material. The Churchill publications make it difficult to ascertain whether or not smallpox blankets were used in the west. Other reports are suspect, suffering from the stigma of Churchill's fraud.

What is clear is that the United States funded the vaccination of indigenous peoples against smallpox (Vaccination Act of 1832). And it is clear that smallpox continued to be a scourge of the indigenous peoples. It is also clear that thousands of Mandan Indians died in the smallpox epidemic which swept through the tribe at this time.

Was there a culprit? Probably. It is generally documented and believed that a steamboat carrying trade goods, the *St. Peter*, came upriver at this time and that smallpox broke out on board. The captain of the steamboat, Pratte, refused to change his voyage when smallpox broke out on board and bears the responsibility for the infection spreading among the Mandan. The reason for his refusal, "bad for trade".

Churchill's (apparently) false claims seem to be the last word about the use of smallpox in the American west. Does that mean it didn't happen? No, it just means that if it did happen it was well concealed, which is possible when something occurs rarely and randomly. Its place in American mythology is well established. What is there of truth when you can spout a good story.

But even when deception and lies are rooted out of the equation, there are still reasons enough to fear our differing perceptions of risk and appreciate the problems it creates. Belief trumps fact every time. If a person adheres to a belief/belief system he or she will hold fast to that belief, even in the face of overwhelming factual information which demonstrates that their belief is incorrect, in part or as a whole. Part of the issue here is that beliefs are often a primary mechanism used to establish pack identity. Humans, like many other animals, are drawn to packs (whether we call them groups, tribes, clans, families, nations, religions, whatever). The "us" and "them" mindset is strong. Sometimes it overwhelms all other emotive reactions. Remembering that sometimes those "others" are really after whatever we have (land, goods, or family members), it is doubtful that the pack instinct can (or perhaps even should) be eradicated.

Poor science increases the perception of risk in many people. When individuals extrapolate from reports of erroneous findings, to research as a whole, they may reject the scientific process as a whole.

Science is a process, not a steady state. What we believe to be factual at this moment may prove to be incorrect when tomorrow's findings hit the press. At the very least, tomorrow's findings will be more nuanced than those of today.

The quality control systems which scientific journals and institutions have built into research and the publication of research findings are generally very good, generally better than those found in political institutions, for instance. But they are not perfect. At times they fail to stop outright fraud (take a look at recent published research claims on super conductivity, for instance), sometimes they are not as open minded as they should be (suppressing research findings which are later proven to be accurate), sometimes they are subverted as part of political agendas, and sometimes they are simply overwhelmed by the amount of research being conducted and the efforts to publish the results of that research. But generally, they do a decent job, better than most other cultural systems.

Still, it is the bad apples which get noticed. Unfortunately, we can't always recognize a bad apple, especially when it is served with a lot of sugar.

This general issue, determining the appropriate balance in making risk assessments, is not limited to problems in public health. In "Uncertain Pathways to a Future Safe Climate", Sherwood et al. (*Earth's Future*, AGU, 06 June 2024) argue that our response to global climate change does not adequately encompass low potential - high risk scenarios. This particular risk assessment scenario is one of the most difficult to plan for and to address when such an event does occur. On an individual level, when humans decide to take the lazy way out and then face a highly negative impact because of their earlier decision, society, as a whole, suffers.



ARIZONA'S 300 POUND COUGAR

By Harley G. Shaw

Anyone using the internet is painfully aware of the rate at which false information can travel these days. Most of us interested in cougars have seen the photos of a very large cougar and a cougar-killing mule to the point of boredom, each time professing a different source and backed by a different story. Add to this the capability of "photo-shopping" pictures, and one becomes extremely cautious of believing anything seen or read on the computer screen. Perhaps the positive outcome of this will be the advent of a generation of true skeptics who believe nothing coming from the media, forcing our reporters to learn the age-old skill of backing up their statements with facts. But dispensing erroneous information is not a new pastime, nor did it have to await the arrival of the internet. In some cases, misinformation has been published in prestigious scientific journals, leaving us stuck with it for a long time. If this misinformation is of the gee-whiz ilk, it may be quoted so often as to become "truth" regardless of its veracity. Weights of trophies taken by hunters and fishermen alike fall in the gee-whiz realm. We are all fascinated with the size of creatures killed.

So, if you read the cougar literature, at least up until the last decade, you will discover that the largest mountain lion killed in North America was an Arizona cat that dressed out at 276 pounds. This animal was reported to have been killed near Hillside, Arizona, by a federal hunter named Ramsay Patterson. If you accept the report, this animal would have had to weigh well over 300 pounds before its entrails were removed. Number two in the weight records is a 265-pound animal taken by Frank C. Hibben in Utah, and number three on the record book is a Colorado cat taken by Teddy Roosevelt at 226 pounds. Such records, once in the literature, tend to appear again and again as unquestioned data. The value of the scientific approach, of course, is that it demands periodic scrutiny of old information to see if it holds up under more recent fact. Contrary to what some non-scientists may think, the job of a scientist is to question authority rather than to seek to sustain it. A couple years back, while writing a chapter on the history of cougar research in the U. S., I had cause to revisit the weight records of cougars and assess their veracity.

By the time I had finished several years of field research on cougars, I had already become extremely doubtful about the above-mentioned Patterson lion. Through eight years spent capturing and collaring cougars near Prescott, as well as on the North Kaibab, I had never weighed a cougar that came within 100 pounds of this cat's reported weight. We carried a scale throughout our studies which, because of our need to use only the lightest equipment, was very small and accurate only to the nearest five pounds. On the Spider Ranch northwest of Prescott, our heaviest record was a 160 pound tom; on the North Kaibab, one very large male tipped the scales at 175. Keep in mind that these are live, not dressed, weights, and as I remember, both of these animals were full of deer meat when captured. Empty, they could have weighed 5-10 pounds less.

Most other biologists working on cougars in the western U. S. reported similar weights. The few animals that approached 200 pounds were invariably from colder country. A decade of research over a wide range of habitats by a host of researchers has failed to come up with an animal weighing anywhere near the Patterson cat or, for that matter, the Hibben cat. Even Teddy's 226 pound animal was certainly pushing it. What is the truth regarding these animals?

The most-quoted source for the Patterson cat is a Journal of Mammalogy paper published by a Federal Predator and Rodent Control "inspector" named M. E. Musgrave, who had been Patterson's supervisor. It was entitled "Some Habits of Mountain Lions in Arizona" and appeared in 1926. As I read the paper and then delved into correspondence associated with it, I discovered that its credibility dissolved. The paper should never have been accepted for publication and, under modern criteria and peer review, almost certainly would not have appeared in a scientific journal. Frankly, Musgrave knew nothing about cougars and everything he wrote was based upon hearsay. As it turns out, Musgrave came to Arizona two years after the Patterson lion had been killed. He never saw it, but rather heard about it from citizens of Prescott, who claimed to have seen the eviscerated carcass after it had been shipped by rail from Hillside to Prescott. A picture exists of Patterson with a very large male lion, but there is no way to be sure that it is even the same cat. Nothing in the original article or associated correspondence claims that the animal was ever actually weighed and, in fact, the weight given seems to have been merely the opinions of the unidentified citizens of Prescott who told Musgrave about it two years after it had been killed.

Actually, Musgrave was not the first to publish about this gigantic cat. No less than Ernest Thompson Seton had noted in "Lives of Game Animals" in 1925 that a mountain lion of ". . . probably 300 lbs. has been taken at

Two medium-sized males taken by Roosevelt in Colorado weighed 164 and 160 lbs. A very large male which he secured was only 8 ft. in total length, though it weighed 227 lbs. For long this stood as the record, but recently a much larger one of probably 300 lbs. has been taken at Hillside near Prescott, Ariz. It was killed by J. R. Patterson, March, 1917.

Concerning this monster, E. W. Nelson, Chief of the Biological Survey, writes me, Aug. 3, 1923: "A letter from M. E. Musgrave contains the following information: 'After the Lion had been killed and skinned, I made a trip to Prescott where I was told of the weight of this Lion. Becoming interested I asked the express agent and several of the citizens of Prescott regarding the weight of the Lion, and they said he had been shipped in from Kirkland to Prescott by express, and that he weighed 276 lbs. after the intestines had been removed.

"'The only measurements I got on the Lion were taken by a man in Prescott and by J. R. Patterson, the man who killed the Lion. He measured 8 ft. 7¾ in. from the tip of his nose to the tip of his tail. . . .

"'I have found since beginning our work in Arizona that Lions run much heavier in Arizona and New Mexico than they do in the northwestern part of the United States that I am familiar with. This, however, I believe, is the largest Mountain Lion that has ever been killed in this State.'"

Lives of game animals : an account of those land animals in America, north of the Mexican border, which are considered "game," either because they have held the attention of sportsmen, or received the protection of law / by Ernest Thompson Seton p. 39

Hillside near Prescott, Arizona. It was killed by J. R. Patterson, March 1917." But Seton's source of information, as it turns out, was a letter written to Biological Survey Chief E. W. Nelson by M. E. Musgrave on August 3, 1923. In this letter, Musgrave actually acknowledges that he had never seen the cat and was taking the word of locals who said they had.

Stanley and Goodman gave this record additional credibility, when they reported it unchallenged in their 1946 book, *The Puma—mysterious American cat* (p. 53). Until well into the 1970s, when field workers began to capture and collar live cougars, this book was considered the bible of cougar biology.

One other writer, Claude T. Barnes, in his book *The Cougar or Mountain Lion*, further confused the issue by citing Seton and Musgrave as if they were reporting two different animals, thereby suggesting that 276 pound cougars were not all that rare!

All of the above reports stemmed from M. E. Musgrave, who arrived in the state two years after the cat was killed, never saw it, and initially reported it some six years later. His technical paper placing the record in the world of science was written a full 10 years after the animal was killed. Musgrave pretty much faded from view about the time he published the paper, having moved to New Mexico and transferred to the U. S. Forest Service. Ramsay Patterson, who killed the cat that provided the basis for the rumor, continued on with the Biological Survey in Prescott until he died of pneumonia in 1932.

Coming down to the number two cat, at 265 pounds, we find again, no confirmation that the animal had actually been weighed. It was killed by Frank C. Hibben during a 1951 hunt near the Book Cliffs of Utah and reported in another Journal of Mammalogy paper in 1961. Authors of this paper were W. Leslie Robinette, Jay S. Gashwiler, and Owen W. Morris, all respected field biologists of their time. These authors, too, record the eviscerated Patterson lion as holding the record. No mention is made whether either animal was actually weighed. No doubt it was a large animal, for Hibben had seen many cougars by this time, but this figure is probably an estimate, and estimates are not legitimate records.

This leads us to TR's 226-pound animal. Here, we find that Teddy, ever the hunter scientist, went afield prepared to weigh his animals. In the 1901 Scribner's Magazine article where the story of the hunt is told, Roosevelt mentions having his guide leave his rifle at home, so that his saddle scabbard could be used to carry the steelyard. For those who are not acquainted with the term, a steelyard is a portable balance scale that can be hung from the limb of a tree, or a constructed wooden tripod. As far as I know, few of us in cougar research carried heavy steelyards into the field, and I doubt that the scales that most of us carried approached the accuracy of a steelyard, properly used. Thus we can accept TR's record, which has been rounded off to 230 pounds by some subsequent writers.

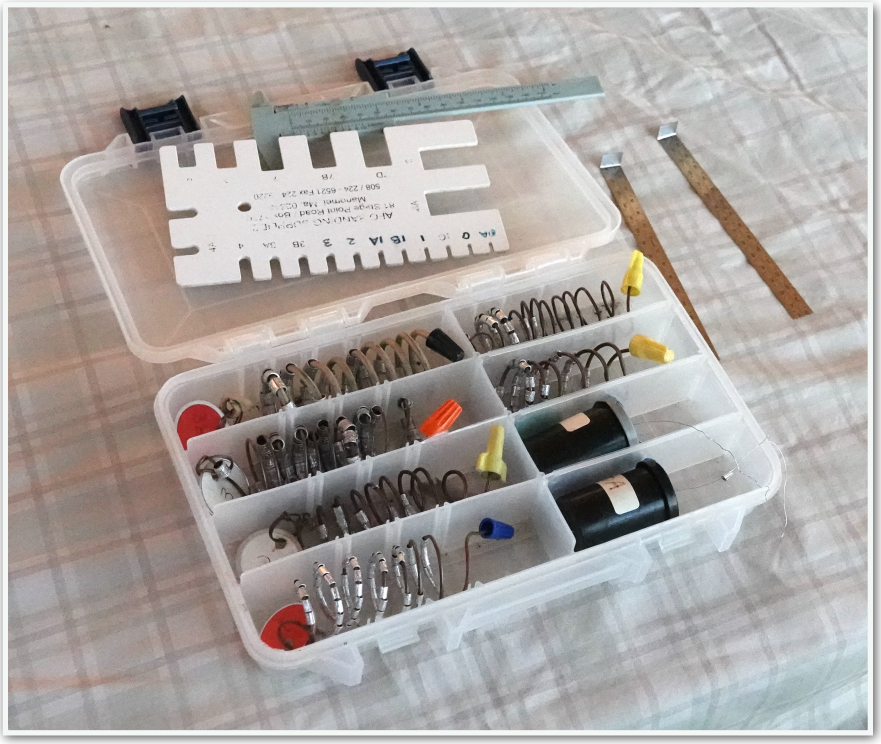
Have heavier cats than Teddy's been taken since 1901? It is certainly possible. But few hunters carry scales, so such records are not documented. I've found only one record of a cat over 200 pounds—one from Washington State at 201. Among cougar biologists, a 160-pound male is considered a big cat; anything larger exceptional.

But, as it turns out, Patterson wasn't the greatest prevaricator regarding cougar weight. A South American scholar reported a 375 pound cougar, and this has been reported in a recent popular treatise on the species. So, it seems, cougars, like fish, can grow in the telling.

Tools of the Trade - Bird Banding

On September 18, 2024, Ken Steigman (Las Cruces) provided a bird banding demonstration to a group of birders from the Hillsboro and Lake Valley areas. He demonstrated how mist nets are used to capture birds, the banding process, banding tools, and record keeping. An extra-ordinary and well appreciated presentation.

Bird bands are stored on rolls of coiled wire (see below). Bands come in a variety of sizes, each stamped with a unique identifier. The white card on the lid of the plastic box is used to measure the leg diameter of birds so that the proper sized bands can be placed on their legs. To the right of the box are two metal rulers, used to measure birds in just about every way you can imagine.









In the photograph at the top left, a Gray Flycatcher, *Empidonax wrightii*, has its leg measured. At the center, a Green-tailed Towhee, *Pipilo chlorurus*, has a larger leg and will require a larger band. A Pyrrhuloxia, *Cardinalis sinuatus*, has an even larger leg and an even larger band is required (above right).

Guidance is provided by the US Geological Survey on recommended band sizes. Ultimately, however, it is the measurement at the banding station which will determine the size of the band affixed to a bird.

Bird bands vary in size from those with an internal diameter of 1.27 mm (band size X, - used for Hummingbirds - and shown to the right next to a U.S. penny) to those with an internal diameter of 28.5 mm (band size 9C - used for Golden Eagles), for example. Ken Steigman bands songbirds, so his





bird bands are in the smaller range. He uses bands like those pictured above, called butt-end bands. Each of these bands has a unique identifier imprinted on it. The bands are squeezed together to assure a firm butt fit. Bird bands are controlled products and are provided free of charge to licensed bird banders.

Right: Closing pliers come in a variety of sizes, to accommodate different band sizes.

Bottom Right: Pliers are used to close a band around the leg of a MacGillivray's Warbler, *Geothlypis tolmiei*.



Immediately Below: The band is in place.





Immediately Above: A Brewer's Sparrow, *Spizella breweri*, is banded later in the morning.





A Green-tailed Towhee, *Pipilo chlorurus*, (top left) and a Pyrrhuloxia, *Cardinalis sinuatus*, (bottom left) were also banded.



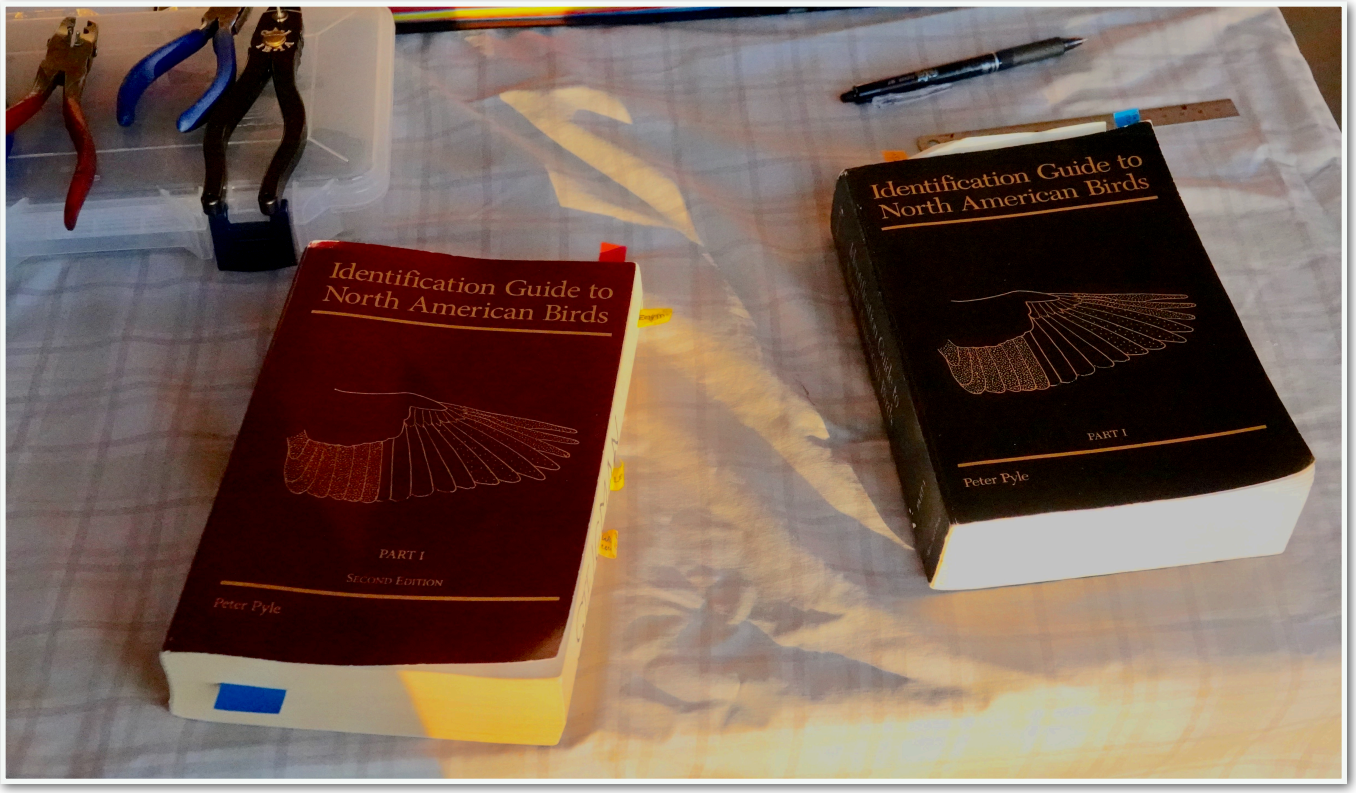


Of course, all of this banding stuff starts when a bird flies into a mist net. Mist nets vary in weight and structure depending on the bird species the researcher is targeting. Ken Steigman focuses on small passerines like the MacGillivray's Warbler, *Geothlypis tolmiei*, caught on the morning of our visit. Ken "runs" four nets at a time and each net is checked at short intervals to assure that birds which have been caught are processed quickly, ensuring they suffer as little stress as possible.

Banders immediately take a number of measurements, including bill width and length as shown below. Each measurement is checked and cross-checked against reference guides like Peter Pyle's *Identification Guide to North American Birds*, shown at the top of the next page. (The new edition of this reference was released in 2023. Listen to a podcast with Peter Pyle [begins at 5:00] by clicking the link button on the identification guides photo.)







These guides are not for the casual, or even the semi-pro, birder; they are meant for banders, who have a bird in hand. For those who have not had the experience, a bird in hand is very different from one in the bush. The cues are different, what you see is different, in hand versus in the bush are really very different experiences. For instance, as a casual birder you probably never will get an exact measurement of the tail feathers of a Gray Flycatcher (below right) or assess the condition of its feathers or the length of various types of feathers (below left). Or log every measurement as it is made.











The molt of the bird, the length of its feathers, the condition of the feathers, the bird's weight, etc., all play a role in determining not only the species/subspecies of the bird but also its sex, age, and overall condition. In the image above, the wing length of a MacGillivray's Warbler is measured. At the upper right, its head is gently raised and the feathers of the breast are lightly blown on to expose the skin of the breast. The fat reserves of the bird can be determined by looking at the skin in this area. By gently doing the same on the head of the bird the degree of cranial ossification can be determined, and thus the age of the bird (in many cases).



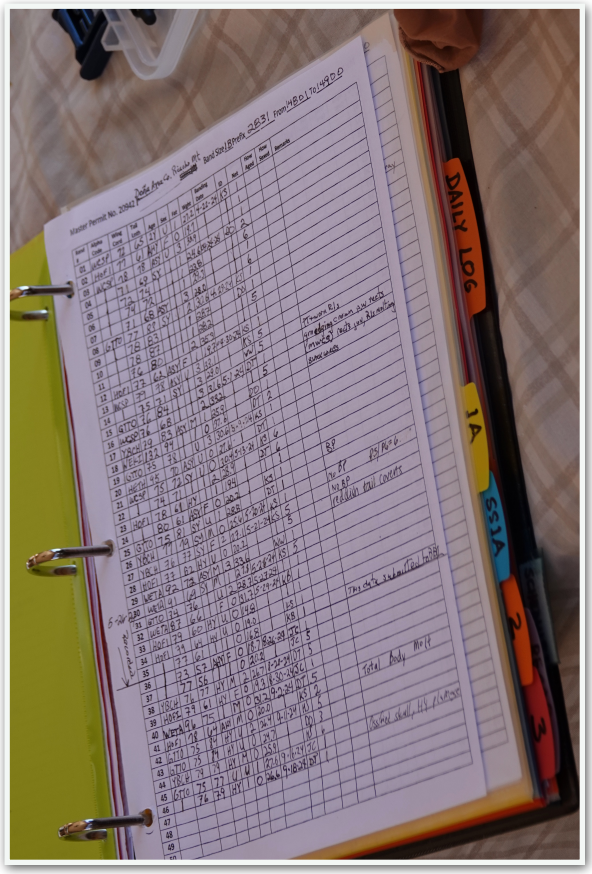
The amount of feather wear and the overall feather condition can also be very informative. The wings of a Brewer's Sparrow, *Spizella breweri*, shown at the right, are typical of a healthy individual. The same individual, seen in hand at the bottom right, shows breast feathers in good condition. And, yes, in case you were wondering, the tail feathers of a Green-tailed Towhee really are green (see directly below).





And how do you weigh a bird? On a scale of course. The Pyrrhuloxia at the top of the next page is undergoing the indignity of checking the weight - made worse by the knowledge that it will be recorded and placed in a national database.


AWS-600


DAILY LOG
1A
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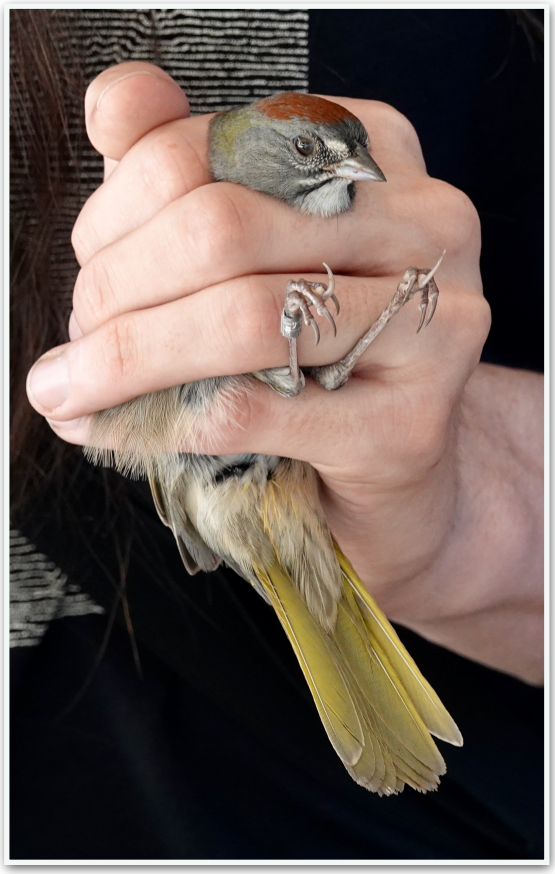
3

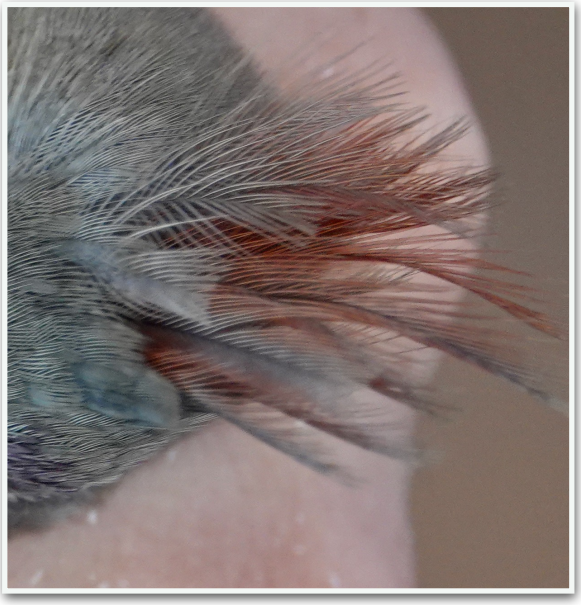


Is everyone as calm about the process as the Green-tailed Towhee at the bottom right on the previous page? Mostly, but not universally (see the Pyrrhuloxia below).



The effort and dedication of researchers like Ken Steigman have advanced our knowledge of the avian natural history immensely. – Many thanks to them.

A Yellow-breasted Chat below, the head feathers of a Pyrrhuloxia (top right), a MacGillivray's Warbler (middle right) and, a Gray Flycatcher (bottom right). A Pyrrhuloxia from this banding session is shown on the back cover.









Seven 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 begin the eighth year of publication. 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 journal:

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