The Black Range Naturalist

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Front and Back Covers: Screwbean Acacia (Mesquite), *Strombocarpa pubescens,* by James Von Loh

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Unattributed material is contributed by the editor.

Mexican Spotted Owl

Initial Photographs by Marco Prince

On June 1, 2024, Marco Prince of El Paso photographed a Mexican Spotted Owl, *Strix occidentalis lucida*, on the west slope of the Black Range and shared several of the photographs he had taken with us. Three of his photographs are shown here (all photographs have been cropped). He posted his sighting to iNaturalist.

Marco Prince's observation, photographs, and sensitive reporting led to some follow-up visits to the site by regional naturalists. The Mexican Spotted Owl was observed by several people in the weeks following the sighting by Mr. Prince (it is not known if his was the original sighting).

Some observers had significant experience with this species, having conducted research and/or surveys for it in the Gila. Others, less so. And some, like the editor, had little experience with this subspecies but much more with the Northern Spotted Owl subspecies.

The remaining photographs in this article were taken by Bob Barnes on June 23, 2024. These photographs and the video (which may be viewed at this link) were recorded between 6:30 p.m. and 7:00 p.m.

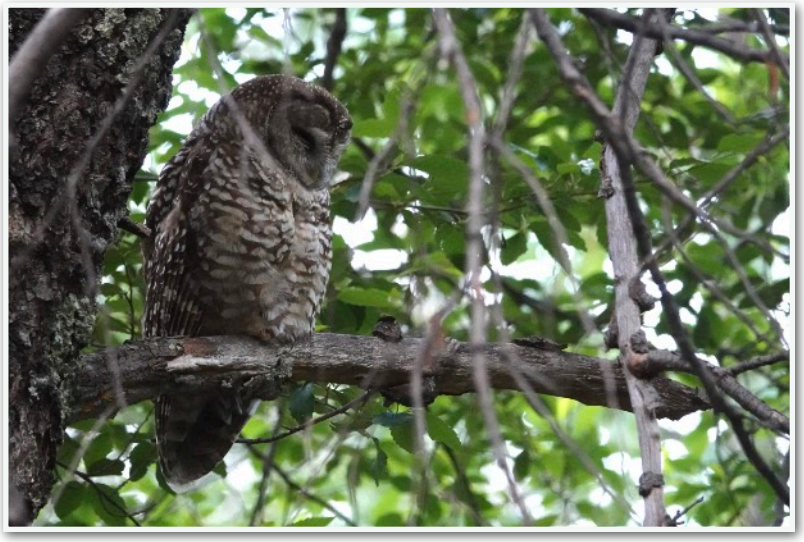
M. Prince and other observers report seeing this* owl at other times of the day. In all cases, observers reported that it was a very calm bird and did not appear to be bothered by nearby human activity. Some observers reported that the bird would fly in and

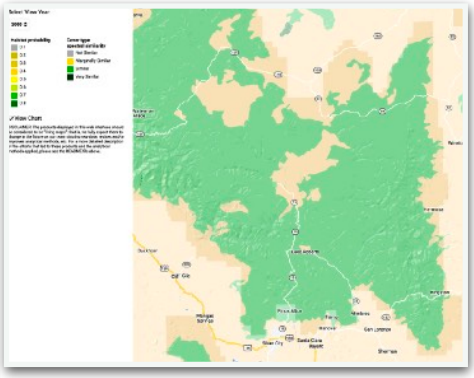
spend a fair amount of time just watching them. That behavior comports with the editor's experiences in the Pacific Northwest. On one occasion he was collapsed beside a trail mulling how to make his pack lighter when a Northern Spotted Owl flew in, perched on an open branch - near the trunk of the tree - and just looked at him with those big black eyes.

The Mexican Spotted Owl is listed as threatened by both Mexico and the United States. New Mexico has listed it as a "species of concern". The U. S. Fish and Wildlife Service considers "the increased risk of landscape scale stand-replacing wildland fire" to be the primary threat the subspecies now faces.

Some range maps for this subspecies make it appear as if it occurs over a large geographic area (see the range map from the Center for Biological Diversity below). Within the boundaries of such maps, the subspecies is found in disjunct areas, generally "sky islands" and particular canyon areas. A much more precise map has been developed by the Rocky Mountain Research Station of the USDA Forest Service. Their "living map" is based on surveys

and independent reports of Mexican Spotted Owl activity. A detail from the app they use to display the data on google maps is shown on the following page. The living map indicates that the Black Range, down to the foothills, is prime habitat for the Mexican Spotted Owl. Within "the Range", however, the owl is not likely to be found in all locations. This individual was found





along a stretch of creek which still had some stream flow. At the time of these sightings, many of the creeks in the Black Range were dry. It may be that this owl was attracted to this area because the bit of water which remained was an attractor for its prey.

On March 15, 2019, an individual of this subspecies was observed along the lower reaches of Palomas Creek (east of the green shaded prime habitat in the map above). Conjecture at the time was that it had followed the riparian area down-stream from the higher areas of the Black Range. At other locales (e.g. Upper Railroad Canyon in July 2021) sign was found after the flow in the stream had increased. The April 2023 issue of this journal included several photographs of Mexican Spotted Owl by Steve Metz, who was operating out of Kingston at that time. Additional photographs from June 23, 2024, may be viewed here.

* In this article we used the singular to describe "this" bird. Several observers reported that there were two individuals at this site, however. Whether or not this was a mated pair is unknown but is probable given the reported behavior. I do not know if this is the same bird which M. Prince originally reported. While I recorded the video and these images, this individual spent a fair amount of time looking up, which confused me, until I heard and glimpsed another large owl leaving the area.

Echinomastus intertextus Chihuahua Pineapple Cactus

The Chihuahua Pineapple Cactus typically starts to bloom in mid March. It is an exceptionally early cactus bloomer, and indeed during 2024 it was one of the first flowers we saw in the eastern hills of the Black Range.

Scientific synonyms for *Echinomastus intertextus* include *Echinocactus intertextus, Neolloydia intertexta, Sclerocactus intertextus* (see below), *Pediocactus intertextus*, and *Echinomastus dasyacanthus*. Its English common names include Chihuahua Pineapple Cactus, Early-bloomer Cactus, White Fishhook Cactus, Interlacing Spine Cactus, White-flowered Viznagita, and Woven-spine Pineapple Cactus.

This species was first described, as *Echinocactus intertextus*, by Englemann in 1856. There are two recognized varieties; *E. i.* var. *dasyacanthus* and *E. i.* var. *intertextus*. The current description of this species was made by N. L. Britton & J. N. Rose in 1922 in their four volume *The Cactaceae - Descriptions and Illustrations of Plants of the Cactus Family*. Volume 3, pages 149-150, describe this species and are shown to the right. The internet being what it is, all four volumes are available at no cost in digital form. See links later in this article (note that pp. 149 and 150 of the book will be pp. 191 and 192 of the .pdf document).

SEINet has several photographs of live plants and of specimen sheets of this species. In addition, several additional photographs can be found at the Black Range Website.

Some sources, like *The Encyclopedia of Life* and the Integrated Taxonomic Information System (ITIS), list this species as *Sclerocactus intertextus* ([Engelm] N.P. Taylor).

The nominate form *Echinomastus intertextus* ([Engelm.] Britton & Rose) var. *intertextus* is found in west Texas and southeastern Arizona. The American Southwest website

2. **Echinomastus intertextus** (Engelmann).

Echinocactus intertextus Engelmann, Proc. Amer. Acad. 3: 277. 1856.
Cereus pectinatus centralis Coulter, Contr. U. S. Nat. Herb. 3: 386. 1896.
Echinocereus pectinatus centralis Schumann, Gesamtb. Kakteen 271. 1898.
Echinocereus centralis Rose, Contr. U. S. Nat. Herb. 12: 293. 1909.

Simple, globular or nearly so, 2.5 to 10 cm. in diameter; ribs 13, somewhat acute, more or less divided into tubercles; areoles 5 to 6 mm. apart, somewhat elliptic; spines rigid, red with darker tips; radial spines 16 to 25, appressed, 8 to 15 mm. long, 3 or 4 of the upper radial spines white or nearly so, more slender than the others, almost bristle-like; central spines 4, subulate, 3 of them turned upward and similar to the radials, 10 to 18 mm. long, the other one very short, porrect; flowers 2.5 cm. long, nearly as broad as long, purplish; outer perianth-segments about 20, broadly ovate, white-margined; inner perianth-segments 20 to 25, oblong, mucronate; fruit nearly globular, 8 to 10 mm. in diameter, with a few scarious scales; seeds black, shining, 2 mm. in diameter.

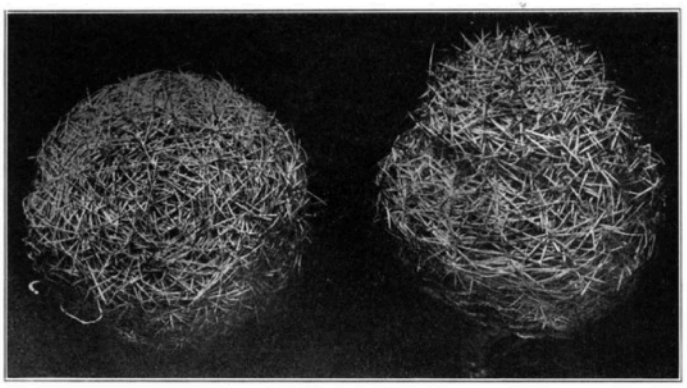


FIG. 156.—Echinomastus intertextus.

Type locality: Not definitely cited.
Distribution: Southwestern Texas, to southeastern Arizona and northern Mexico.

Engelmann states that the scales on the fruit are with or without some wool in their axils. The fruit is always in a mass of wool, but so far as we have seen the scales are always naked in their axils.

When Engelmann described this species he also briefly characterized a variety *dasyacanthus* which we have treated here as a distinct species. He says that *Echinocactus intertextus* in this broad sense ranges from El Paso to the Limpio and southward to Chihuahua and adds that the variety is more common about El Paso. We have seen only

Echinomastus dasyacanthus about El Paso while we have the true *Echinomastus intertextus* from Chihuahua. This latter station may be the type locality for this species.

In making this study we have at last been able to place definitely *Cereus pectinatus centralis* from near Fort Huachuca, Arizona. This *Echinocereus*-like plant was described from two sterile specimens whose flowers and fruit were not known. In 1921 J. W. Gidley sent a single specimen from southeastern Arizona. This flowered a few months afterwards, showing clearly that it was not an *Echinocereus*, but that it belonged to *Echinomastus*. Further study shows that it is referable to *Echinomastus intertextus*, although coming from west of the hitherto known range of the species.

Echinocactus krausei Hildmann (Schumann, Gesamtb. Kakteen 446. 1898) which came from Dragoon Summit, eastern Arizona, may belong here, but Schumann states that the ovary bears spines; it is known to us only from his description.

Illustrations: Schelle, Handb. Kakteenk. 201. f. 133, as *Echinocactus krausei;* Förster, Handb. Cact. ed. 2. 561. f. 72; Cact. Mex. Bound. pl. 34; Blanc, Cacti 46. f. 524, as *Echinocactus intertextus*.

Figure 156 is from a photograph of the type specimen of *Cereus pectinatus centralis*.

3. **Echinomastus dasyacanthus** (Engelmann).

Echinocactus intertextus dasyacanthus Engelmann, Proc. Amer. Acad. 3: 277. 1856.

Plants cylindric, 10 to 15 cm. high; ribs somewhat spiraled, made up of numerous compressed tubercles; spines slender, more or less purplish; radials 19 to 25, 12 to 22 mm. long; centrals about 4, nearly equal; top of flowering plant and young areoles very woolly; scales and outer perianth-segments red with white margins; inner perianth-segments white or purplish, about 2.5 cm. long, acute or acuminate; ovary bearing a few ovate scales, these naked in their axils; stigma-lobes 9, erect, truncate at apex, deep purple.

Type locality: Near El Paso, Texas.
Distribution: Southwestern Texas.

Most writers, including Engelmann, have treated this species as a variety of *Echinocactus intertextus* but in the light of a fuller series of specimens we believe it deserves specific rank. In the past many plants which we now know are true *Echinomastus dasyacanthus* have been passing as *Echinocactus intertextus*.

Besides the difference brought out by Engelmann this species has much larger flowers than *Echinomastus intertextus* and the inner perianth-segments are acute or acuminate. This species has also a more northern and eastern range.

Coulter (Contr. U. S. Nat. Herb. 3: 375. 1896) refers to *Echinocactus intertextus dasyacanthus*, a plant from San Luis Potosí, which we have not seen but which we suspect belongs elsewhere.

Illustrations: Cact. Mex. Bound. pl. 35, f. 1 to 5, as *Echinocactus intertextus dasyacanthus*.

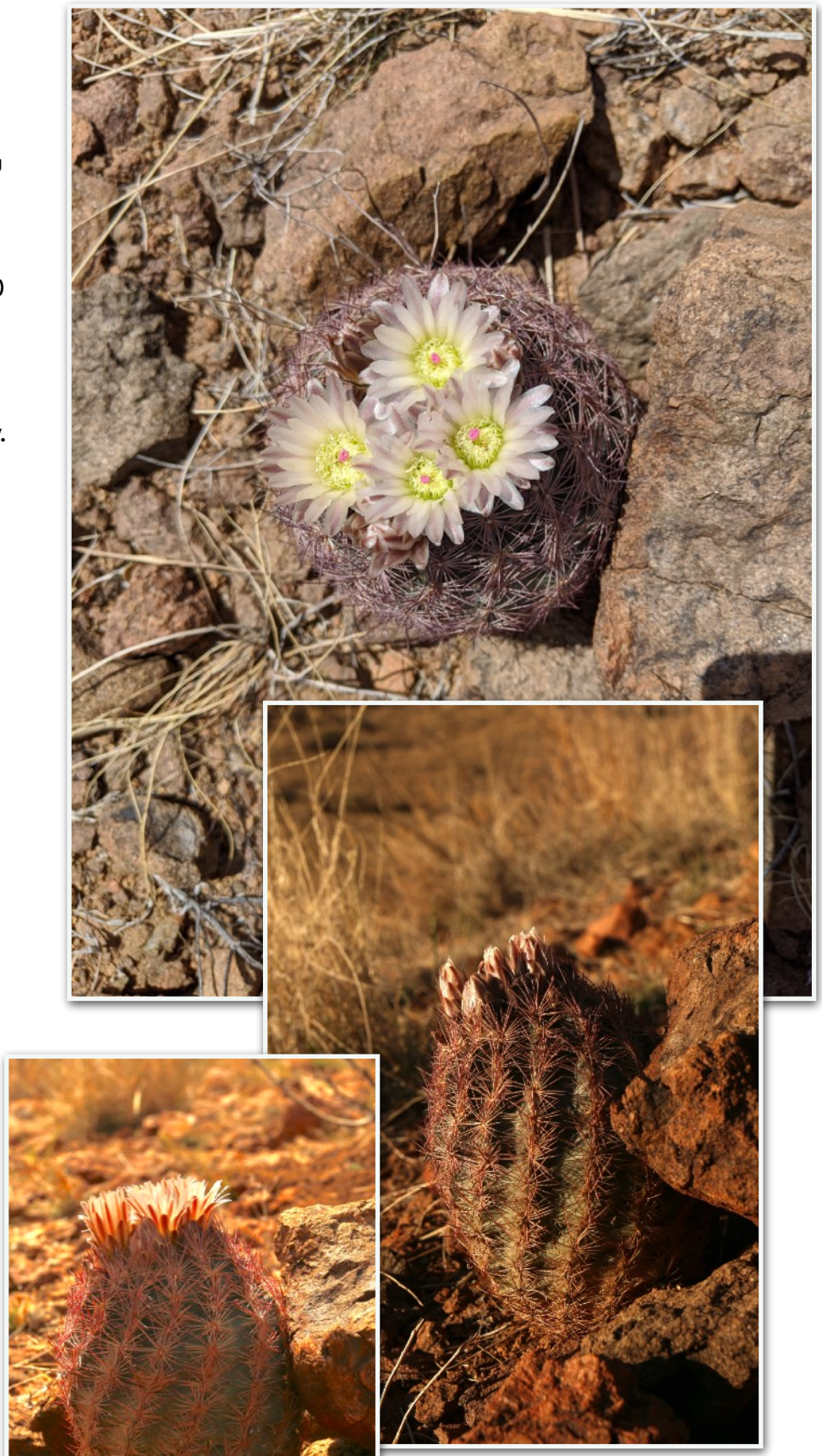
Figure 157 is from a photograph of a plant sent by F. C. Platt from El Paso, Texas, in 1908.

(previous link) notes that "The common name, woven-spine pineapple cactus, refers to the usual array of the spines, nearly all of which (excepting the downward-pointing central spine), are closely appressed to the stem, and overlapping, forming a dense lattice. Plants with this characteristic are var *intertextus*." The other variety, *Echinomastus intertextus* ([Engelm.] Britton & Rose) var. *dasyacanthus* ([Engelm.] Backeb.) is, according to the American Southwest website, found "along the Rio Grande in south and central New Mexico, and the Franklin Mountains near El Paso . . . all spines are spreading, held at a variety of angles".

The map below is from Flora of North America. That website notes that many populations are intermediate between the two varieties.

The flowers of this species last only a few days and are described as diurnal. Plants monitored two miles northeast of Hillsboro demonstrated that the buds closed at night and opened during the day. In Rebecca Hallgarth's photograph (top right), from near the Opportunity Mine, the flowers are open at 1:00 p.m. on March 21. In the two photos at the bottom right the buds were closed at 8:45 (center photo) and open at 1:30 p.m. (bottom photograph).

On March 23, which was overcast, the buds of the cactus in the two bottom photographs had not opened by 12:30 p.m. Among other things, the video at this link shows the flower opening sequence later that afternoon.



Two bottom photographs by R. A. Barnes on March 22, near the Wick's Mine. The center photograph was taken at 8:45 a.m. and the left photograph was taken as 1:30 p.m.

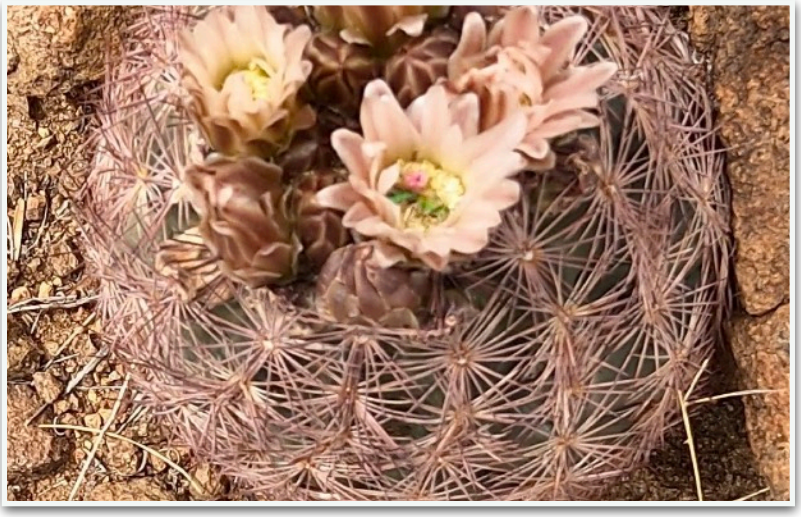
We assume the plants depicted here are *Echinomastus intertextus* var. *dasyacanthus.* (Some authorities consider var. *dasyacanthus* to be a subspecies. In botany the ranking goes species - subspecies - variety.) The Encyclopedia of Cacti states that this variety (which it lists as a subspecies) is "identifiable by its shaggy appearance. It is simply a larger form, with relatively long, protruding spine which contrasts with the smooth aspect of typical *E. intertextus*. These spines obscure the stem giving the plant a pale brownish appearance. Besides this subspecies has much larger flowers and the inner perianth-segments are acute or acuminate. It has also a more northern and eastern range. The flowers, fruits, and seeds of var. *dasyacanthus* appear to be identical to those of var. *intertextus*."

The photographs on this page were taken on March 22, 2024. The photograph to the right shows the array of spines which distinguish this variety, the spiraling rib structure, and the "pineapple" shape which explains the common name. The stem enlarges above the root and then tapers near the top. The bottom photo shows habitat.

The video referenced above records numerous small ants swarming over and around the buds and then the flowers. These ants do not appear to be the major pollinator of the species however. That role appears to belong to various species of "Cactus Bee", the genus *Diadasia*. Cactus Bees are native solitary bees which nest in burrows they create in the ground - some of the small holes you see when you are looking closely at the dirt around you. There are 23 species of Cactus Bee in the U. S. Southwest (42 species in 3 subgenera in total). Some of these species commonly pollinate cactus.

In "Pollination of Two Species of Ferocactus: Interactions between Cactus-Specialist Bees and Their Host Plants", M. E. McIntosh (*Functional Ecology*, Volume 19, No. 4 [August, 2005], pp. 727-734), studied the pollination of two cactus species by bees which were specialized pollinators. His conclusion: "The most striking result of this study is that despite their generalized morphology, the flowers of both species of barrel cacti are predominantly visited by, and almost exclusively pollinated by, a handful of pollen-specialist bees. The lesson for pollination biologists is that, just as apparently specialized flowers may be visited and pollinated by a more diverse assemblage than one would assume from their appearance (Fishbein & Venable 1996), apparently generalized flowers may be visited and pollinated by a much more restricted group than would be expected."

Rebecca Hallgarth took the bottom photograph on March 21 a mile and a half northeast of Hillsboro. The pollinating species may be *Diadasia australis*. The Discover Life website does not list *E. intertextus* as a host plant for *D. australis* but does list 17 or more *Cactaceae* species as hosts. *Diadasia rinconis* is also known from this range and does pollinate a number of *Cactaceae* species - but perhaps not *Echinomastus*. The bee shown in the middle photograph may be the same species as that shown at the bottom. It was photographed on March 23 roughly ½ mile from the location of the bottom photograph. But any guess may be better than these. The green bee in the top photograph is even more of a mystery but did stay at the flower for almost three minutes each time it visited. It may be a member of the subgenus *Agapostemon*, the Striped Sweat Bees - perhaps *Agapostemon angelicus*. There is a sighting on iNaturalist from Jan Richmond in Hillsboro (see photo below, used under a Creative Commons license). That species does pollinate some members of the *Sclerocactus* genus.



Tree New Mexico has a blog post from May 5, 2021, "Bees and Trees That Please In New Mexico" which despite the title is fairly informative.

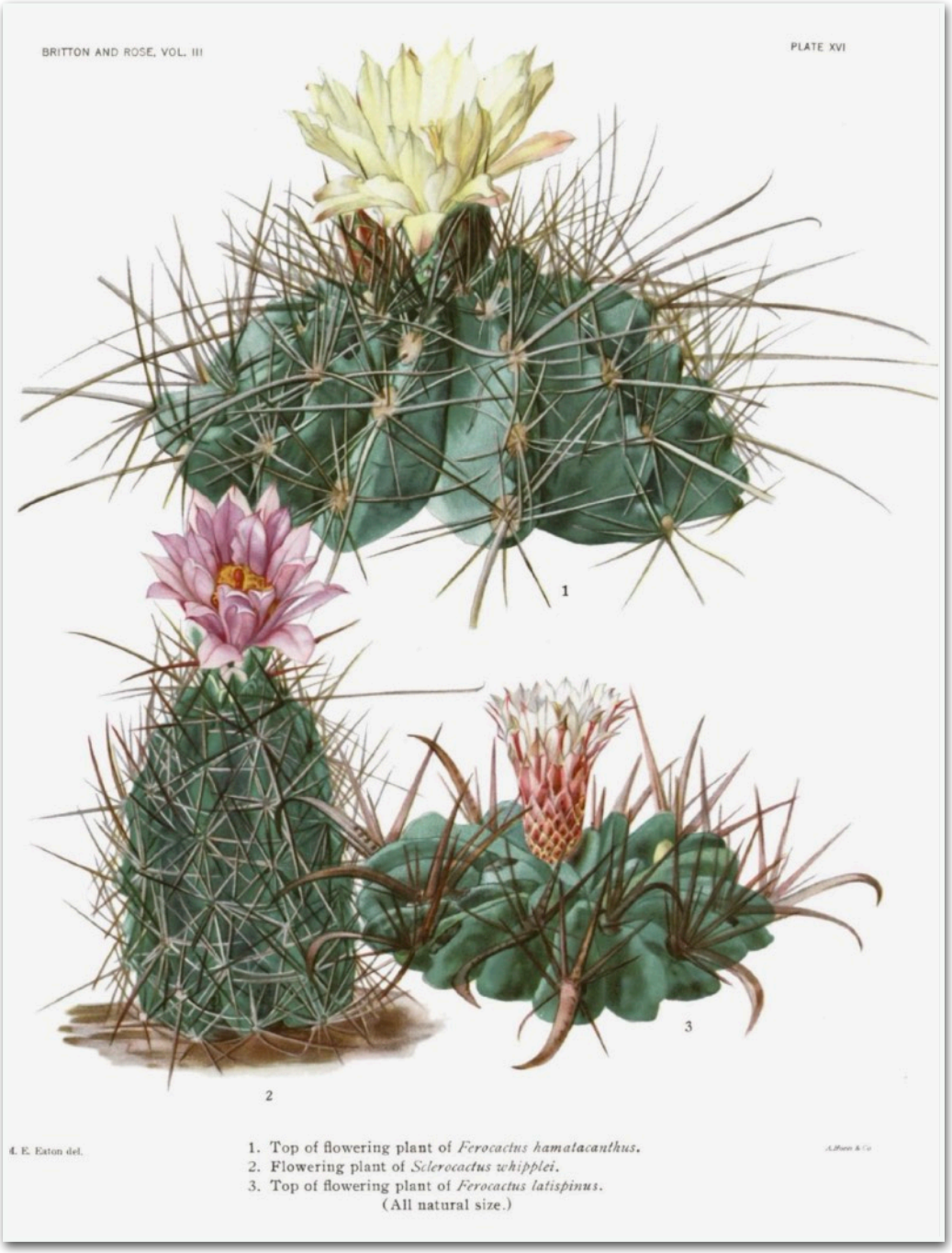
***The Cactaceae* referenced earlier may be accessed at these links.**

The Cactaceae - Vol. 1 - Britton and Rose
The Cactaceae - Vol. 2 - Britton and Rose
The Cactaceae - Vol. 3 - Britton and Rose
The Cactaceae - Vol. 4 - Britton and Rose

Mary Emily Eaton

Our understanding of the natural world in the Black Range is often enhanced by individuals who were never in the Black Range, and indeed many probably didn't know the Black Range existed. We will forgive them for their lack of geographic knowledge and focus instead on how they have enriched our lives.

One such individual was Mary Emily Eaton. She was born in England (1873) and died there in 1961. Between 1911 and 1931 she lived in New York City where, among other things, she worked for the New York Botanical Garden and created illustrations for numerous publications, including those of the National Geographic Society. Her works are in the permanent collections of the Smithsonian Institution, the National Geographic Society, and the British Museum of Natural History - among others. And she was the principal illustrator for *The Cactaceae* and is the primary reason that it is so lavishly beautiful. Her illustrations of the cactus found in the Black Range are accurate and beautiful, catch the essence of the species, and are detailed enough for the most intricate study. The forward of the National Geographic Society's 1924 *The Book of Wildflowers* notes that "Those best qualified to judge regard Miss Eaton the greatest of living wildflower painters. She has not only painted the likeness of the flowers with the highest botanical

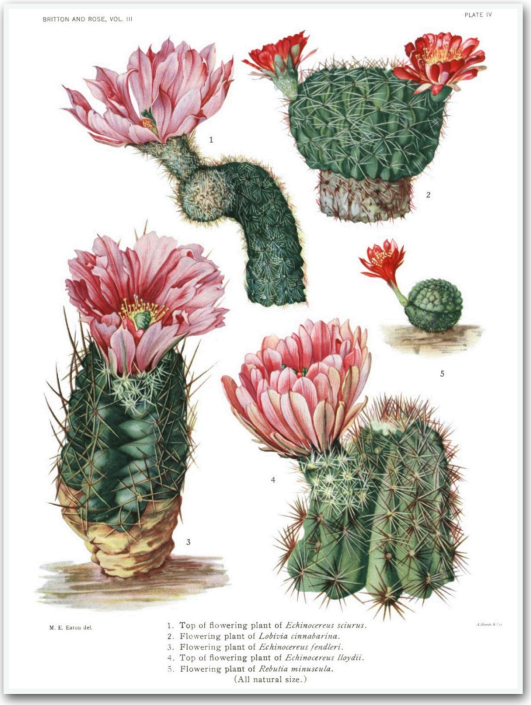


Mary Emily Eaton drew many of the illustrations in *The Cactaceae*, including the one above which is included as an example of the shear beauty of this work.

accuracy, but she has been able also to put the very soul of the plants into her paintings." (William Joseph Showalter)

But if you believe that her art was simply botanical, consider her plate of moths from Jamaica. She painted this work in about 1909 while visiting family in Jamaica. Although beautiful, this work is overshadowed by her botanical work, performed while she lived in New York City.

This photograph of Eaton is from about 1900, when she would have been in her late twenties and before she ventured to the United States. The photographer is unknown. The plate below (and detail to left) is from *The Cactaceae* and depicts *Echinocereus fendleri* (see the July 2024 issue of this journal). She drew this specimen from a live plant collected by W. H. Long in Albuquerque in 1915.



Insect Visitors to, and Potential Pollinators of, Chihuahuan Pineapple Cactus Flowers in Doña Ana County, New Mexico

By James Von Loh

This article presents the Chihuahuan Pineapple Cactus (*Echinomastus intertextus* ([Engel.] Britton & Rose) flower visitors that have been photo-documented by Gordon Berman and the author during seven seasons (2018-2024) in Doña Ana County, New Mexico. The narrative and unattributed photographs are by the author.

A surprising number of insect species visit these higher-elevation, early blooming (mid-February through mid-April), shiny, white-to-pinkish and yellowish flowers. However, not all that visit could be considered potential pollinators. The striking flowers are typically the only nectar-source present on the surrounding landscape. It is likely that cross-pollination between different Chihuahuan Pineapple Cactus plants is required for viable seed production; successful pollination would thus involve wider-ranging pollinators.

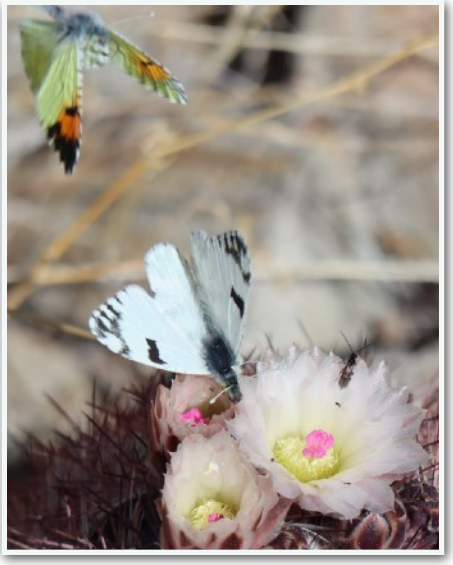
Potential pollinators that are almost always encountered on flowers during field visits include species of small *Halictid,* Sweat Bees, and relatively large Western Honey Bees; *Pierid* Butterflies were encountered nectaring from flowers in one "hilltopping" (migration/mating) event. Commonly encountered species that are less likely to be pollinators include species of ants (*Formicids*) and flies (*Syrphid, Tachinid, Oestroids*, etc.) Because the cactus flowers are predominantly white, moth species may visit them but we have not observed any visits of local flowers to date. Please note that our field observations occur from mid morning to late afternoon, the warmest portion of the late winter-early spring days, and the more cold-resistant moth species may be active nearer twilight (crepuscular) and/or at night (nocturnal).

Pieridae: Desert Marble and Pima Desert Orangetip

Two *Pierid* butterfly species: 1) Desert Marble, *Euchloe lotta* (Beuttenmuller, 1898) and 2) Pima Desert Orangetip, *Anthocharis cethura pima* (W. H. Edwards, 1888) were documented taking nectar/nutrients from Chihuahuan Pineapple Cactus flowers while "hilltopping" (mid March/mid day mating behavior) on a small hill extension of the Doña Ana Mountains (Chihuahuan Desert Nature Park, 03/19/22). They flitted from plant to plant (8 plants with 17 flowers, ranging from fully opened to just-opening, were present) on this small site to access open flowers and should be considered potential pollinators for the Chihuahuan Pineapple Cactus. All of the following photos of these species were taken at that location on that date.

Top: Desert Marble perches on tepals of a newly opening flower and is taking nectar and nutrients.

Bottom: Another individual, same behavior as described above, but perched on a fully opened flower.



Above: Foraging Desert Marble acts as a decoy and attracts a Pima Desert Orangetip to the same flower group (while tiny ants and a small Potter Wasp also forage).

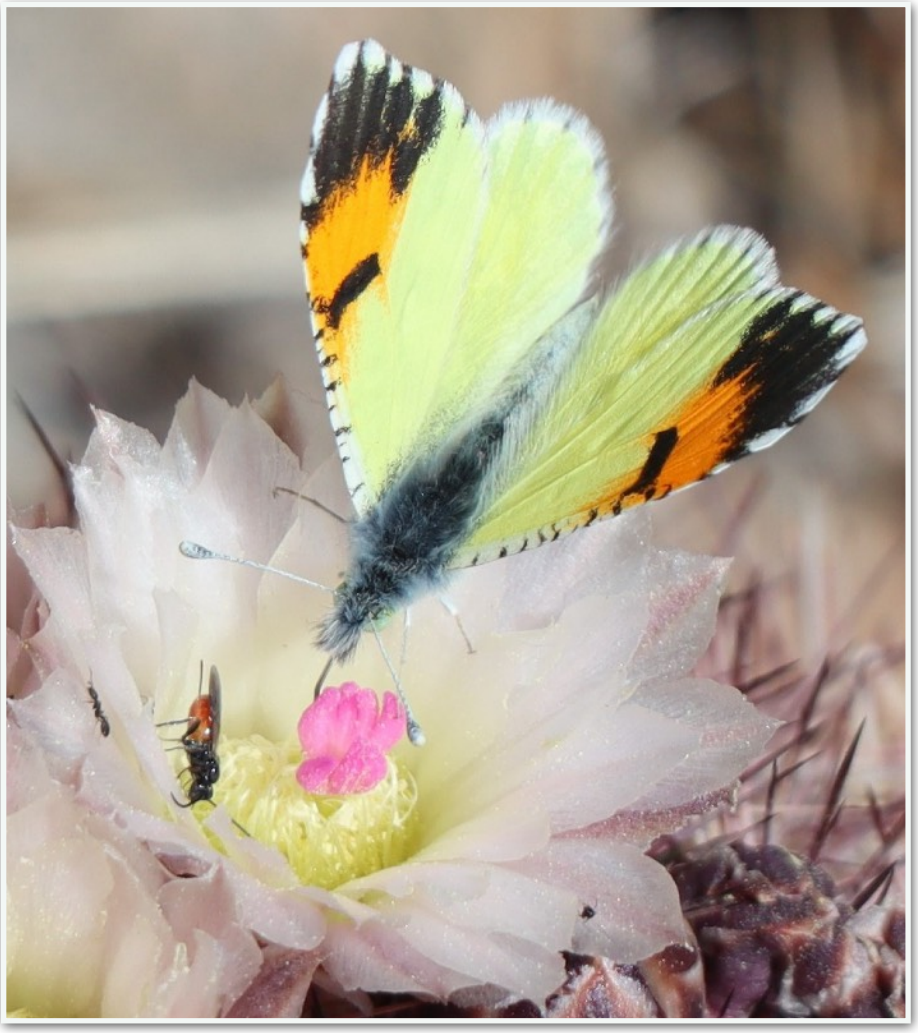
Bottom: As above, then the two *Pierids* forage from different flowers of the same plant.

Top Right: Same butterflies as the bottom photo with a better perspective on the nearly equal size of these small butterflies.

Right: The largest Chihuahuan Pineapple Cactus on site attracted a Pima Desert Orangetip to forage from its single open flower (another type of perspective).

Top Left (Following Page): Pima Desert Orangetip perches on tepals of a newly opening flower and begins to take nectar and nutrients.

Bottom Left (Following Page): A foraging Pima Desert Orangetip shares the fully opened flower with a foraging Potter Wasp species (see later) and an ant.



Top Right: The Pima Desert Orangetip above is joined by another, in addition to the Potter Wasp and ant, to forage.

2nd From Top Right: The Pima Desert Orangetip, Western Honey Bee, and an ant each exhibit a different foraging behavior/method at their selected flower.

3rd From Top Right: Foraging Pima Desert Orangetip is approached by a species of Sweat Bee (*Anthophila* sp.) as they use different areas of two flowers.

Previous Page - Second From Bottom Right: Three foraging Pima Desert Orangetips share the flower cluster illustrated in the center right image (of that page).

Previous Page - Bottom Right: Foraging Pima Desert Orangetip shares the flower cluster with a Western Honey Bee and an *Oestroid* species (bot flies, blowflies, and allies).

Top: An aggressive Western Honey Bee (note its full pollen sac) flies to a flower occupied by a Pima Desert Orangetip. Atypically, the butterfly continues to forage rather than taking flight.

Right: Ventral wing pattern of a Pima Desert Orangetip foraging from a translucent white flower with bright pink stigmas.

Following Page - Top: One foraging Pima Desert Orangetip (ventral view) attracts two others, in succession, to the same flower cluster.

Following Page - Bottom: As the imposing Western Honey Bee moves to the next flower, the *Oestrid* Fly retreats from its perch (immediately below the bee).

Apidae: Western Honey Bees

(Editors Note: The Western or European Honey Bee is a non-native. Please see p. 33 of Volume 5, Number 4 of this journal for a discussion of its "status" and "Follow-Ups" in this issue [p. 32]).

In the mountains of Doña Ana County, numerous and sometimes aggressive foragers of Chihuahuan Pineapple Cactus flowers were Western Honey Bees, *Apis mellifera* (Linnaeus, 1758). Present throughout the flowering season (February to April), they tolerate cold-to-cool temperatures well and forage over wide expanses of mountain habitats that support this cactus (Organs, Doña Anas, Picacho, Robledos, etc.) on slopes (typically warmer SE to W exposures) and along arroyos. They are particularly aggressive in selecting flower buds that are just opening and are strong enough to force themselves between the tepals to

access the as yet unexposed stamens/pollen grains. Honey bees forage for flower nectar and females collect pollen grains that are stored in sacs (corbiculae) on their back legs (sacs full with cactus pollen are yellow-colored, see right).

Western Honey Bees often intimidate other flower visitors to flight when they arrive but also forage alongside the individual small bees (Sweat, *Halictid*, etc.), flies, ants, butterflies, etc. that remain. It is not unusual for 2-4 individual Western Honey Bees to forage within a single flower at once.

Top: Three Western Honey Bees forced open a just-opening flower bud to collect pollen from the newly-exposed anthers (note the tiny beetle among the foraging bee melee). This and photo to the right from the Doña Ana Mountains, Chihuahuan Desert Nature Park on 03/19/21.

Right: Each of the three crawled deep into the stamens several times during the photo session.

Top Left: While a small *Halictid* Bee burrowed into stamens of the open flower, two Western Honey Bees competed to collect nectar and pollen from the partially opened adjacent flower bud. Organ Mountains, Bar Canyon Trail, 03/15/22.

Bottom Left: Full leg sacs attest to the success of the foraging Western Honey Bee, here walking on an open flower between a larval grasshopper instar above and a metallic green *Halictid* (Sweat) Bee perched on the stamens of the adjacent flower. Doña Ana Mountains, Chihuahuan Desert Nature Park, 03/19/22.

Top Right: An individual Western Honey Bee lands on a mostly open flower occupied only by a tiny beetle foraging from a tepal. Doña Ana Mountains, Chihuahuan Desert Nature Park, 03/19/21.

Following Page

Top: Foraging Western Honey Bee under an aggressive approach by an equally large ground-nesting Digger Bee (*Anthophora* sp.) Bees and wasps often intimidate each other and nearly all other insects away from foraging perches on available flowers. Doña Ana Mountains, Chihuahuan Desert Nature Park, 03/19/22.

Center: Three partially open flowers are occupied by either a foraging Western Honey Bee or what appears to be a small Mason Bee (note the full pollen sacs on the honey bee legs). Organ Mountains, Bar Canyon Trail, 03/20/22.

Right: A successful Western Honey Bee continues to hunt for additional pollen, even with nearly bursting leg sacs (this flower is occupied by another bee, burrowed among the stamens). Organ Mountains, Bar Canyon Trail, 03/22/20.

Halictidae: Sweat Bees

This bee family includes over 20,000 species worldwide and several species are common within the habitat of the Chihuahuan Pineapple Cactus in Doña Ana County. On late winter/early spring cactus flower image collection trips/hikes, the largest number of individual bees observed will be these tiny *Halictids*, even though the larger Western Honey Bees tend to skew perception. These tiny bees approach humans when sweat is present to lick the salty fluids as a nutrient source.

Top photos: Gordon Berman took these photos and noted that he "had found this cactus uprooted and planted it in his yard at home, delightedly watched it flower with an emergent green sweat bee a year later on 3/10/22. This plant died within months thereafter. Two other uprooted pineapples that I transplanted followed a similar pattern - surviving long enough to flower once, then expire."

Above Left: Gordon Berman collected this image of an Angeles Striped Sweat Bee, *Agapostemon angelicus* (Cockerell, 1924) emerging from within a Chihuahuan Pineapple Cactus flower with many pollen grains attached to leg hairs and elsewhere; in my opinion they are mobile enough to be considered pollinators.

Above Right: Gordon Berman collected this image of an Angeles Striped Sweat Bee, as above; they are difficult to differentiate from Texas Striped Sweat Bees described below.

Center Right: A pair of Texas Striped (aka Metallic Green) Sweat Bees, *Agapostemon texanus* (S.B. Cresson, 1872) forage nectar and collect pollen from the anther mass; in my opinion they are mobile enough to be considered pollinators of Chihuahuan Pineapple Cactus flowers. Doña Ana Mountains, Chihuahuan Desert Nature Park, 03/24/20.

Bottom Right: Texas Striped Sweat Bee forages atop a just-opening cactus flower bud. Doña Ana Mountains, Chihuahuan Desert Nature Park, 03/24/20.

Following Page - Top Left: Peridot Sweat Bee, *Augochlorella pomoniella* (Cockerell, 1915) perches on a tepal tip while foraging nectar from a Chihuahuan Pineapple Cactus flower. Organ Mountains, Bar Canyon Trail, 03/15/22.

Following Page - Top Right: A Furrow (Sweat) Bee, *Lasioglossum* (Curtis, 1833) species forages from the anther mass of a Chihuahuan Pineapple Cactus and collects pollen grains on its leg hairs and body. Doña Ana Mountains, Chihuahuan Desert Nature Park, 03/20/19.

Vespidae: Potter Wasps

I consider these wasps to be potential pollinators for the Chihuahuan Pineapple Cactus, where they are sometimes present.

Center Right: Gordon Berman collected this striking image of a Potter Wasp, *Odynerus* cinnabarinus (Bohart, 1939) perching on tepals just above the stamens on 03/27/22. GB noted that the photograph was taken "about 2/3 up Picacho Peak, where a small but growing population of pineapple cacti inhabit a rock strewn northeast facing slope. Three days earlier, I had visited this same spot, chanced upon multiples of the same bug, drawn to the same cluster of pineapple cacti."

Bottom Right: A reddish-orange Potter Wasp, *Odynerus sp.*, forages under or possibly hides beneath the open cactus flower. Doña Ana Mountains, Chihuahuan Desert Nature Park, 03/08/23.

Megachilidae: Mason Bees

I consider these small bees to be potential pollinators for the Chihuahuan Pineapple Cactus. They are uncommon on these cacti but are present.

Bottom Left: A small, Green Summer Mason Bee, *Hoplitis fulgida* (Cresson, 1864) crawls along tepal tips while foraging for nectar from flower to flower. Organ Mountains, Bar Canyon Trail, 03/15/22.

Formicidae: Ants

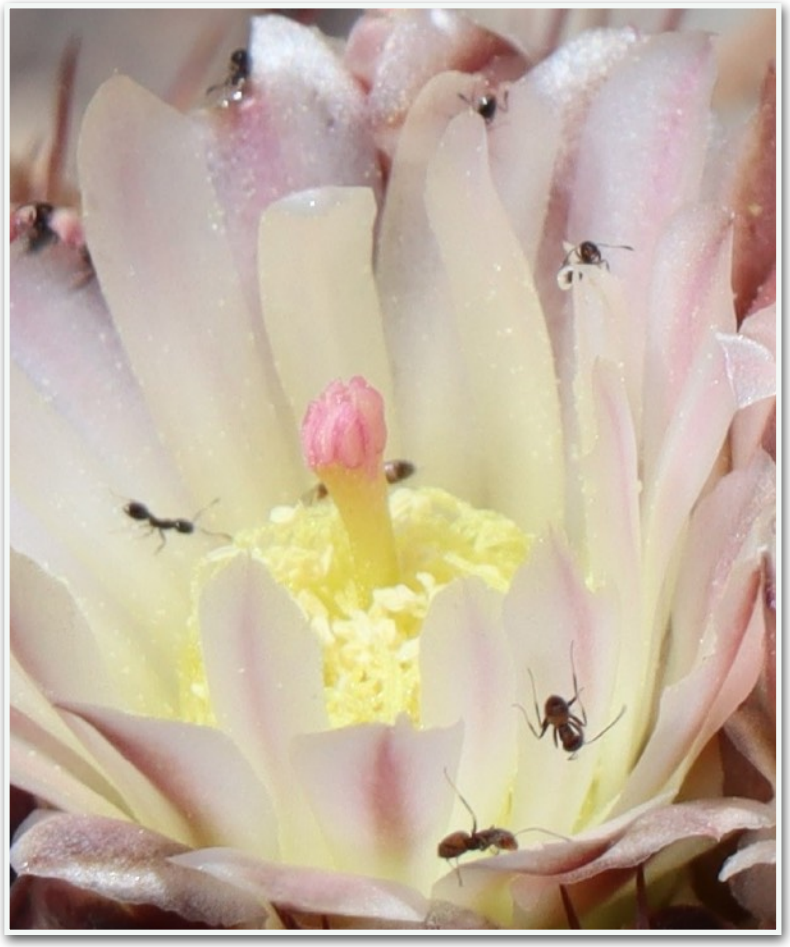
The common blackish-red ants that occur locally within Chihuahuan Pineapple Cactus habitat are likely Red Harvester Ants of the *Barbatus* Complex, *Pogonomyrex barbatus,* (Smith, 1858). In terms of numbers, Harvester Ants when present are the most numerous insect species observed on the flowers. However, because their distribution from nest sites is relatively small, I believe these ants provide little pollination while foraging on the flowers. However, where several plants are in proximity, cross-pollination by ants could occur.

Top: A Red Harvester Ant appears to be collecting pollen from the inner tepal surface just above the anther mass. Organ Mountains, Bar Canyon Trail, 03/28/19.

Bottom: Red Harvester Ants forage throughout this Chihuahuan Pineapple Cactus flower. Doña Ana Mountains, Chihuahuan Desert Nature Park, 03/19/22.

Following Page

Top: While collecting Chihuahuan Pineapple Cactus flower images this spring, I moved a large, flat rock from which adult Red Harvester Ants were emerging to forage; there were many larvae present in addition to three small Darkling Beetles (sheltering under a different part of the rock). The rock location was ~1.5m from a flowering Chihuahuan Pineapple Cactus. Organ Mountains, Bar Canyon Trail, 03/19/24.



Bottom: Quickly, these small Darkling Beetles, *Tenebrionidae*: *Argoporis* (Horn, 1870) species (includes a mating pair) became part of the Red Harvester Ant and larvae diet. Organ Mountains, Bar Canyon Trail, 03/19/24.

Tachinidae: Bristle Flies

I consider these flies, rarely present, to be potential pollinators for the Chihuahuan Pineapple Cactus.

Following Page

Top Left: A species of Bristle Fly, *Cylindromyia intermedia* (Meigen, 1824) perches on and appears to forage from Chihuahuan Pineapple Cactus tepals (inner surface). Organ Mountains, Bar Canyon Trail, 03/15/22.

Top Right: In this photograph the Bristle Fly encounters a green Sweat Bee (foraging and previously hidden among the flower stamens). Organ Mountains, Bar Canyon Trail, 03/15/22.

Syrphidae: Flower Flies, Hover Flies, etc.

I consider these flies, which are sometimes present, to be potential pollinators for the Chihuahuan Pineapple Cactus.

Bottom Left: Gordon Berman collected this Large-tailed Aphideater, *Eupodes volucris* (Osten Sacken, 1877), foraging directly from stamens where it could collect pollen grains for transfer to another plant, and I believe it could be a potential pollinator. This photograph and the one at center right were taken 2/18/22 at a very productive location just off US 70 southwest from the town of Organ.

Center Right: Gordon Berman collected this interesting three-species image with each species selecting a different flower for foraging. On the right is a Yellow-spotted Bromeliad Fly, and on the left is the Flower Fly, *Copestylum lentum* (Williston, 1887). The insect in the middle resembles a Mason Bee.

Bottom Right: A Yellow-spotted Bromeliad Fly hovers while avoiding a Western Honey Bee foraging in an open cactus flower. Organ Mountains, Bar Canyon Trail, 03/20/18.

Above: A Yellow-spotted Bromeliad Fly, *Copestylum avidum* (Osten Sacken, 1877) perches on Chihuahuan Pineapple Cactus stigmas and stamens while foraging and is a likely potential pollinator; an unknown fly rests behind on the tepal surfaces. Photograph by Gordon Berman.

Oestroidea: Bot Flies, Blow Flies, and Allies

Sometimes present, these flies may provide some pollination for the Chihuahuan Pineapple Cactus.

Below: A detail from a photograph shown earlier, this is a member of an unidentified *Oestroid* fly taxon perched on and foraging from Chihuahuan Pineapple Cactus tepals. Also present on the cactus was a nectaring Pima Desert Orangetip and flower-foraging Western Honey Bees; the fly represents a possible flower pollinator. Doña Ana Mountains, Chihuahuan Desert Nature Park, 03/19/22.

Coreidae: Leaf-footed Bug

I do not consider these sap-sucking bugs to be pollinators for the Chihuahuan Pineapple Cactus, although they are present on rare occasions.

Below: A Cactus Coreid Bug, *Chelinidea vittiger* (Uhler, 1863) uses the Chihuahuan Pineapple Cactus upper stem and unopened flower buds to likely forage and also to locate a mate. Organ Mountains, Bar Canyon Trail, 04/14/22.

Above: This individual bug appears to be using a flower bud for conducting reconnaissance, or perhaps warming in the sunshine, at the top of the cactus stem. It is a true bug that sucks sap from plant stems and leaves. Organ Mountains, Bar Canyon Trail, 03/15/22.

Above: A pair of Cactus Coreid Bugs use the upper cactus stem as a mating rendezvous. Organ Mountains, Bar Canyon Trail, 03/20/22.

Unknown Insect Larval Forms

Two larvae apparently hiding/ foraging among the Chihuahuan Pineapple Cactus tepals or on the flower buds were observed in the Organ Mountains, along the Bar Canyon Trail (03/27/22). The first appears to be a true bug, possibly a leaf-footed bug as illustrated in the above images. It would be interesting to determine if the Chihuahuan Pineapple Cactus serves as a host plant for Cactus Coreid Bug life cycles.

Top Right: Unidentified larval instar hiding/foraging among cactus flower tepals. Organ Mountains, Bar Canyon Trail, 03/27/03.

Center Right: Unidentified larval instar perched/hiding on cactus flower buds. Organ Mountains, Bar Canyon Trail, 03/27/03.

Acrididae: Short-horned Grasshoppers

Short-horned Grasshoppers are not considered pollinators for the Chihuahuan Pineapple Cactus for this article. They may prevent pollination of some flowers if they graze on the buds/just-opening tepals, stigmas, and/or anthers.

Right: Short-horned grasshopper larval instar perches on the stigmas, above the anthers of this Chihuahuan Pineapple Cactus nearly-open flower. I did not observe foraging activity (they may be bud/flower grazers) and believe pollination unlikely as cool season "hoppers" would have a limited range. This instar may be of the Pallid-winged Grasshopper, *Trimerotropis pallidipennis* (Burmeister, 1838), the most common grasshopper species locally. Organ Mountains, Bar Canyon Trail, 03/27/22.

Tettigoniidae: Shieldback Katydids

Shieldback Katydids are not considered pollinators for the Chihuahuan Pineapple Cactus for this article. They may prevent pollination of some flowers if they graze on the buds/just-opening tepals, stigmas, and/or anthers.

Right: This Sooty Longwing, *Capnobotes fuliginosus* ([Thomas] Scudder, 1897) perches partially on the tepals of a Chihuahuan Pineapple Cactus fully-opened flower, a behavior that alone would not result in pollen transfer; they may be flower grazers. Organ Mountains, Bar Canyon Trail, 03/20/22.

Chihuahuan Pineapple Cactus Flower and Root Grazing

Rarely, Chihuahuan Pineapple Cactus plants exhibiting obvious grazing effects and other physical stress are observed: Plants may topple due to soil saturation/erosion (sites on steep slopes) during heavy monsoon rainstorms; plants may be kicked over and roots exposed/uprooted by the hooves of grazing/browsing large mammals (Mule Deer, Oryx, range livestock) or uprooted and root-grazed by foraging Javelina; on some sites Pocket Gopher mounds from burrowing are observed near the cactus plants and some root grazing could occur; and flower bud/tepal/stigma grazing is sometimes encountered, as below. Generally, potential poaching of this and all cactus plants by humans should never be discounted.

Right: Occasionally, Chihuahuan Pineapple Cactus buds/flowers are grazed, often when in the late bud/early flower opening stage; the grazing species is unknown and this foraging behavior would prevent flower pollination. Doña Ana Mountains, Chihuahuan Desert Nature Park, 03/28/24.

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Top Left: A clean, wide-grooved bite mark that removes the roots from an uprooted Chihuahuan Pineapple Cactus base likely represents foraging behavior of Javelina, *Tayassuidae*: *Dicotyles tajacu* (Linnaeus 1758), which occur on this habitat. Note that the hollowing of the stem was performed by other species, perhaps by insects and small mammals. Doña Ana Mountains, Chihuahuan Desert Nature Park, 03/06/24.

Center Left: A Javelina freshly uprooted and root-grazed this Graham's Fishhook Cactus, *Cochemiea grahamii* ([Engelm.] Doweld) growing adjacent to the hiking trail where the top left cactus was located. Doña Ana Mountains, Chihuahuan Desert Nature Park, 10/29/20.

Bottom Left: Even in rocky/gravelly volcanic material, Javelina rooting areas/holes can be quite deep and large (the soil and gravel here had been moistened by a late autumn rainstorm). Doña Ana Mountains, Chihuahuan Desert Nature Park, 10/29/20.

Top Right: Javelina track in moist soil (enlargement) next to a dried Sotol leaf, on the same date and at the same location.

Bottom Right: Recently dead Javelina piglet lying on the hiking trail just above the rooting locations and probably crushed by a larger herd member (perhaps a nursing sow or larger siblings/aggressive boar); it likely became forage for insect scavengers and/or larger hunting bird/mammal scavengers or predators.

And Lastly - Variability

Gordon Berman shares the photographs on this and the following page to show color variation in the species. He notes that these photographs were taken on "3/21/24 on the upper Soledad/Bar Canyon Trail. They are some of the most numerous, most widely dispersed, and most color varied pineapple cacti I have found."

Ed.: Compare Berman's photos (top two) with the more "traditional" color of the specimen photographed by Bob Barnes (below) in Wicks Gulch, east of Hillsboro.

Cats

There are 14 genera and 47 extant species of *Felidae* (the cats) in the world. This assessment is by Mammal Diversity and differs from the 45 species listed on the chart to the right or the 41 referenced by Wikipedia. There is general agreement that the *Pantherinae* subfamily includes the seven species listed under the Panthera lineage to the right.

The diversification of the *Felidae* has occurred fairly recently. The last common ancestor of the *Pantherinae* is thought to have existed about 6.4 mya (million years ago). The last common ancestor of the Lynx lineage lived about 3.2 mya and the last common ancestor of the Puma lineage lived about 4.9 mya. Each group diverged from a common lineage and not from each other (see the work of Pawl Kraszewski at the bottom of this page).

What does all of this have to do with the Black Range? Mostly it has to do with that question mark at the upper right. On the other hand, the presence of Cougar/Puma/Mountain Lion and Bobcat in the Black Range is thoroughly documented.

The Border Wildlife Study of the Sky Island Alliance has proven to be very successful. Indeed, the Sky Island Alliance has been instrumental in the documentation of Jaguar in southern Arizona. One of their "Coffee Break" videos discusses the regulatory twists and turns in trying to protect Jaguar habitat.

On occasion, someone will advance a possible sighting of a Jaguar in the Black Range. None of these possible sightings has met the criteria for authenticated sightings used by the U. S. Fish and Wildlife Service (see the above video at 20:53). Good documentation (as in a clear photograph) is critical for establishing a good record. Given the general lack of protection which a Jaguar would have in the Black Range you may wish to discuss possible sightings with Harley Shaw, our Associate Editor Emeritus, prior to making a report.

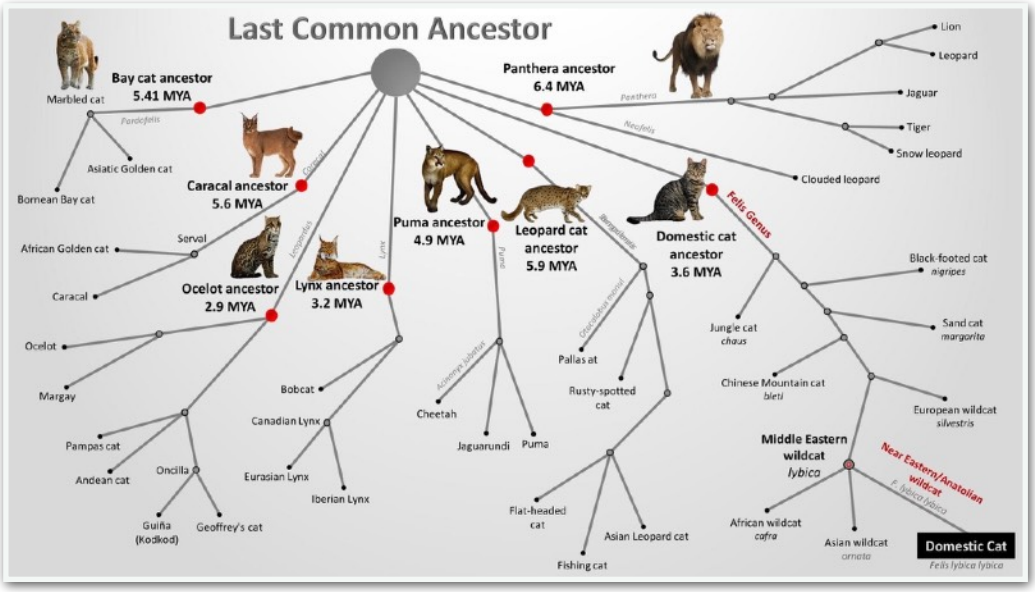
Wild Cat List by Lineage

Lineage #	Common Name	Genus	Species
Panthera lineage			
1	Lion	*Panthera*	*Panthera leo*
2	Leopard	*Panthera*	*Panthera pardus*
3	Jaguar	*Panthera*	*Panthera onca*
4	Tiger	*Panthera*	*Panthera tigris*
5	Snow Leopard	*Panthera*	*Panthera uncia*
6	Mainland Clouded Leopard	*Neofelis*	*Neofelis nebulosa*
7	Sunda Clouded Leopard	*Neofelis*	*Neofelis diardi*
Bay Cat lineage			
8	Asiatic Golden Cat	*Catopuma*	*Catopuma temminckii*
9	Bornean Bay Cat	*Catopuma*	*Catopuma badia*
10	Marbled cat	*Pardofelis*	*Pardofelis marmorata*
Caracal lineage			
11	Caracal	*Caracal*	*Caracal caracal*
12	African Golden Cat	*Caracal*	*Caracal aurata*
13	Serval	*Leptailurus*	*Leptailurus serval*
Ocelot lineage			
14	Geoffroy's Cat	*Leopardus*	*Leopardus geoffroyi*
15	Guiña, Kodkod	*Leopardus*	*Leopardus guigna*
16	Northern Tiger Cat	*Leopardus*	*Leopardus tigrinus*
17	Southern Tiger Cat	*Leopardus*	*Leopardus guttulus*
18	Eastern Tiger Cat	*Leopardus*	*Leopardus emiliae*
19	Andean Cat	*Leopardus*	*Leopardus jacobita*
20	Margay	*Leopardus*	*Leopardus wiedi*
21	Central Chilean Pampas Cat	*Leopardus*	*Leopardus colocola*
22	Brazilian Pampas Cat	*Leopardus*	*Leopardus braccatus*
23	Uruguayan Pampas Cat	*Leopardus*	*Leopardus fasciatus*
24	Northern Pampas Cat	*Leopardus*	*Leopardus garleppi*
25	Southern Pampas Cat	*Leopardus*	*Leopardus pajeros*
26	Ocelot	*Leopardus*	*Leopardus pardalis*
Lynx lineage			
27	Iberian Lynx	*Lynx*	*Lynx pardinus*
28	Eurasian Lynx	*Lynx*	*Lynx lynx*
29	Canada Lynx	*Lynx*	*Lynx canadensis*
30	Bobcat	*Lynx*	*Lynx rufus*
Puma lineage			
31	Puma	*Puma*	*Puma concolor*
32	Jaguarundi	*Puma*	*Herpailurus yagouaroundi*
33	Cheetah	*Acinonyx*	*Acinonyx jubatus*
Leopard Cat lineage			
34	Mainland Leopard Cat	*Prionailurus*	*Prionailurus bengalensis*
35	Sunda Leopard Cat	*Prionailurus*	*Prionailurus javanensis*
36	Fishing Cat	*Prionailurus*	*Prionailurus viverrinus*
37	Flat-headed Cat	*Prionailurus*	*Prionailurus planiceps*
38	Rusty-spotted Cat	*Prionailurus*	*Prionailurus rubiginosus*
39	Pallas's Cat	*Otocolobus*	*Otocolobus manul*
Felis lineage			
40	European Wildcat	*Felis*	*Felis silvestris*
41	Afro-Asiatic Wildcat	*Felis*	*Felis lybica*
42	Sand Cat	*Felis*	*Felis margarita*
43	Black-footed Cat	*Felis*	*Felis nigripes*
44	Jungle Cat	*Felis*	*Felis chaus*
45	Chinese Mountain Cat	*Felis*	*Felis bieti*

Lineage Reference: O'Brien, J. S. and Johnson, W. E. (2007). The evolution of cats. Scientific American July 2007: 68-75.
Species References:

- Mammal Diversity Database. 2023. Mammal Diversity Database (Version 1.11) [Felidae].
- Kitchener et al. 2017. *A revised taxonomy of the Felidae*. The final report of the Cat Classification Task Force of the IUCN / SSC Cat Specialist Group.

The basic chart (above) is from The Wild Cat Family website and was assembled from the references at the bottom of the chart.



Follow-ups and Tidbits

Red-naped Sapsucker

Later in this issue we note the presence of this species at the Dripping Springs Retention Pond and that Red-naped Sapsuckers were a possible predator of Tadpole Shrimp. The Red-naped Sapsucker is one of three species in the *Sphyrapicus* superspecies. In the Las Cruces area it is possible that the range of two of the species, the Red-naped and the Yellow-bellied Sapsucker, overlap. Since species in this superspecies are known to hybridize freely it is possible that the individual shown on page 63 is an intergrade, but note the red nape in that photograph, clearly marking it as a Red-naped (or at least more Red-naped than Yellow-bellied).

Large Language Models (LLM) And Evolutionary Change

In the April 2023 Issue of this journal (Vol. 6, No. 2) Jon Barnes walked us through the use of ChatGPT and emerging language models and how they can be used. Wikipedia has a nice history of the development of this type of model. In a recent email Jon alerted us to Grok, which is one of the LLMs which are taking the next big leap forward. As they note on their site, "Grok is an AI modeled after the Hitchhiker's Guide to the Galaxy. It is intended to answer almost anything and, far harder, even suggest what questions to ask!" That last phrase, "what questions to ask" is a fundamental departure (or step forward) from earlier programs, and its implications are immense.

"Something for the experts" you might say, and I would certainly agree it is well beyond my abilities. Jon wrote, "I wonder what emergent capabilities will appear with this monster of an LLM? Who will be able to run this 314 billion parameter model? It's very cool that the weights are open source. The last model I tried was 7 billion parameters, this is 40x bigger. I was able to run llama locally on my laptop - slowly but it does run."

He went on to note that: "COVID continues to show how evolution works. It seems to have moments of punctuated equilibrium followed by convergent evolution. If this observation is correct, we could see a sizeable evolutionary jump from JN.1.

"What is causing this evolutionary pattern? Is it from having a lot of infected people all the time? Well luckily, the last estimate I saw, the average American has only been infected 2.7 times. It could be from people who are infected for a period of time of over 6 months at a time with gut infections; however the sewer wastewater catchments with the large mutation rates often don't take off and become the dominant strain. What is causing this evolutionary pattern?

"Do birds have a similar evolutionary pattern? Will LLMs have a similar evolutionary pattern of large jumps in capabilities/size/structure followed by a variant soup of a bunch of similar LLMs converging on similar capabilities?"

(Ed.) I first became aware of the concept of punctuated equilibrium (Stephen Jay Gould and Niles Eldredge) in about 1973, the year following the publication of the *The Structure of Evolutionary Theory*.

Chapter 9 of that group of essays was later published as the book above. Evolution as a concept is understood throughout the world and in all sectors of society. However, the processes of evolution have been the source of controversy in some countries, like the United States. The lightening rod for some groups has been the concept of natural selection, which they often confuse with "evolution". When first espoused by Wallace and Darwin, natural selection met with resistance from conservative elements but is generally accepted in the modern era.

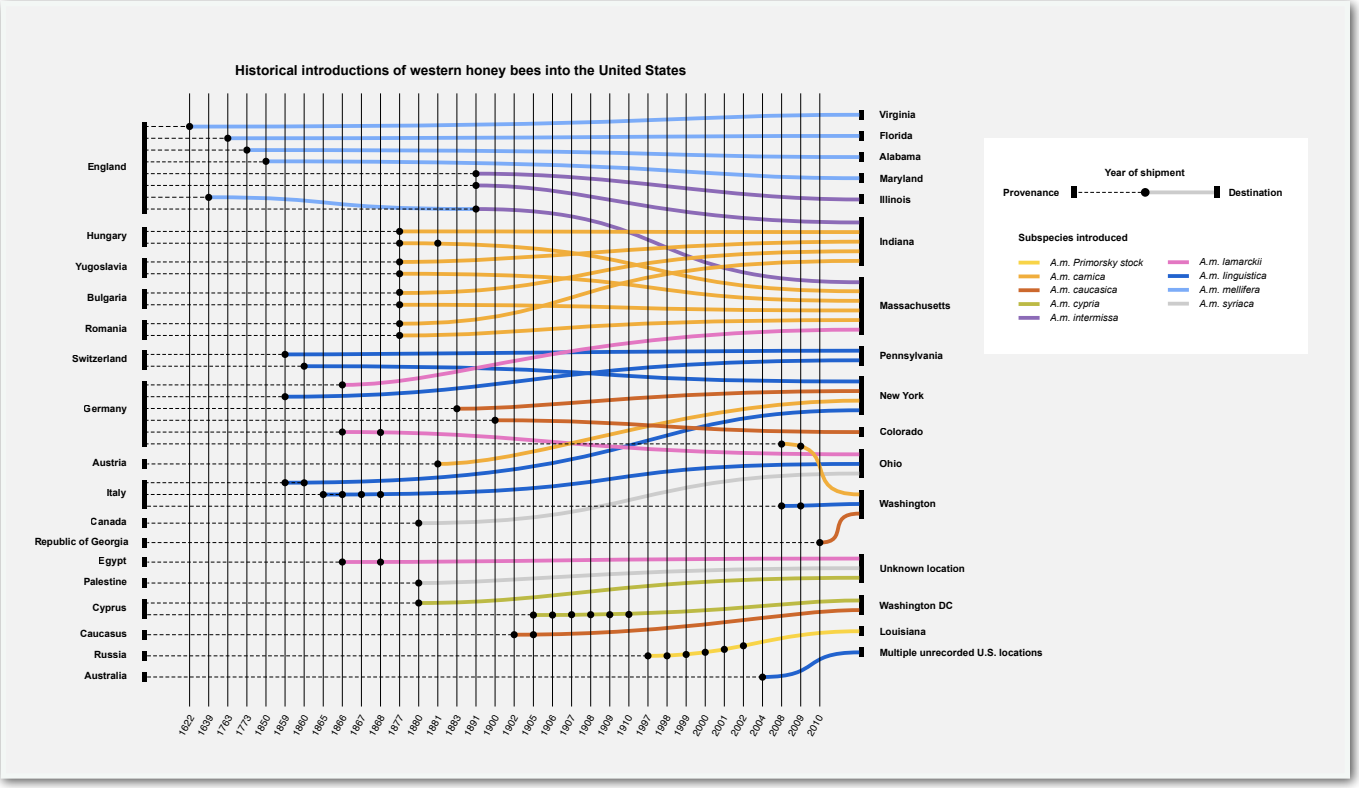
Several other evolutionary concepts have emerged since Wallace and Darwin made their ideas known. Punctuated equilibrium was one of those concepts as was lateral (or horizontal) gene transfer. Both of these concepts added to the soup of how evolution happens, and concepts like lateral gene transfer have been just as unsettling to "Darwinian Evolutionists" as the concept of natural selection was to many people in the mid-1800's (and even today in certain American sectors).

But change is change and it is going to happen. The root of all insight is being able to predict (with some accuracy) what is going to change, how it will change, and when it will change.

Understanding the evolution of change is a fundamental tool in guiding that change. (Note that we are discussing change and evolutionary processes here, not biological natural selection.) If machine learning will have periodic evolutionary spurts followed by periods of sorting (and there is no reason to believe that it will be any different from most other change processes - whether biological or technological), then a key question for us is where are we in that evolution? Living in the middle of it we may assume that we are in one of those evolutionary spurts because everything seems to be changing. In the longer term, however, our perspective may change and we may be in a period of relative calm.

A Little Sex

Caenorhabditis elegans probably belongs in the realm of creatures of immense importance which you are likely to have never seen or thought about much. This species was "the first multicellular organism to have its whole genome sequenced, and in 2019 it was the first organism to have



its connectome (neuronal 'wiring diagram') completed." The connectome is the system of neural pathways which exists in the brain or nervous system of a creature. The term is new; the first record for the term which the Oxford English Dictionary has is from 2005.

You may have guessed by now that *C. elegans* is probably a relatively simple creature. Morphologically that appears to be true. It is a transparent nematode found in most of the temperate soils of the world. Because it needs a fairly, and consistently, moist environment, it does not do that well in the foothills of the Black Range, but higher up it thrives. Fruit flies and *C. elegans* have been used extensively to enhance the human understanding of the world.

In "C. elegans males optimize mate-preference decisions via sex-specific responses to multimodal sensory cues" Luo et al. report on their study of the reproductive history of this species. (*Current Biology*, Volume 34, Issue 5, pp. 1309-1323, March 11, 2024). Given the importance this species plays in research, there seems to be a growing belief that maybe we should know something about it. (The gut biome of individuals of this species from different parts of the world is now being studied as a way of enhancing that of the human.)

Luo et al. noted that "For sexually reproducing animals, selecting optimal mates is important for maximizing reproductive fitness." They found that "In the nematode *C. elegans*, populations reproduce largely by hermaphrodite self-fertilization [ed.: each individual has both female and male gametes], but the cross fertilization of hermaphrodites by males also occurs. Males' ability to recognize hermaphrodites involves several sensory cues, but an integrated view of the ways males use these cues in their native context to assess characteristics of potential mates has been elusive. Here, we examine the mate-preference behavior of *C. elegans* males evoked by natively produced cues. We find that males use a combination of volatile sex pheromones (VSPs), ascaroside sex pheromones, surface-associated cues, and other signals to assess multiple features of potential mates. Specific aspects of mate preference are communicated by distinct signals: developmental stage and sex are signaled by ascaroside pheromones and surface cues. . ."

You might be asking, "other than the perfume industry, who cares"? We should care because it is an object lesson in the diversity of natural history. The "human" way is not the only way. In fact it is not even the most common way.

The Western Honey Bee

Apis mellifera, the Western or European Honey Bee, is a non-native species. In Volume 5, Number 4 of this journal we discussed its "status" both in terms of introduction and in terms of feral vs. native populations.

The Western Honey Bee is documented as one of the pollinators in "Insect Visitors to and Potential Pollinators of Chihuahuan Pineapple Cactus Flowers in Doña Ana County, New Mexico", see earlier in this issue.

In an early review of this issue, Harley Shaw mentioned that in the diaries of those involved in the early government surveys there were comments like "upon seeing honeybees we knew we were approaching Anglo settlements." One of these early explorers of New Mexico, James William Abert, served on John Frémont's third expedition. A short biographic sketch about Abert can be found at p. 44 of *Early Naturalists of the Black Range*.

An NMSU webpage (download May 24, 2024) states that "Honey bees

have been in New Mexico since the 1500s when the earliest Spanish missionaries and settlers imported them along with other livestock." The USDA publication "*Rio to the Sierra*" states that the date of introduction is unknown and that Josiah Gregg (*Commerce of the Prairies*) stated that honey bees had not reached New Mexico as of 1841. Whatever the date of introduction, our feral populations are well established.

The chart on the previous page documents the importation of *Apis mellifera* into the United States: where they came from, where they went, when they came, and what subspecies were involved. ("Click" on the graphic to access the study.)

The Blue Dasher
Pachydiplax longipennis

In April of this year we published *The Natural History of the Odonata of Doña Ana County With Notes on the Black Range* (*Odonata*). At pages 70-85 James Von Loh provided an extended discussion of the natural history, and wonderful photographs, of *Pachydiplax longipennis*, the Blue Dasher.

The discussion in *Odonata* is augmented by a study published in the Proceedings of the National Academy of Science entitled "An evolutionary innovation for mating facilitates ecological niche expansion and buffers species against climate change", Michael P. Moore et al., February 26, 2024. The abstract of that study reads: "One of the drivers of life's diversification has been the emergence of 'evolutionary innovations': The evolution of traits that grant access to underused ecological niches. Since ecological interactions can occur separately from mating, mating-related traits have not traditionally been considered factors in niche evolution. However, in order to persist in their environment, animals need to successfully mate just as much as they need to survive. Innovations that facilitate mating activity may therefore be an overlooked determinant of species' ecological limits. Here, we show that species' historical niches and responses to contemporary climate change are shaped by an innovation involved in mating – a waxy, ultra-violet-reflective pruinescence produced by male dragonflies. (ed.: underline added) Physiological experiments in two species demonstrate that pruinescence reduces heating and water loss. Phylogenetic analyses show that pruinescence is gained after taxa begin adopting a thermohydrically stressful mating behavior. Further comparative analyses reveal that pruinose species are more likely to breed in exposed, open-canopy microhabitats. Biogeographic analyses uncover that pruinose species occupy warmer and drier regions in North America. Citizen-science observations of *Pachydiplax longipennis* suggest that the extent of pruinescence can be optimized to match the local conditions. Finally, temporal analyses indicate that pruinose species have been buffered against contemporary climate change. Overall, these historical and contemporary patterns show that successful mating can shape species' niche limits in the same way as growth and survival."

Some of the physiological stress of mating, due to the niche location where it occurs and how it occurs, has been reduced by the development of pruinescence on the abdomen. A timely and elegant study which helps explain why one of our local dragonflies looks the way it does.

A Rogue Chunk of DNA

A cautionary note is thrown into the research mix by "Complexity of avian evolution revealed by family-level genomes", Josefin Stiller et al., *Nature*, 01 April 2024, and "A region of suppressed recombination misleads neoavian phylogenomics", Siavash Mirarab et al., April 1, 2024, *Proceedings of the National Academy of Science*. If you do not have access to these articles you may have access to a summary of the study at "How a 'rogue' chunk of DNA scrambled the bird family tree - One inverted genome region spent millions of years frozen in time, obscuring the true history of avian evolution", Phie Jacobs, 01 April 2024, *Science*.

A new avian tree of life has been developed as a result of this study. Depicted below is the The bird tree of life, based on the genomes of 363 bird species. The major bird groups are color-coded in the tree. *Paintings: Jon Fjeldså, Natural History Museum Denmark, University of Copenhagen.*

From the *Science* article: ". . . shortly after the mass extinction of the dinosaurs, this piece of DNA (ed.: 20 million base pairs on chromosome four) stopped recombining and

changing, possibly after becoming inverted – essentially flipping its orientation within the long strand of DNA that constitutes chromosome four. And for the following 3 million years, it simply refused to mingle with the genetic material around it."

This finding does more than disrupt the understanding of avian linages and their development. When determining age and relationship in genetic analysis the possibility of such events occurring in other genomes should be considered. The basic assumption of a more-or-less fixed steady rate of change is challenged.

Also from the *Science* article: "Although the 'rogue' segment of chromosome four proved to be something of an outlier in birds, similar nonrecombing stretches lurk in the genomes of other organisms. Some have already cropped up in plants, fungi, insects, and even a few primates."

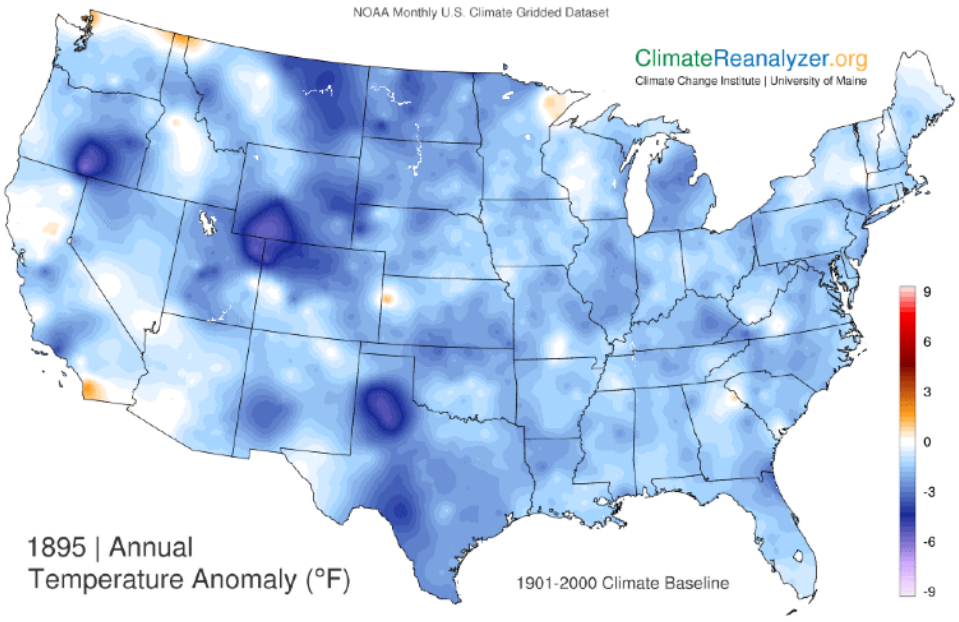
New Mexico Temperatures

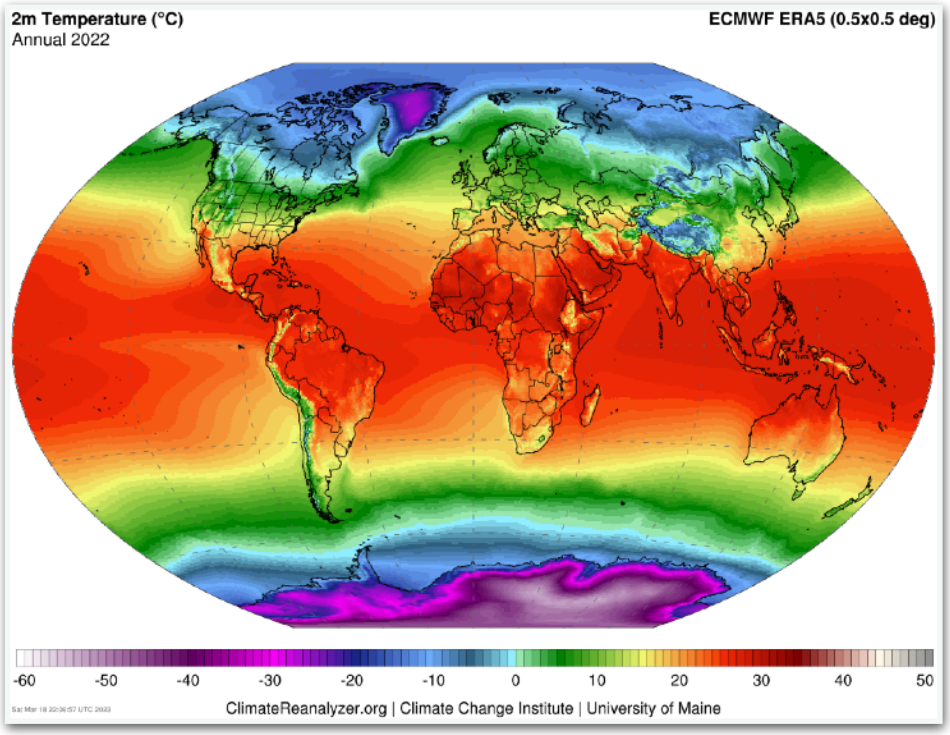
Follow the link (the orange circle at the bottom right is a link which will lead to an interactive webpage). At the website you may click on the chart to view how temperatures deviated from the norm at various times. For instance, following the mining busts at the end of the 1800's, things cooled down in the Black Range in more ways than one.

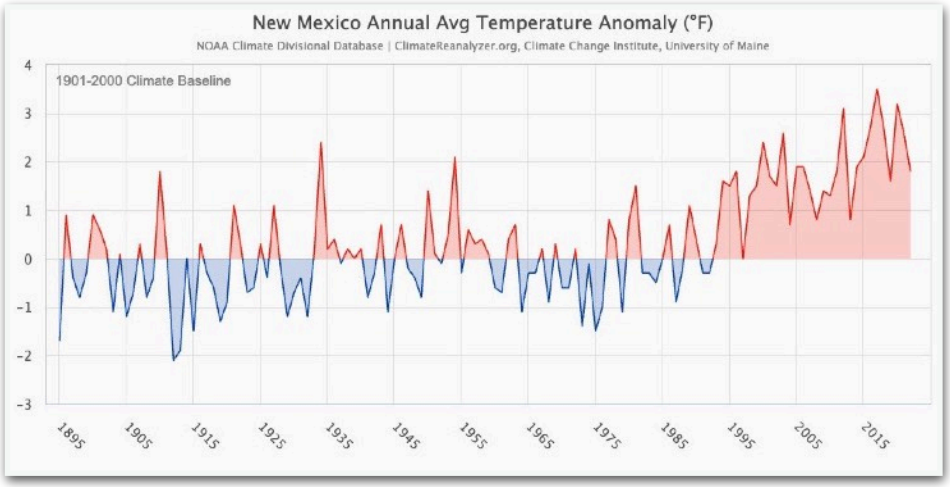
The Climate Reanalyzer website administered by the Climate Change Institute at the University of Maine is the repository of an extensive amount of weather data, from today's forecast to extensive histories.

Red Rock Skimmer Version 2 of *Odonata*

In our last issue we announced the publication of *The Odonata of Doña Ana County - With Notes on the Black Range*. We have started







compiling Version 2 of this work with a scheduled publication date in the fall of 2025.

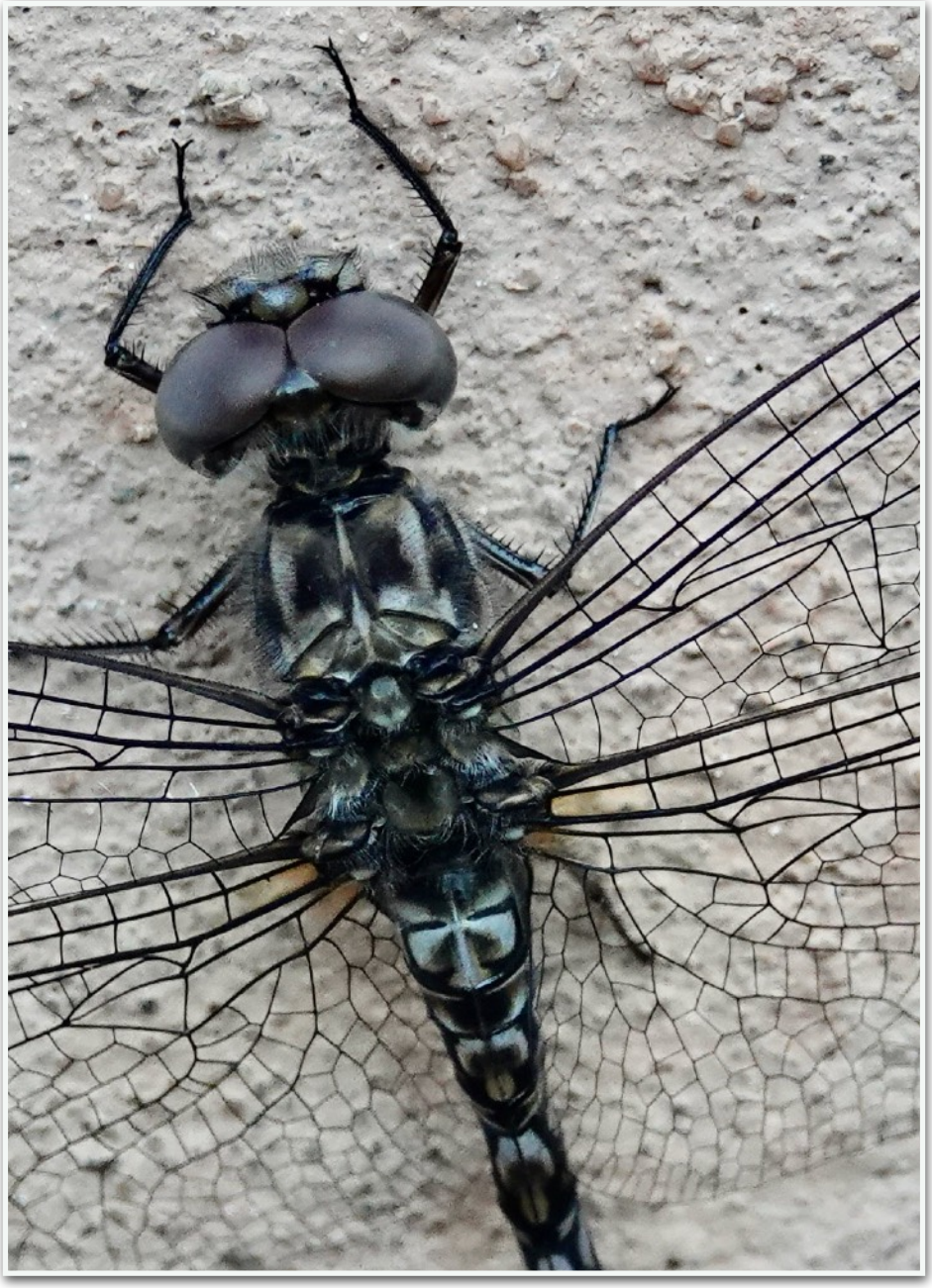
Although it was well received, we would like to make it better. Specifically we would like to include images, observations, and thoughts you might have from the 2024 and 2025 field seasons. Perhaps by exploring issues like that noted by Jonathan Batkin (see below) in greater detail.

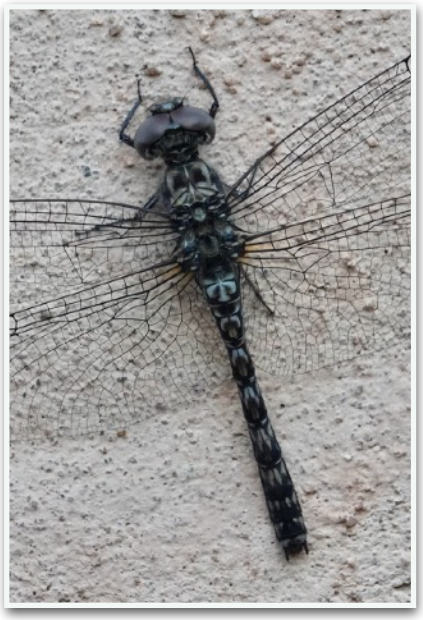
Version 1 was a substantial work and we are still grappling with the basic concept of Version 2. One model under consideration is to release Version 2, in two volumes; one an identification guide and one focused on the natural history. We would appreciate your thoughts and perspectives.

In the meantime, we share some photographs of Red Rock Skimmer, *Paltothemis lineatipes*. These images were taken in Hillsboro on August 8, 2023. (Yes, the editor did take the photographs and yes, he did completely overlook them in the preparation of Version 1 - just saying.)

Jonathan Batkin noted the following during the vetting of these photographs: "I'm sure this is a female Red Rock Skimmer, though the coloration throws me. The strong blue color may be influenced by the shaded location – the temperature of the light – but no matter what I do to adjust light and color, most pale spots remain blue. Some bright blue damselflies are known to darken to a purplish color when they are exposed to cool temperatures and during mating, but it is unclear whether air temperature might have affected the color of this specimen, even in the photo that renders the stucco on which she is perched as a warm tone."

J. Batkin followed up his initial review with an email to John Abbott (University of Alabama, creator of Odonata Central). J. Abbott passed on a link to Amanda Whispell's website. (She is is presently editor of the journal *Argia*, the magazine of the Dragonfly Society of the Americas.) Her study of physiological color change in some species of Odonata is enthralling. The video, link at the bottom of the main page on her site, is excellent.





Although the differences in color between the individual on the previous page and the one on this page are undoubtedly physiological, there are factors which contribute to variations in color rendition in photography. We discuss those factors in greater detail in the "Tools of the Trade" article in this issue and hope to explore them further at a later date.

Satomi Lander took the photographs on this page of a Red Rock Skimmer in Kingston in mid June 2023. They show the coloration which most references depict.

Whispell's research into physiological color change during mating displays/ mating, differences in temperature (both magnitude and rate of change), humidity (both magnitude and rate of change), sex and age differences, genetic shift, and the epigenetics of color morphology are all potential agents in the variation of color in living beings. There are few studies of how such factors might influence color variation between two individuals.

As mentioned earlier, differences in the individuals being photographed and differences in the photographs are two very different factors. Being able to look at an individual, or a photograph, and being able to accurately identify it is a skill based on experience. When you hear "Yes I know it is the wrong color, but that is what it is" you know you are in the presence of an expert or of someone who is wrong.

Coffey and Robinson's Cave

Jeff Forbes (Hillsboro) has been mining historic copies of the Sierra County Advocate (images on this page) for information about Coffey Cave (Coffey's, Coffees, or Coffee) and Robinson's Cave. (See our articles in the October 2022 issue [Coffee] and January 2024 issue [Robinson's]). He has turned up some interesting information (four large articles on this page) and generated a few questions in the process.

—J. S. P. Robinson, the North Percha merchant, is also interested in mining. One day last week while looking over some of his mining property down the creek, about a mile below his store, he ran across a deer track. Following the trail it led him to a cave—which it seems he nor any one else had ever discovered. Gathering some "fat" pine near by, he entered and began an exploring expedition and lost himself, not getting out until near dark. He left torches so that he could see from one to the other. The first one went out. After wandering around for some time he tore his pants into strips and trying all the various openings, marking them as he went along, he finally found daylight.

—SinceCol. Robinson's accidental discovery of the cave on the North Percha, some of the boys have been exploring it, and have gone in about four hundred feet, through numerous channels and drifts. M. J. Moffit and Date B. Whitham were among the first in and found various evidences of its former occupancy by human beings. It is the largest cave ever found in this section. Coffey's cave, on Mineral Creek, about two miles away, is a small affair compared with it. The Bledsoe cave, on the Tiger Mine, about a mile west of Kingston, is still smaller. This new discovery is just over the hill southeast, and down the creek from the Sweepstakes-Consolidated Mine, and near the Hillsboro mine.

January 13, 1893

Denver for some time.

With Mrs. S. F. Keller, chaperon, the Misses Grace Robins and Anna Bucher, Rob Robins, with Ray Hiler, as guide, visited the famous Robinson cave on North Percha last Wednesday.

Tomorrow Rob and Grace

August 31, 1906

News has been received here within the past few days of the discovery of an enormous cave in the North Percha country. While Ed. Coffey was drifting on a claim which he owns, and which lies on the Mineral creek side of the divide between Mineral creek and the Keystone, he ran into an underground cave. He explored the cavern to a distance of over five hundred feet and found the roof, sides and floor covered with the most beautiful lime crystals, stalagmites, &c. So far no word has been received here of whether silver has been found in the cave or not. Though if it has not, it is probable from the formation that valuable deposits of the precious metal may be found underneath the coating of lime crystals that cover the interior of the cavern.

March 19, 1889

Note the newspaper's orientation - "we have to tear away those formations because there may be 'precious metal' underneath"

Ladders?

Mr. Ed. Coffey will make arrangements this week to throw open his big cave to the public. The total length of the cave thus far explored s seven hundred feet. Ladders, ropes and other necessary fixtures will be taken to the cave Monday, and further explorations will be attempted. A sheer precipice of eighty feet will have to be overcome before any further advance can be made. Everybody is welcome to visit the cave; but Mr. Coffey kindly requests visitors not to molest nor break down the stalactites or stalagmites which adorn the cave from one end to the other.—Shaft.

September 6, 1889

the week.

The young folks are planning a Sunday trip to Robinson's cave on North Percha.

Henry Essinger, the well-known

March 21, 1913

Kingston, N. M., Aug 27, 1889.

EDITOR, ADVOCATE:—Enclosed please find a 5x8 photographic view of what is called "the Bridal Chamber," in Coffee's cave. I send you this view as an example of flash-light photography, the latest and grandest achievement from the hand of scientists, who are devoting their lives to the advancement of our beautiful art. With the flash-light the workings of the mines, caves, interiors of ancient ruins, machinery in dark basements, evening parties and hundreds of other things can now be successfully photographed, that otherwise could never be seen by the masses. What a blessing indeed is the flash-light!

The cave, known as "Coffee's Cave," is situated in the mountains on and north of Mineral creek, and about six miles north of Kingston.

Mr. Ed. Coffee, the gentlemanly miner on whose claim the cave is situated, has by hard labor placed many ladders at points where most needed, to aid visitors n viewing this most wonderful freak of nature; and generously pilots and assists he visitors around and through the intricate windings.

The cave has been explored some six hundred feet, and still more rooms or caverns are to be seen beyond. When once within, we stand with candles uplifted, gazing with wonder and awe at he magnificent scene which presents itself on every side, overhead and upon he floors. We can but exclaim, "Beautiful!" "Wonderful!" "How grand are Nature's works!" The beautiful chrystals stalactite and stalagmites greet the eye everywhere. Beautiful miniature lakes of the brightest sparkling water are seen here and there. The Bridal Chamber, the Queen's Chair, Chrystal Lake, the Capitol Dome, the Bridal Cake, the Grotto, and many other beautiful places, the names of which the visitors failed to catch, go to make up one of the grandest sights in New Mexico, if not the grandest.

Nothing was ever known of this cave until very recently. Mr. Coffee invited some friends to call on him and he would show them through, which he generously did; and since which, many parties have availed themselves of the privilege to explore this most wondrous cave.

J. C. B.

August 27, 1889

J. C. B. (Joseph Campbell Burge) was a photographer in the Hillsboro/Kingston area at this time.

The top center article on the preceding page may offer some insight into what may have happened to some of the smaller caves in the Black Range. Some articles from this era refer to miners finding caves and excavating them.

Care should be exercised before assuming that newspaper articles of this period (or perhaps of any period) are completely accurate. However, the articles on the previous page are insightful. Some articles are puzzling, like the *Sierra County Advocate* article from Aug 9, 1901, shown directly below.

A few days ago Carlos Padilla and others found a cave on the Animas of mammoth proportions. They explored two or three different chambers which are beautifully decorated with stalactites and stalagmites. They made the descent by means of ropes. In the third chamber they explored they found the partial remains of a human skeleton, also some poles. It is evident that some ill-fated prospector lost his life in attempting to explore the cavern. From this chamber Padilla and his friends could not venture into the next chamber below them owing to the great depth it presented. They report the rooms investigated to be very extensive and beautiful. One of the small stalactites now adorns our sanctum. Further exploration of the caves will probably be made.

Last week Frank Waterman, John Traub, John Bweeteke, Anthony O'Neal and others, prospecting on the Animas discovered high upon the side of a precipitous and rugged mountain a hole which from its size and appearance they took to be an ancient Spanish shaft. One of the party made a trip to Hillsboro, distant eight miles, for a supply of candles, and the party spent several days in making an exploration of the opening which proved to be a cave of generous dimensions. The tendency of the cavity was toward the perpendicular but the course was turned by frequent benches and shelves, and capacious rooms hung with magnificent stalactites and crystals were numerous. The party explored the cavern to the depth of more than two hundred feet and pronounce the sights contained therein, as the most splendid that ever greeted their eyes. At the bottom was found the skeleton of a mountain lion, and by this and other indications they concluded that they were the first human explorers of this remarkable cave. A fine lead of white quartz cuts across the cavity and this the gentlemen staked for future prospecting.

Black Range, April 27, 1883

The two articles from the *Black Range* Newspaper of Chloride (4-27-1883 and 3-30-1883) hint at the possibility of finding more caves in the range.

MAMMOTH CAVE.

Discovered in the Black Range, by a Party of Prospectors.

The greatest discovery yet made in this county belongs to two old prospectors, Jack Woods and Bill Morris, well known as men of truth. The cave is situated in the extreme Black Range portion of this county, and is comprised of seven distinct chambers. The entrance is scarce large enough for one to squeeze through. Once inside, however, a dazzling brightness awaits the awe-struck viewer, he standing in a chamber nearly a hundred feet long and about eighty feet wide, with the ceiling fully seventy-five feet above. Thousands of scintillating stalactites reach to the floor, while numerous stalagmites of fantastic and curious shapes and indescribable beauty, mystifies and astonishes. In the second chamber, which is reached by descending an almost perpendicular flight of stairs of twenty steps, the views and picturesqueness are more beautiful even than in the first. Gigantic pillars of immense circumference and continually changing hues, sparkling like diamonds at every turn, looming up like towering giants, take the place of the constantly dripping stalactites. The air of this room is singularly bracing—almost intoxicating. A stream of water, clear as crystal and of briny saltness, about twenty feet in width and from four to ten feet in depth, flows from under the north wall, across the floor some sixty feet, and out again under the south wall, where can be heard the rumble of a waterfall, evidently but a few feet away. The next room was the last explored, and is about a hundred feet square, with arched roof studded with twinkling stars fully two hundred feet from the floor, which is covered with fine white sand. Some rude implements of copper, and of great weight, tell the story of ages ago. The remaining rooms were quickly examined, owing to the failing of hastily improvised torches, but each seemed to vie with the other in beauty and strangeness. In the last room was discovered a small aperture leading to the south, through which pebbles were rolled and heard to drop, showing that the extent of this wonderful formation is yet to be determined. We shall form a part of an exploring party to visit the cave in April, and will then give a complete and minute description of the place.—Georgetown Courier.

Black Range, March 30, 1883

The loose use of terminology found in the newspapers at this time makes it difficult to ascertain whether or not an article was about a cave or a mining chamber. The examples given here apparently refer to natural caves.

We do know that caves are popular, as popular then as now. See the *Sierra County Advocate* article from March 28, 1913, below, as proof of that. Some of the names are now thought of as Hillsboro and Kingston historical luminaries.

The following visited the Robinson cave on North Percha last Sunday: Frank Harris, John Dye, Darwin Wolford, Roger Sherman, Monroe Pague, J. Gilbert, Percy and Sim Reid and the Misses Mary Armer, Lila Fergusson, Jonny Fergusson, Jennie Schale, Caroline Hardin, Mary Sherman and Mildred McLannahan.

Moths
(Cryptic and Aposematic)

Moths can be aposematic (strongly visible and recognizable) or cryptic (camouflaged). Their color and pattern traits are tied to whether they want to alert potential predators (to the fact that they taste bad and/or are toxic) or hide from them. The later case (cryptic color and patterns) is what most people learned in middle school as the example of natural selection (moths on soot covered tree trunks in industrial Great Britain).

As reported in "Predator selection on phenotypic variability of cryptic and aposematic moths" (Nokelainen, O., Silvasti, S.A., Strauss, S.Y. *et al. Nat Commun* 15, 1678 , 2024) the authors set out to robustly test this standard truth by examining thousands of digital moth images.

As opaque as such a study could be, it provided some interesting evolutionary insight. For the naturalist studying moths (and perhaps many other creatures) it provides some guidance about how to go about identifying

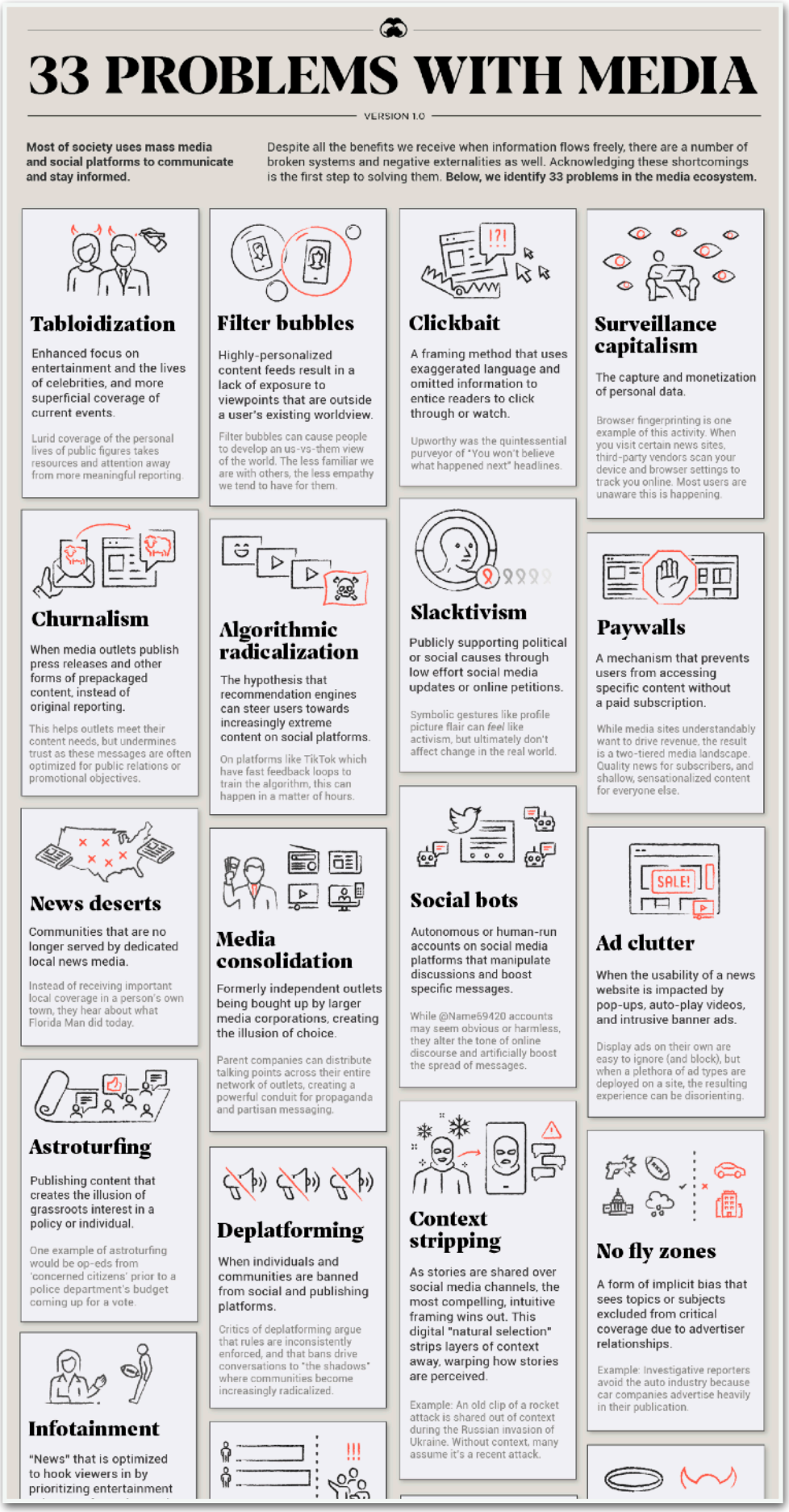
those cryptic little flying machines. Two things to consider when identifying moths to species are their coloration and the patterns of that coloration. It turns out that it is the patterns that vary most within cryptic species, more than the color. Don't assume that cryptic moths of the same species will have identical wing patterns. One theory advanced for this evolutionary trait is that the prey image that a predator uses to find its next meal may be strongly linked to pattern recognition. A corollary might be that aposematic species will lack evolutionary pressure to change color or pattern.

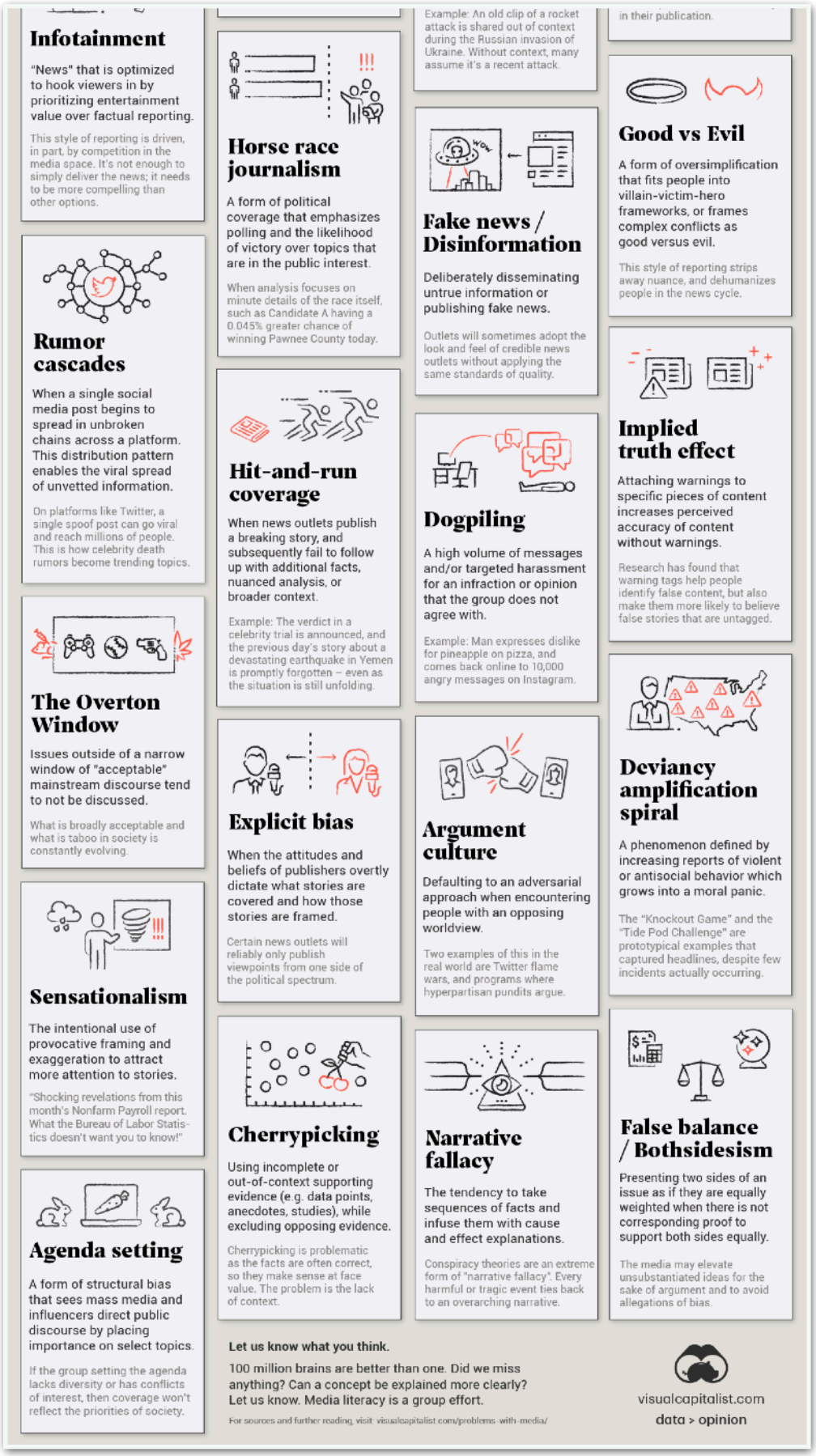
Pattern sequencing is notoriously difficult, and in situations where there is a great deal of variability, say in wing patterns, it can be dumbfounding. As the researchers noted: "To extract pattern information, we applied a pattern ('granularity') analysis technique that decomposes an image into a series of spatial frequencies using Fourier analysis and band pass filtering and follows with determining the relative contribution of different marking sizes to the overall pattern. Granularity analysis is a powerful tool for quantifying animal patterning as it objectively measures variation in phenotypic appearance in terms of arrangement in luminance composition."

What We Ain't

The graphic shown here and on the following page was originally published at this link.

There is a big election in November, a lot is at stake, and that means that there are bad actors out there who will distort reality to match their goals (which are probably not your goals). Some of the techniques they will use to confuse the facts are shown on this and the following page. It really is worth reading. Even if you know it, it is good to be reminded.





The Power of Observation

Generalist vs. Specialists
Observation vs. Analysis

Some version of how we know the world, how we study, how we research, how we think; some version of whether you are a generalist or a specialist; some version of whether you prefer observation or analysis as a form of study; some version - well you get it. On almost any topic, you can find people who will settle into one camp or the other and often they are dismissive of the other camp.

All too often language is used as a boxing mechanism. We seem to need to put things into boxes. Sometimes we call the boxes species, sometimes we call the boxes "types of people", sometimes . . .

Here we note a bit of observation, proven by analysis. One without the other is not terribly useful.

Hot water can freeze (become ice) faster than cold water. This process is known as the Mpemba Effect. It is named after Erasto Bartholomeo Mpemba. He first described the process in 1963 when he was in secondary school in Tanganyika, Tanzania. He was, of course, ridiculed at the time. He and Denis Osborne published their work proving the point in 1969. Two things here, first is that good observation is better than preconceived ideas and second, the effect has been known for a long time. Aristotle described it, Francis Bacon described it, Joseph Black conducted experiments seeking to discover the circumstances under which this effect happens. But it is named after the one who published.

It's In The Legs
Positive Deviance

As the assessment of social behavior became more data driven, the findings gained from social research became more accurate, useful, and insightful. The physical sciences have generally been able to most accurately portray their subjects of inquiry through the use of mathematical projections of probability, followed by the natural sciences, and least accurately by the social sciences. The difference in the number of variables in any study of the physical world versus the biological world explains the difference in the robustness of analytics in the two science realms. Reasons for the social sciences' being less rigorous is less obvious, despite a human-centric assertion that the social sciences must deal with more variables (which is not likely to be accurate).

So, from a strictly analytic perspective, do the social sciences have anything to teach us about the assessment of the physical and biological worlds?

"Positive deviance" first appeared as a term of art in the social sciences in the early to mid 1970s but did not gain widespread acceptance in that field of study until the 1990s. In a nutshell, the concept is simple and straightforward: in any distribution the legs can be extremely informative. That is, for some assessments the deviation from the norm can be of critical value. This because, in the social sciences, the focus has been on the deviation from the norm. In the world of "social and economic development" the concept has been used extensively to describe "best practices". What is it that the better performers, those which deviate from the norm in whatever the positive (value laden) attribute is, do? This is articulated in many fields, including diversity, where a diverse society is assumed to have more opportunities for "best practices" because there are more "practices" than in a monocultural society.

The United Nations Data Powered Positive Deviance handbook describes how this concept can best be applied to enhance economic development. There is not an obvious corollary in the biological sciences and what there is, is fraught with misapplication.

Megan Higgs, the editor of the International Statistical Institute's blog *Statisticians React to the News* is quoted as saying that "In research in general we have an overemphasis on quantifying averages." She notes that few people in a research pool may actually fit the average. Sometimes, averages obscure vital information (speaking of the social sciences.)

In descriptive analytics, where a population is depicted as a distribution (of some attribute - and note the obvious issues with the selection of a singular index or even small set of attributes) those observations which deviate from the norm may be described as subspecies or varieties.

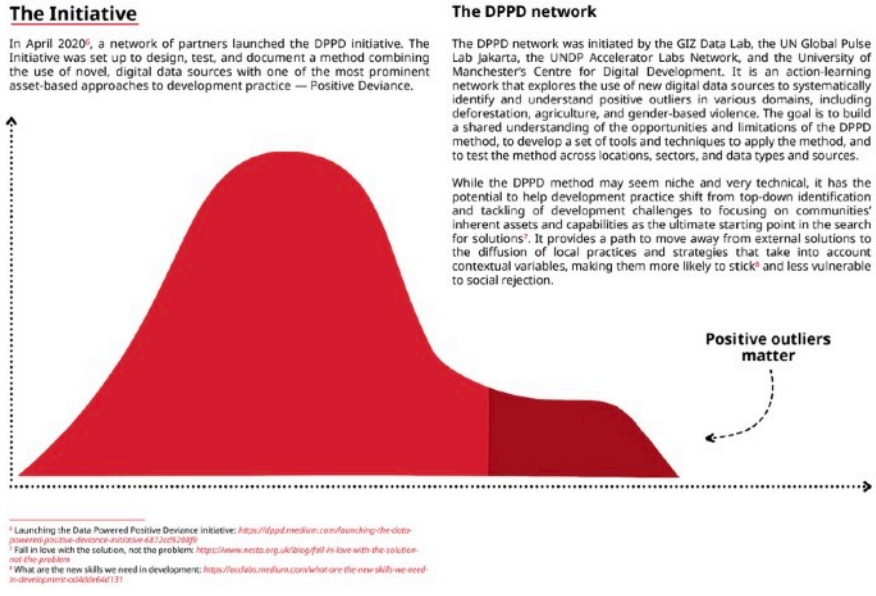
In statistical analytics, in which the researcher attempts to assess whether something causes something else to happen or if it is simply a correlation, much reliance is placed on mathematical modeling. Even in the best of cases, however, a statistical finding is an assessment of probability. If everything about a study is done correctly, an assessment of standard deviation simply tells a researcher that there is a 95% (99% or some other number) chance that the finding is due to (insert whatever the study parameters were).

Even a finding of causation, which is often assumed to be an absolute, and generally one-way, relationship can suffer from a lack of rigor. "Causes" like all other "facts" tend to change over time as we learn more about whatever is being studied. The facts (and causes) of the Stone Age or even Newtonian physics are not necessarily the facts and causes we understand today.

So what?

An observation (regardless of the analytic scheme involved) which is outside the "norm" or a standard deviation (or some other descriptor of inherent variability) tells us something. It may be a product of an error in protocol or measurement, but it is more likely, if a researcher is doing it right, to indicate that at least in some cases there is more going on in the world than that described by a normative value. It is these deviations from the norm which are the drivers of evolutionary sciences, for instance. They are often the triggers for additional study in whatever field of inquiry we are engaged in. We need to pay attention to what is different. The most precise articulation of our current appreciation of this concept comes from the social sciences.

The graphic below is from the cited handbook.



Tiger Beetles & Tiger Moths
Batesian Mimicry

Harlan M. Gough, Juliette J. Rubin, Akito Y. Kawahara, and Jesse R. Barber report in "Tiger beetles produce anti-bat ultrasound and are probable Batesian moth mimics" (*Biology Letters,* 15 May 2024) uncovered layers of mimicry previously unrecognized. From the abstract of the study: "Echolocating bats and their eared insect prey are in an acoustic evolutionary war. Moths produce anti-bat sounds that startle bat predators, signal noxiousness, mimic unpalatable models and jam bat sonar. Tiger beetles (*Cicindelidae*) also purportedly produce ultrasound in response to bat attacks."

The researchers gathered several tiger beetle species from southern Arizona, including beetles of the species *Cicindelidia ocelata*, which occurs in our area. (Jared Gorrell took the photo at the upper right, of a *Cicindelidia ocelata,* in Las Cruces. Other observations in our area include several at Caballo Reservoir.) *Cicindela ocellata* (Klug, 1834) is a synonym for this species.

As the authors note, "Several species of tiger beetles (*Cicindelidae*) in the tribe *Cicindelini* possess ultrasonically sensitive ears and purportedly produce ultrasound in response to bat attacks. . . . Upon hearing ultrasound, tiger beetles swing their elytra (ed: the hardened forewing found in beetles) backwards contacting the leading edge of their beating hindwings producing ultrasonic clicks in time with their wingbeat frequency. These researchers hypothesized that this acoustic response functions as an aposematic warning of chemical protection."

The authors discovered, however, that the bats found the beetles quite edible. That, in fact, the beetles were practicing Batesian mimicry (when a harmless species mimics a harmful species which has the same predator as they).

"It is evident that tiger beetle ultrasound production is an incredibly labile trait found throughout the tribe *Cicindelini*. Nocturnal flight, and thus exposure to bat predation, seems to be a powerful predictor of acoustic response. While we do not have the taxon sampling for inference concerning the number of origins of this trait, all available data show that anti-bat sound production in tiger beetles is limited to *Cicindelini*, a group with a crown age of (approx. 48 ± 10 Ma) around the same time that tiger moths, the purported acoustic model, arose (approx. 50 ± 10 Ma). These dates closely align with the origin of laryngeal echolocation in bats (approx. 50 ± 10 Ma) and suggest that these predators may have been driving cross-order acoustic mimicry for millions of years. Adding tiger beetles to the now substantial list of moths that acoustically respond to bat sonar means that acoustic mimicry is even more phylogenetically broad than previously thought. We predict that many additional insect taxa will be shown to produce similar anti-bat sounds, and that acoustic mimicry rings of the night sky occur world-wide and are phylogenetically diverse." And we might add, in the Black Range the hills are alive with the sound of mimicry.

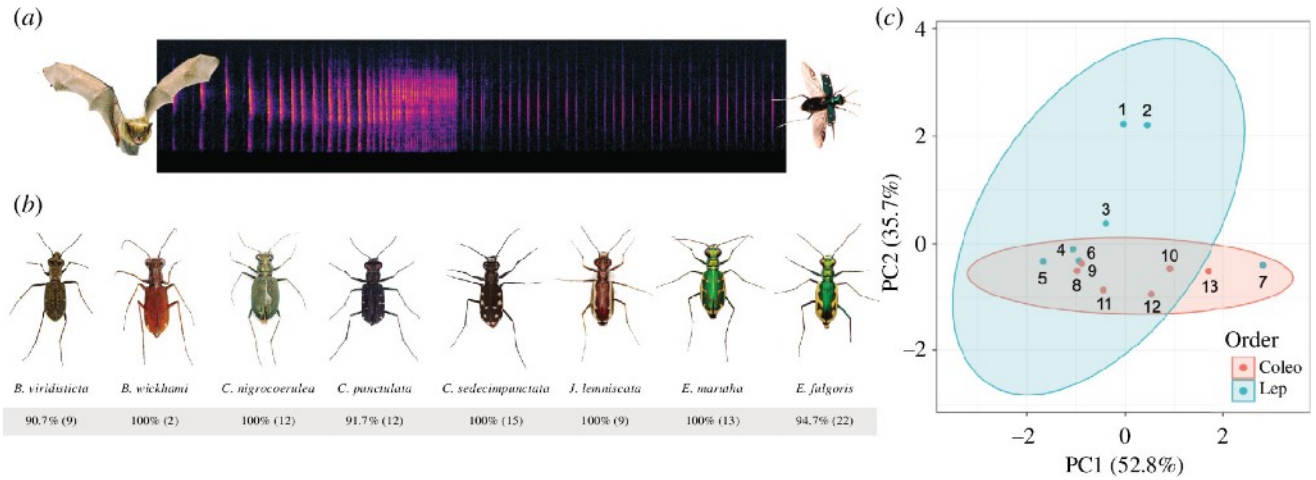


Figure 1. Tiger beetles produce anti-bat ultrasound. (*a*) Spectrogram of a played-back echolocation attack with ultrasonic response produced by a tethered *Ellipsoptera marutha*. (*b*) Percentages indicate palatability to big brown bats (*Eptesicus fuscus*; see §2). Numbers in parenthesis are sample sizes for palatability trials. (*c*) Principal component analysis (PCA) plot of tiger beetle sounds and sympatric chemically defended tiger moth sounds. Tiger beetle sounds are nested within the acoustic space of tiger moth warning signals. The following species are associated with the numbered points on the PCA: 1. *Bertholdia trigona*; 2. *Carales arizonensis*; 3. *Cisthene tenufaschia*; 4. *Cisthene martini*; 5. *Pygarctia rosciapitis*; 6. *Euchates antica*; 7. *Ctenucha venosa*; 8. *Ellipsoptera marutha*; 9. *Brasiella wickhami*; 10. *Eunota fuigoris*; 11. *Jundlandia lemniscata*; 12. *Cicindelidia sedecimpunctata*; 13. *Cicindelidia ocelata*.

Black Range Weather - The Monsoon

It is one of the most frequently used weather terms in the Black Range. Often referred to as "THE monsoon" it is a weather pattern of immense consequence in our region.

Monsoons occur in India, South Asia, in the western part of the borderlands of the Estados Unidos de Mexico and the United States of America, and in other parts of the world.

Usually, the term monsoon is used to refer to the rainy phase of a seasonally changing pattern, although technically there is also a dry phase. Speaking of technicalities, the official (in some quarters) definition of monsoon is that it involves the seasonal reversing of wind and the rains which come with it (the typical "India" model of a monsoon). The annual wind flows in this area are more complex than a simple "inflow-outflow" pattern.

In North America the "North American Monsoon System" begins in late May in the Gulf of California and is generally in full swing here by the end of June or early July. Usually it is all over by mid September. (The official National Weather Service dates are June 15 to September 30.)

Unlike the monsoons of India/South Asia our monsoon manifests itself in a series of fronts traveling south to north. Sometimes they move northeast from the Pacific off of northern Mexico, sometimes north out of Mexico proper, and sometimes from the southeast out of the Gulf of Mexico. Generally, the monsoon is when we receive most of our precipitation. We have a definite wet and dry period and the variation in the frontal patterns makes "our" monsoon quite complex. A variety of factors, which may influence some or all of the frontal patterns, may change the duration and strength of our monsoon.

Russ Bowen (Hillsboro) compiles a "Climate Summary for Hillsboro, NM (National Weather Service Station #29-4009)" each month. In his report on Hillsboro precipitation during July 2024 he summarized the complexity of our patterns nicely. "Precipitation, on the other hand, varied significantly from the average, but not in typical monsoon fashion. A normal monsoon flow for New Mexico has south and southeasterly flow bringing moist air from the Gulf of Mexico into the state for almost daily showers and thundershowers. Instead, we experienced a 'reverse monsoon' with a nearly stationary high pressure system aloft over the Great Basin resulting in persistent north and northeasterly flow. The resultant 'continental air mass' is significantly drier than the monsoonal flow but can, on occasion, push a 'backdoor cold front' with more significant moisture into the state. Two such occasions occurred in July, on the 2nd and 22nd of the month, resulting in 3.52 inches or 92% of the month's precipitation."

Véronique De Jaegher (Kingston) photographed the clouds of an early monsoon on May 18, 2023, near Lake Valley (shown above).

Prionus californicus

The California Prionus, *Prionus californicus* (Motschulsky 1845), is also known as the Giant Root Borer. This is a large beetle with lengths to 55 mm (2.1").

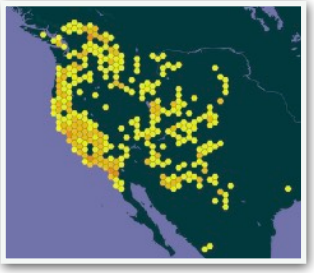
In the larger images look at the pro-thorax, the area encircled in white in the image to the right. The prothorax is composed of the pronotum (dorsal or top part), prosternum (ventral or bottom side), and the propleuron (the lateral or sides of the prothorax). This species has three spines on either side of its pronotum. Its antenna has a saw-toothed edge of 12 segments. Based on the length of the antenna, this may be a female (length of antenna about ½ the length of the body vs. the male's antenna which is about ⅔ the length of the body).

The life cycle of this species may last five years. Larvae feed on the roots of live deciduous trees (also grasses, vines, decomposing hardwoods and conifers). Larvae may be quite plump and up to 4" in length. They leave circular tunnels in the wood in which they feed.

This individual was found under a living cottonwood in late June 2024. It was at the end of its life cycle and had significant mobility issues.

The various species of Longhorn Beetles (Family *Cerambycidea*) can be difficult to identify to species. In the case of this individual, most other species were dismissed based on range. It was distinguished from *P. heroicus* (Semenov 1907), which is found in Arizona, Colorado, and (eastern and southern) New Mexico, based on its antenna configuration and the fact that *P. heroicus* tends to be blackish in color. (BugGuide includes blackish images of *P. californicus*.) Distinctions based on this methodology are arguable. As noted in Ted Macrae's blog of February 16, 2015, *P. heroicus* may be associated with Gambel Oak.

We began this issue with an article on the Mexican Spotted Owl. *Prionus californicus* is known to be a prey species for the Northern Spotted Owl and it is safe to assume that the southern subspecies of the Spotted Owl also feeds on this beetle. ("Diets and Foraging Behavior of Northern Spotted Owls in Oregon", Forsman et al., *J Raptor Res.* 38[3]:214-230, September 2004).



The range of *P. californicus* is usually described as west of the Mississippi. The range map for this species (above) is from the Global Biodiversity Information Facility.

Video of this individual may be viewed at this link.

Tools of the Trade: Part 3 - Images

Just about everyone takes photographs and just about everyone will modify the image they have taken in some way. They may compensate for an over-exposed or underexposed image by darkening or lightening the image, for instance. In other cases, a photographer may change the color saturation or color balance, or they may crop an image. All of these processes can be responsibly utilized in scientific study. In the case of lightening or darkening an image, in cases of under or overexposure in the first instance, it may not even be necessary to note the change.

Darkening an overexposed image does not manipulate the reality which was captured by the photograph - it only modifies the image. This is an important distinction. A photograph and the reality which it captured are two different things. Ensuring the integrity of the reality is of paramount importance. What is done to a photograph in the process of depicting that reality with integrity is simply part of the photographic process.

Ensuring that a viewer of the image understands modifications which you have made to the image is important in establishing photographic integrity. This goes substantially beyond the deep fake or machine generated images which are the rage of the pulp press. Here we are talking the basics. Ensuring that a viewer of the image understands that you could barely see the subject of the image when a photograph was taken is an important data point.

Color manipulation, including saturation and contrast, seem to be the favorite forms of modifying images used by advertisers and others. Oversaturating, in particular, making those colors deep and ensuring that they pop from the page/screen, is used routinely today.

Modifying saturation and contrast can be very misleading because it may lead a viewer to believe that a particular element of the image is easier to see than it really is, may not accurately depict reality (enhancing color patterns so that they appear dramatic rather than the much less dramatic subdued character they have in nature). But again, these methods of modifying images can be very useful; they can be used to draw attention to particular elements in a photograph or they can be used to enhance patterns when an understanding of those patterns is desirable.

False colors are routinely used to highlight particular elements in an image or to show a human viewer something that she/he can not view in reality. In astronomy, for instance, an instrument may take an image of infrared or ultraviolet radiation - or wavelengths even farther afield - and depict them in a color which humans can see. This is useful in enhancing our understanding of the phenomena being observed, but it does not depict what we see.

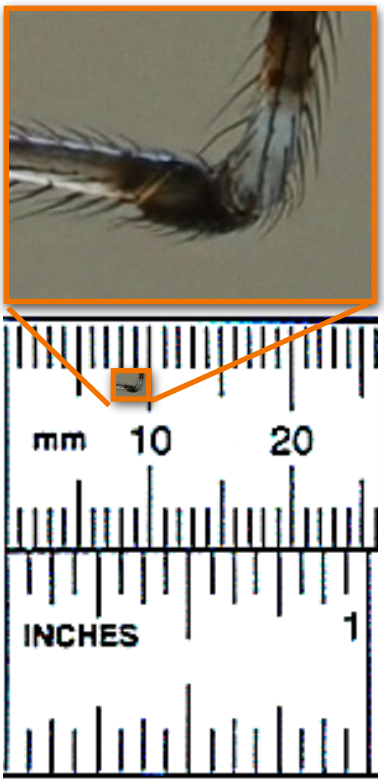
The photograph of a robberfly (top right of the next page) taken east of Hillsboro on October 8, 2021, is fairly straightforward. But attention is drawn to the robberfly by focus and depth of field. Although it does not accurately depict reality (things in nature are not inherently in or out of focus) it does capture the reality of

our perception fairly accurately. In my hubris I sometimes forget that I do not always see things clearly (broad definition here). Speaking in a more focused mode, the human eye does not see all things in its field of view with the same clarity: Peripheral vision lacks color, depth of field is definitely an issue. (Stare at an object, focus on it, and take in the back ground - it will not be as clear as the object.) These facts and all of the advantages and problems associated with how your brain interprets and stores the information transmitted to it from your eyes, mean there is more to the world than we see at any given time. Like looking at realty ads in some flyer, what is not shown can be just as important as what is.

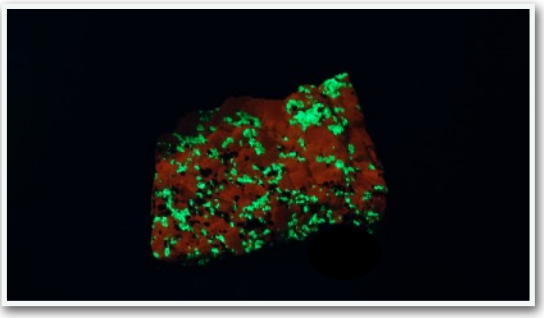
Lighting is sometimes used to enhance detail or add a dramatic effect. See the photo at the lower right (not photographed in the Black Range). Sometimes such lighting may change the apparent hue of the object being photographed.

Most humans can not perceive ultraviolet (uv) light (and none can do so well). Many other creatures can perceive ultra-violet light and the world looks quite different to them. We have all seen the uv images of flowers (as bees see them) and the false color images of the universe in every astronomy article ever printed, but one of the most intriguing uses of uv illumination is the fluorescence of certain minerals. The center images at the right are of the same rock sample. The top image is the sample seen under "normal" lighting. In the image below it, willemite glows green under uv and calcite glows orange.

Close-up and macro photography can be especially useful in the study of natural history. What is often lost in translation, however, is a sense of scale. Sometimes scale has to be understood intellectually rather than perceptually, as when viewing an electron microscope image. At other times, including something in an image to provide scale, or adding a scale in some manner later, can increase understanding. In the top center image, the addition of a scale detracts from the "art" but makes the image more impressive.



Few people would look at the image above and think that it has been manipulated. It is an image taken in Coffee Cave in the Black Range and it is artificially lit. Without the added light the image would look something like that shown in the inset. Artificial lighting like this is an example of modifying what we are able to see with our own senses.



A Historical Perspective

Sometimes we forget what the event horizon of new discoveries and perspectives was like. Jeff Forbes of Hillsboro provided the following article from the *Sierra County Advocate* of August 27, 1889. This

Kingston, N. M., Aug 27, 1889.

EDITOR, ADVOCATE:—Enclosed please find a 5x8 photographic view of what is called "the Bridal Chamber," in Coffee's cave. I send you this view as an example of flash-light photography, the latest and grandest achievement from the hand of scientists, who are devoting their lives to the advancement of our beautiful art. With the flash-light the workings of the mines, caves, interiors of ancient ruins, machinery in dark basements, evening parties and hundreds of other things can now be successfully photographed, that otherwise could never be seen by the masses. What a blessing indeed is the flash-light!

The cave, known as "Coffee's Cave," is situated in the mountains on and north of Mineral creek, and about six miles north of Kingston.

Mr. Ed. Coffee, the gentlemanly miner on whose claim the cave is situated, has by hard labor placed many ladders at points where most needed, to aid visitors in viewing this most wonderful freak of nature; and generously pilots and assists the visitors around and through the intricate windings.

The cave has been explored some six hundred feet, and still more rooms or caverns are to be seen beyond. When once within, we stand with candles uplifted, gazing with wonder and awe at the magnificent scene which presents itself on every side, overhead and upon the floors. We can but exclaim, "Beautiful!" "Wonderful!" "How grand are Nature's works!" The beautiful chrystals [illegible] and stalagmites greet the eye

"Enclosed please find a 5 x 8 photographic view of what is called "the Bridal Chamber," in Coffee's cave. I send you this view as an example of flash photography, the latest and grandest achievement from the hand of scientists, who are devoting their lives to the advancement of our beautiful art. With the flash-light the workings of the mines, caves, interiors of ancient ruins, machinery in dark basements, evening parties and hundreds of other things can now be successfully photographed, that otherwise could never be seen by the masses. What a blessing indeed is the flash-light."

INTERESTING PICTURES.

We have pleasure in recording the fact that Miss Gertrude Fuller, the attractive and talented young lady who is spending the winter in Hillsboro, and who, as we have before observed in these columns, is interested in the artistic possibilities of amateur photography, has just completed some noteworthy work in that line.

Her study entitled "In Flood Time" contains all the qualities necessary to a fine picture. The rushing waters of the Rio Percha present unusual difficulties for photography on account of the rapidity of exposure necessary; but, with remarkable skill, our fair artist has succeeded in producing a most effective result.

The composition, balance and lighting (especially the lighting) are excellent, and all combine to give a true pictorial value to this exquisite bit of work.

Miss Fuller's "Snow Storm" is another fine example of technical skill, and a striking illustration of the difference between a mere photograph and a picture. It is a beautiful subject, delicately rendered, and one of those pictures the beauties of which become more and more apparent the longer they are studied.

In a lighter vein, but of great interest, are her "snap shots" of characteristic scenes during the barbecue last Monday; and some of our dignified citizens might be surprised, if not amused, to see how faithfully her kodak has caught and perpetuated their fleeting expressions and graceful attitudes on that memorable occasion.

An old miner says: "I see many

article was also included earlier as part of a "Follow-up" on our cave articles.

Another example of the initial reaction to photography made available on a wide scale is shown at the center (Sierra County Advocate, November 19, 1897).

3-D Images and Scans

Increasingly, three-dimensional images are being used as instructive devices. As far as I know, they are not available as dynamic imagery in .pdf documents (soon to come, I am sure). Please visit the Images and Graphics page on The Black Range Exchange website to see an example of this type of graphic from the Blackburn Lab at the University of Florida - an "explodable" skull of an American Bullfrog.

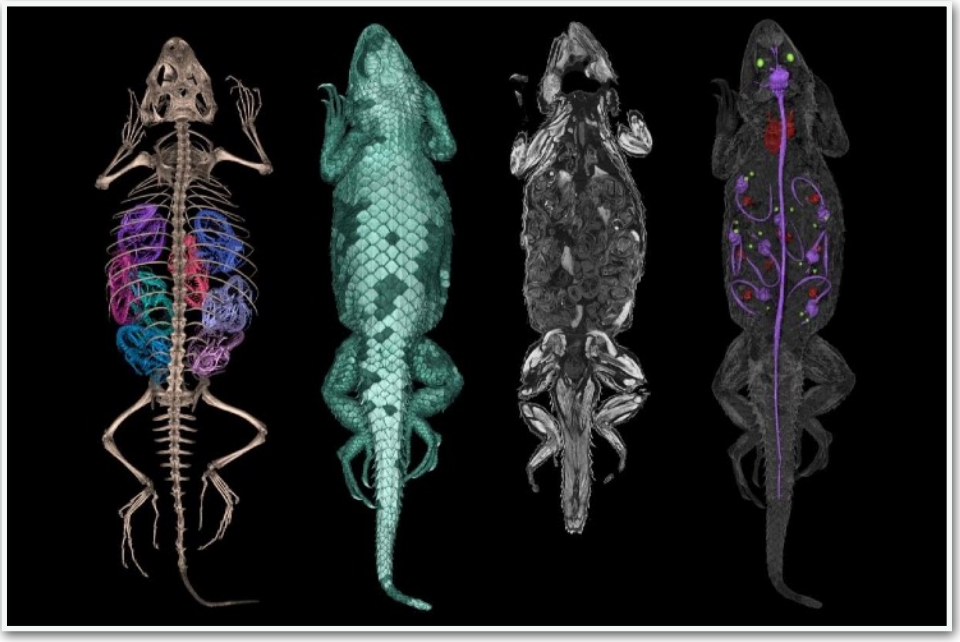
The image above is a three-dimensional scan of a Green Heron, from the Florida Museum. It is part of an effort to "digitize" the vertebrate specimens in the world's educational institutions, a project called openVertebrate.

At the top of the following page there are four more examples of the imagery which is possible and available through this project. In this case there are four images of Spiny Lizards, *Sceloporus*.

"Creating effective, information-laden field sketches is often a key skill for geoscientists to develop as they progress in their career journeys. From our first field trip to our hundredth visit to a research site, we are taught that visuals are vital for documenting important and often subtle place-based information, and for doing good science." Kainz and Halling; "Snapping Science in the Field"; *Eos*, 11 March 2024.

An article about using smart-phone apps for scientific documentation.

See Also: David C Blackburn et al., "Increasing the impact of vertebrate scientific collections through 3D imaging: The openVertebrate (oVert) Thematic Collections Network", *BioScience*, Volume 74, Issue 3, March 2024, Pages 169–186.



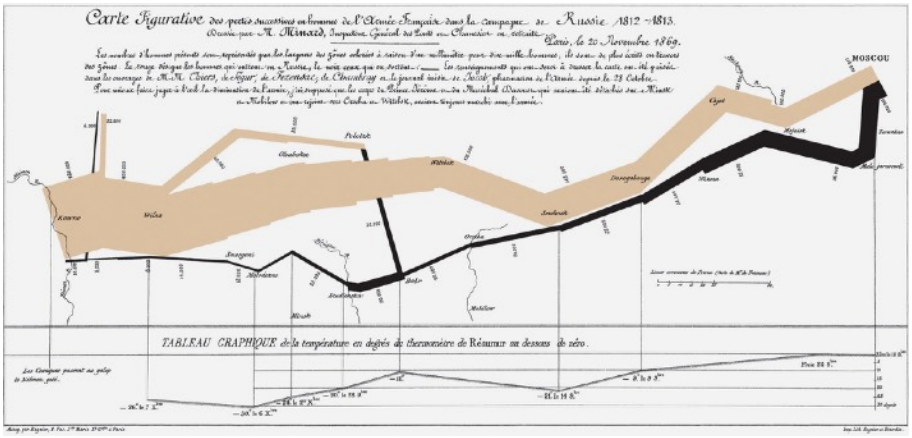
Graphics

Anyone doing basic research today is familiar with scatter diagrams, regression analysis, (perhaps) Monte Carlo runs, the significance of standard deviations, what the importance of long legs vs. short legs is - indeed what the shape of the legs means, and plots of all types and hues. Regardless of the underlying data, the graphic depicting it may or may not be informative or, for that matter, accurate.

A graphic should be information rich. To explain a good graphic in narrative should take at least pages, perhaps chapters.

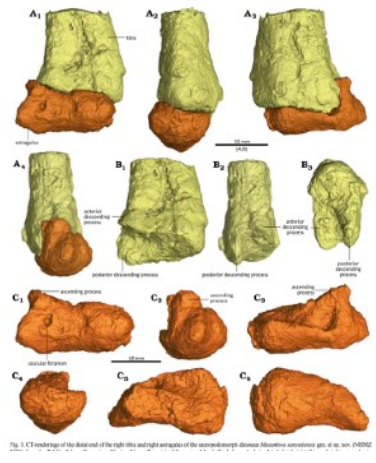
One of the most informative graphics ever created (see below or follow link for a larger version and an extended article) is that by Charles Joseph Minard in 1869 (made when he was 80). Two things leap forward from that statement of creation. First of all, informative data-rich graphics are not a new thing and second, you are never too old to create a historical legacy.

The graphic depicts Napoleons's invasion of Russia in 1812-1813. It starts out on the left with a huge army, shown in tan, (422,000 on the graphic, currently considered to be closer to 600,000) leaving the Neman (Niemen, Nyoman, Nemunas, or Memel) River in central Belarus. It ends at the same location when the French Army (in black) numbered 10,000 (sources which cite 600,000 believe the army numbered about 100,000 at this point). The size of the army dwindles as it marches toward Moscow. The Russians retreated before the French, refusing to fight and burning the countryside. Starvation was severe amongst the French forces. As they retreated from Moscow they froze, and the temperatures along the way are shown at the bottom of the graphic. The graphic is to scale, shows major landmarks, and tells a devastating story in a manner which is instantly understood. That is the goal of any graphic which is created, a story which is instantly understood. And, which is full of nuance and detail as it is studied more closely.

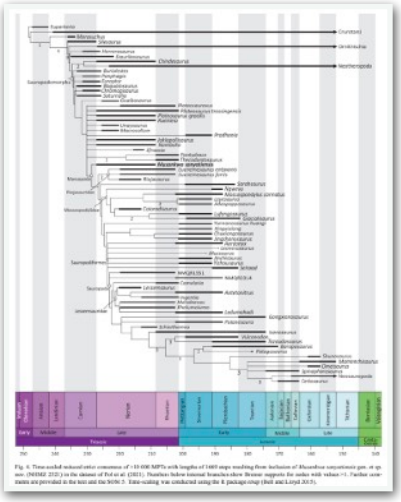


We finish this article with two points made in a paper in *Acta Palaeontologica Polonica*. (This paper has nothing to do with the Black Range, only where research gets done and the accessibility of presentations.) Paul Barrett, Kimberley Chapelle, Lara Sciscio, Timothy Broderick, Michel Zondo, Darlington Munyikwa, JonahChoiniere. "A new Late Triassic sauropodomorph dinosaur from the Mid-Zambezi Basin, Zimbabwe". *Acta Palaeontologica Polonica*, 2024.

There are two nice examples of presentation techniques in this paper. The first is an illustration of some of the bones recovered in the study. But instead of photographs of dirty brown bones (and there are some of those in the paper) this is a depiction of high definition CT scans with color highlights to emphasize particular bone elements.



In our second example, the authors present a standard study in evolutionary relationships, a phylogenetic analysis tree. Something which is always presented in any study having to do with evolutionary relationships. Across the bottom of the tree the authors placed a geologic timescale. Simple. Informative.



Don't have a lab? That can be a big deal. Should that stop your observations and research? The research done for the article above was done on this loaned houseboat.

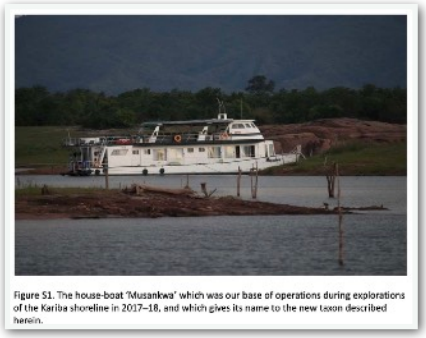


Figure S1. The house-boat 'Musankwa' which was our base of operations during explorations of the Kariba shoreline in 2017–18, and which gives its name to the new taxon described herein.

The American Geophysical Union (AGU) regularly provides free virtual workshops on presentation techniques and topical issues. An example of their presentations is "What is a Successful, Effective Data Visualization" (youtube.com link - contains ads - prepared by Don't Use this Code - James Powell)

A Perspective on What Walks This Way . . .

A Review by Harley Shaw

A Perspective on Sharman Russell's new book - *What Walks This Way--discovering the wildlife around us through their tracks and sign*

In my early teens, my favorite authors were Stewart Edward White and Zane Grey. I preferred Grey's books about the Lorna Doone and Lew Wetzel era over his westerns. Even better were White's Andy Burnett stories. The fictional hero of White's books was based upon legendary woodsmen like Boone or Crockett and mountain men like Jedediah Smith and Jim Bridger – men who rambled the shifting wilderness frontiers of their day. According to White and Grey, survival in the wilderness required finely honed awareness of hostile humans and large carnivores – vigilance that involved reading of "sign" in order to avoid unexpected contact.

Sign was important to these wilderness wanderers for economic reasons as well. Unlike the pre-European Native Americans who derived their weapons and tools from local materials, these newcomers had to purchase their Kentucky rifles, metal knives, metal axes, metal cookware, and the steel traps they used to catch furbearers. Despite their reputations as free agents, most of them were economically tethered to eastern fur conglomerates. As skilled as those early trappers and hunters might have become, the differences between their abilities and those of the American Indians probably remained immense. Any lore they acquired from the Indians arose from necessity, but only supplemented European technologies they brought with them. To acquire their tools, they had to sell their goods, and this happened either at annual rendezvous held by the fur companies or at settlements such as Taos, where fur-buyers resided. Many returned to civilization after a season or two; some became guides for the American military or waves of settlers that soon rendered their wild lifestyle obsolete.

Prior to the arrival of Europeans, most American Indian tribes experienced no such separation from nature. Their knowledge of natural sign was embodied in their upbringing. Nature was who they were. Their stories, their games, their competition for mates all involved a skin-to-land contact. They did not "learn" tracking and seeing out of economic necessity; such knowledge began seeping into them from the day they crawled across their parents' threshold. For this reason, early writers such as Fenimore Cooper were hard-pressed to describe the abilities of the native; they could only acknowledge that such skills existed. We know that the natives were good at living on the land; we probably can't envision how good.

In a recent article in The American Scholar, Elizabeth Marshall Thomas describes this phenomenon in the San, or Bushmen, of Africa. She calls the area where these people ranged "The Thoroughly Studied Area," referring to the depth of knowledge the San had for the landscape within which they lived. She says they knew everything about every life-form big enough to see. She takes affront at a comment by a Harvard professor who said they "knew almost as much as we do" about their ecosystem, noting that any San teenager knew more about that ecosystem than all the Harvard professors combined. But they are talking about totally different kinds of knowledge.

By the time the brief Mountain Man era was winding down, a couple of generations of more literary nature seekers had emerged. Henry David Thoreau, John Muir, and John Burroughs all trained their eyes to see detailed relationships within nature. Theodore Roosevelt contributed his brand of nature adventure and hunting stories. None of these specialized in tracks or tracking, but tried instead to describe in words the interactions of plant and animal species.

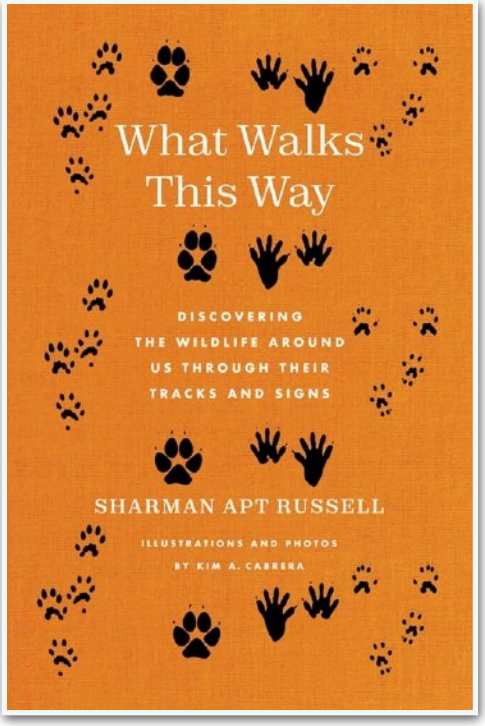
One exception was Ernest Thompson Seton, who as a youth growing up on the Canadian prairie, taught himself to interpret sign. When Seton began to write, some of his contemporary naturalists, especially Burroughs and Roosevelt, doubted his observations and accused him of nature faking.

They were skeptical of animal stories based upon his drawings of tracks. This was exacerbated by Seton's tendency to fictionalize and anthropomorphize his animal characters. But Seton was an honest observer, and he wanted readers to relate closely to the animals he knew via the marks they left on the land. Making his animal characters sentient made them more interesting. Drawing sign, depicting stories written in the dirt by the animals themselves, was his way of displaying evidence. Seton ultimately brought study of tracks, sign, and Indian lore into the program of a precursor to Boy Scouts. Through the first three quarters of the 20th Century, Scouting was about the only place youth was likely to be introduced to tracking.

On the whole, however, tracking remained the realm of hunters and trappers. Some of these, like New Mexico's Ben Lilly and the Evans brothers, or Arizona's Goswicks and Lees, became extremely good at following tracks of bears and mountain lions through the Southwest's dusty landscapes. These men used trained hounds to trail and tree their quarry, but when the dogs bogged down, the hunters could visually follow faint and shapeless smudges over hardened land surfaces until scent freshened up and the dogs could trail again. During my early years I carried out mountain lion research in Arizona, I was privileged to watch and learn from these hunters, and to bring their skills to bear upon field research.

But none of us – early eastern woodsmen, mountain men, latter day houndsmen or biologists learned to identify, much less follow, sign of most of the species present where we lived and worked. We were specialists with special reasons to see particular sign. Few, if any, of us might stop to distinguish a ringtail track from that of a weasel. Certainly none could tell the difference between tracks of a *Peromiscus* and a *Perognathus*. I'll confess that such blanks in knowledge become an embarrassment, when you have biology degrees and do research for a wildlife agency. Tracking was not in the curricula of any of the colleges I attended. Amazingly, such a basic skill is rarely, if ever, part of biologists' job descriptions. Let us hope the pros aren't too proud to avail themselves of the kind of training Sharman describes in her new book, *What Walks This Way*.

I'm not sure when the first tracking field guide was published. The earliest in my library is Joseph Brummer's *Tracks and Tracking*, printed in 1929. Brummer's book is slanted toward hunters and repeats some of the myths of that period. Ellsworth Jaeger's *Tracks and Trailcraft* was published in 1948. Jaeger acknowledges Brummer's book, as well as the help of Seton. Jaeger was clearly an artist-naturalist like Seton. He draws and describes sign and



behavior of mammals, birds, reptiles and even crustaceans, mollusks, and insects. He also discusses keeping journals, making plaster casts and other recording methods and even presents ideas about children's tracking games. To someone with the in-depth training available to modern tracking devotees, as described by Sharman, the writings of Brummer and Jaeger might seem superficial and in some cases, wrong.

Shortly after Jaeger's book came Olaus Murie's *A Field Guide to Animal Tracks*, one of the enduring Peterson field guides. Murie was a natural scientist and brought a new rigor to his track descriptions and sketches.

Seton's own *Animal Tracks and Hunter Signs* was published posthumously in 1958, 12 years after he died. My copy disappeared some time ago, so I can say little about the book. Other tracking manuals have since been published, culminating in the fine series illustrated with high quality photos by Mark Elboch and his coauthors. Also, Louis Liebenberg and his peers have revealed a long and different tracking tradition in Africa. Sharman brings these experts from the dark continent into view.

Even in tracking, technology rears its head. There are now tracking apps for smart phones and a whole digitized process call Cybertracker. As Sharman demonstrates in her enjoyable ramble through the world of citizen trackers, simply learning the tools and technology of tracking has become an end in itself.

I suspect that some people take to tracking more easily than others. The disjunction between nature writers like Thoreau, Burroughs, and Muir and artist naturalists like Seton and Murie perhaps bespeaks a difference in the kinds of minds that interest themselves in nature. By the time I entered kindergarten, for example, I knew that some kids were artistically talented and that I wasn't one of them. Any connection between my eye and my hand was tenuous at best. However, once I practiced writing to the point I could keep a sentence on the page, I found that I could do pretty good at answering written questions. My report cards said I had "good verbal skills." Later, writing essays in high school wasn't all that hard, and college term papers rescued me from mediocre semester grades more than once. I struggled in classes where I had to memorize shapes and colors – art, plant taxonomy, mammalogy, ornithology, etc. What was that visual clue? And if I memorized it verbally, could I actually find it on a specimen.

Recently, I found online discussions that distinguished between lexicoders and opticoders – verbal thinkers and visual thinkers. I'm not certain how solid scientific evidence might be to support these differences; in truth, I'm not sure the dichotomy is all that clear, but for the present, the idea serves as an excuse for my

inadequacies. Lexicoders supposedly record knowledge in words; opticoders recall pictures. One author claimed that about 32 percent of the population is born with a visual brain and decodes the world through visual images rather than verbal description. They supposedly store knowledge in mental slide trays and movie reels. For them, speech, reading, spelling, and writing can seem cumbersome and slow.

But to get thoughts into and out of the brain, even opticoders must use words. The cliché, "one picture is worth 1000 words" is a motto of opticoders; it might be rewritten for people like me, "one picture requires 1000 words."

If the above theory is correct, the extreme opticoders will look at a track, their mental camera will go "click," and they'll ask, "what's next." Could be they'll pass to level one or level two in tracking classes first time around – if they can remember the written name associated with that image of that little brown mouse and its tracks so clearly pictured in their mind.

I'm an extreme lexicoder. I'll be trying to dredge up the lengthy verbal description: toe number, measurements, special identifying traits, none of which bring forth a mental image to compare with the shape I'm viewing on the ground. And field guides, bless them, don't always help. My lexicoder doesn't automatically overlay the drawing or photo in the field guide upon the track on the ground. Unless I can get some descriptive context – what was the animal doing and where? – I'm likely to screw up on the commonest of tracks. This exhibits itself most often when people send me photos to identify. My biologist friend and accomplished tracker Christine Hass is, I'm sure, disgusted with me over the times she's said (or implied), "it's a raccoon, dummy," when I've forwarded her a picture. Describe for me the track in context – habitat, track line, pattern, etc. – and the identity becomes clear.

As an octogenarian who once felt proud to teach field courses about sign of mountain lions and led crudely conceived track surveys for that species, I am overwhelmed by this new tracking paradigm that Sharman describes. I'm also envious. Youth interested in reading sign today will have no trouble finding mentors, tools, and institutionalized training to become recognized trackers. If such don't already exist, college credits, perhaps degrees, in tracking and sign seem likely. Tracking can no longer be called a primitive art. It is becoming a modern tool that has developed concurrently with the concept of citizen science.

I find this especially heartening, because it counters a trend in wildlife studies over which I've become concerned – the unrestrained and perhaps unprincipled application of technology and statistical modeling. Modern wildlife management and research has become increasingly invasive. From harassment by helicopters surveying or capturing bighorns, to recording trail camera arrays that spy on the mountain lion's daily life, to radio telemetry devices attached to animals and sending signals to computers via satellites, machines have become more of a presence in the wild. Species are increasingly hounded by the tools that are supposed to help them survive the encroachments of modern humanity; and such intensive management is blurring the distinction between wildlife and domestic stock. Drones now hover over nesting birds or peer into holes of squirrels. At the same time biologists spend more time in front of their computers and less outside in skin contact with the environments of the species they study.

These modern technologies produce great volumes of data; in many cases more than will ever be analyzed by biologists initiating the studies. Such data can pass directly from radio-collar or camera to the computer, relieving the biologist of clear understanding of the equations buried in complex models. And too often, applying the latest high-tech tools may drive the study, bypassing clearly thought out questions that might be answered by simple observation. All the while, studies of small and inobtrusive species having no economic value or having physiognomy that doesn't lend itself to attachment of some new grant-worthy device, go undone.

I have to acknowledge guilt in that my generation of biologists was the first to start using helicopters and radio-tracking technology. We were heavy handed in catching and marking creatures. Considering we still seem to be fighting the same environmental conflicts now that we were fighting 50 years ago, I wonder if anyone is reading and assessing the effects, the value, of our research. In fact, I wonder who would be qualified. Certainly not the politicians who regularly assume the job through the lenses of party prejudice.

Amidst such personal, old man, grumblings, I found a quiet pleasure in reading Sharman's book about lay naturalists who are developing simple, nontechnological skills seldom used by institutional biologists. These are hobbyists, in the field for the sheer pleasure of learning, and they use simple, noninvasive tools. They ask questions about species for pleasure. They operate below the radar of ecologically ignorant politicians. Should they choose to become activists and represent some inobtrusive and sensitive creature, they can do so with data in hand, but I hope this never becomes their primary reason for studying tracks and sign. Rather, may their purpose remain simple study and sharing knowledge with good companions in an activity wherein learning will never cease.

Stalking *Orobanche multiflora*

by L. Turner Collins

Orobanche multiflora was described by Thomas Nuttall in 1848 from the collections of William Gambel from an 1840 collection near Santa Fe, New Mexico. The epithet has been retained in the Flora of North America despite the nomenclatural shifting between the genera ***Orobanche***, ***Myzorrhiza***, and ***Aphyllon***. I became aware of the species early in my botanical training.

It was the spring of 1965 as I was trudging through the sand dunes of Winkler and Ector Counties, Texas, collecting specimens for a floristic

survey. I had just started my graduate program at Texas Tech, and this was my thesis project. I was totally unaware of flowering plant root parasites at the time, when I stumbled upon the first specimens of *Orobanche*. My mentor pointed me to the work of Philip Munz (1930) for identification. I found the key puzzling and had difficulty deciding what I had collected. I eventually decided that I had collected *Orobanche ludoviciana* Nutt. and also *Orobanche multiflora* Nutt., a decision I would later regret.

This first experience led to my decision to study the genus for my doctoral studies. In the summers of 1968-69, I travelled throughout the western states collecting specimens. I zeroed in on *Orobanche ludoviciana* because it was widely distributed and seemed to be ill defined in the literature as illustrated below.

Munz 1930 monograph treated *O. ludoviciana* and *O. multiflora* as two species, each with four varieties;

O. ludoviciana
- variety *typica*
- variety *cooperi*
- variety *latiloba*
- variety *valida*

O. multiflora
- variety *typica*
- variety *pringlei*
- variety *arenosa*
- variety *xanthochroa*

The first issue was the nature of the corolla lobes in the two species; *O. ludoviciana* was defined by pointed corolla lobes while *O. multiflora* was defined as having rounded corolla lobes. In fact, both species have rounded corolla lobes. This was clarified in my description of *O. riparia* (L.T. Collins et al. 2009), which was originally described in my PhD dissertation. Munz had used a specimen of the then undescribed *O. riparia*, which has pointed corolla lobes, for the illustration of the corolla of *O. ludoviciana*. Many state and local floras still indicate the corolla lobes as pointed.

Subsequently, the list of varieties for *O. ludoviciana* has been "whittled down" to zero. *Orobanche cooperi* is now recognized as a desert species with three subspecies, *cooperi*, *latiloba*, and *palmeri*. *Orobanche valida* is a narrow endemic occurring on a few mountain slopes in Calif–ornia. And, surprisingly, *O. multiflora* variety *arenosa* is now combined with *O. ludoviciana*, sometimes given varietal or subspecies status, as in *Flora of Pacific Northwest*.

This left *O. multiflora* with only three varieties. Variety *xanthochroa* was

based on a specimen of *Conopholis alpina* Lieb. so it was reduced to synonymy. Variety *pringlei* remains questionable because the only specimens cited are those in Munz's 1930 monograph and this varietal name has not been widely used by taxonomists. Unfortunately, my earlier opinion, based only on the corolla lobes, led me to conclude that this was one species which I retained as *O. ludoviciana,* with *O. multiflora* as a subspecies.

This whole scenario was reviewed during the preparation of the treatment of *Orobanche* for the *Flora of North America* Project. The binomial *O. multiflora* was retained without varieties or subspecies. The two species are easily distinguished with *O. multiflora* having larger corollas (22-45 mm) and *O. ludoviciana* with slightly smaller corollas (14-20 mm). In addition, *O. multiflora* has wooly anthers with a tuft of hair at the base of the filament. The geographic distribution was determined to be southern Colorado, eastern New Mexico, extreme western Texas, with a possible outlier population in extreme southern Texas and a few other locations.

Changing A Website Entry - *Orobanche ludoviciana* subsp. *multiflora* to *O. multiflora*

by Bob Barnes

Trying to ensure that The Black Range website is accurate and reflects our current knowledge of the natural history of the Black Range is a task. That effort often takes me into the depths of the unknown - not only what I do not know (a very special and extensive type of unknown) but also into topics of natural history which are evolving, in dispute, or simply do not fit into a nice little box. The Black Range community helps greatly in this endeavor.

In late January 2024 Dr. L. T. Collins offered some support in a particular case. Dr. Collins may be the expert on *Orobanche* and has worked diligently to parse the genus.

In 2018, I had made an entry in the flora photo gallery of the Black Range website for a plant I identified as *Orobanche ludoviciana* subsp. *multiflora*. The photographs on this and the following page, from the Percha Box east of Hillsboro on August 2, 2015, were the basis for that entry.

Dr. Collins pointed me to his current work in *Flora of North America* and the elevation of *O. ludoviciana* subsp. *multiflora* to full species status (*O. multiflora*). I found our email

dialogues over the next few months to be both interesting and edifying.

At the end of those deliberations, I could have simply changed the species name in the photo gallery and called it done. I did not wish to lose the insight which Dr. Collins had provided, however. In the end, I kept my original entry for the species with annotations to bring it up to date and to include the knowledge that Dr. Collins had generously shared. On the following page I repeat the website entry as it now stands with some annotations which explain in further detail why I considered the entry to be important.

In reading this entry you may notice bits of information which do not appear to be consistent. I think this is most notable in the discussion of the distribution (range) of the plants under discussion. Much work has been done to determine the range of the two subspecies in the USDA range maps shown, but there are times when there simply are not data to support such determinations. A finding that *Orobanche multiflora* (or in the case of the map, *O. ludoviciana* subsp. *multiflora*) is found in Socorro County but is not found in Sierra County should be read to say that (these photographs aside) the species has not been found in Sierra County. The same is true of efforts to conform range maps to historical records. E. C. Merton's collection in Guadalupe Cañon, for instance, should be viewed through the same lens. Dr. Collins pointed out that "our" specimen was at the far western edge of the species range.

The years of effort Dr. Collins has put into understanding this genus is noteworthy. But for me his comments are

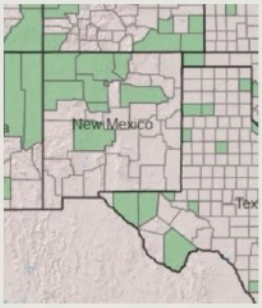
Orobanche multiflora
Many-flower Broomrape
Percha Box, East of Hillsboro, New Mexico, USA
August 2, 2015

When we originally published this entry (June 2018) we identified this plant as *Orobanche ludoviciana subsp. multiflora* (Louisiana [Many-flower] Broomrape. The most current version of Flora of North America (2020) identifies this plant as *Orobanche multiflora*. We have retained our original entry (below) with annotations (SHOWN IN COPPERPLATE FONT IN RED) to bring it up to date. We believe this treatment is useful in clarifiying the taxonomic determinations of this species over time. Our sincere thanks to Dr. Turner Collins for bringing the current taxonomic determination to our attention and for his work on the Flora of North America.

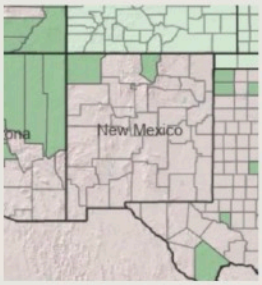
Sometimes a chance encounter can take you aback and cause a moment of reflection. That happened to me on August 2 of this year (2015) as I walked near the Percha Box, east of Hillsboro. I had been walking in the stream bed, jumping across the rivulets of water when I could and wading across when I could not. It had been raining all afternoon in the Black Range to the west and the falling water was getting closer and I was afraid that the running water that would go with it might be coursing down the creek at this very moment. Up on the bank I went, walking along a cow path and there in the sandy soil, on a bank that could wash away in any high water event, was a Many-flower Broomrape, *Orobanche ludoviciana* subsp. *multiflora*. (SEE REVISION OF TAXONOMIC DETERMINATION ABOVE.) Just as I started to take photographs of the Broomrape and its sibling nearby, the rain came, my hat came off to cover the camera and hat and camera went under my shirt for added protection. Then I trudged off up the stream, bent over to provide a bit more protection for the electronics, water streaming off the end of my nose.

As I walked along the stream, I mulled the life of a parasite - I'm not talking politics here. In many ways it is a difficult way to exist, the parameters of existence are so strongly defined by another being. When I am wet and slogging through sand and water I am prone to think about such things, I mean, no one else will... Well, in this case *Artemisia carruthii* (Carruth's Sagewort or Sagebrush) which is a primary host of this broomrape, seems to be doing okay.

The common name of this species is Louisiana Broomrape (it is also the name of the nominate subspecies), as opposed to Many-flower Broomrape which is the name of the subject subspecies - there are only two subspecies. Its range extends south into Mexico. (AS NOTED ABOVE, THE CURRENT TREATMENT FOR THIS SPECIES IS OROBANCHE MULTIFLORA AND THERE ARE NO RECOGNIZED SUBSPECIES - BUT SOME AUTHORITIES HAVE DESCRIBED [UP TO] FOUR VARIETIES. IT WOULD APPEAR THAT THE COMMON NAME, MANY-FLOWER BROOMRAPE, IS APPROPRIATE FOR THE PLANT FOUND HERE.)



The range map to the right (top) is from the USDA Natural Resources Conservation Service and shows the range of the subject subspecies. *O. l. multiflora* was initially described by Thomas Nuttall, as *Myzorrhiza multiflora*, it now has several scientific synonyms. Both subspecies are found in New Mexico so it is not possible to parse the subspecies range from the first map. (THE TOP RANGE MAP [AS OF MAY 2024], OF O. L. MULTIFLORA, SHOWS THE PLANT OCCURRING IN SOCCORO COUNTY BUT NOT SIERRA COUNTY. THE BOTTOM RANGE MAP (5/24), OF O. L. LUDOVICIANA, INDICATES THAT THIS SUBSPECIES IS FOUND, IN NEW MEXICO, ONLY IN THE FAR NORTH. AS OF MAY 2024 THE U.S.D.A. SITE, THE VASCULAR PLANTS OF THE GILA SITE, AND OTHER SITES [LIKE THE LADY BIRD JOHNSON WILDFLOWER CENTER] DO NOT SPLIT O. LUDOVICIANA INTO TWO SPECIES.)



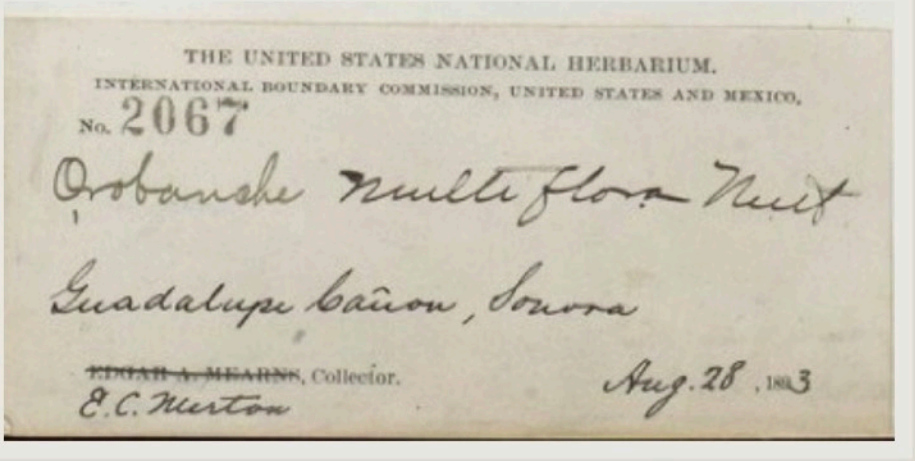
Some people have roasted the roots and young stems of this species to eat and it has been prepared and used as a dressing for wounds and a treatment of ulcerated sores. In this case, especially, care should be taken before eating or using this plant. Parasitic plants absorb a variety of substances from their host (in this case, members of the Aster family in general and the genus *Artemisia* specifically), creating a substantial uncertainty about toxicity (among other things).

The specimen sheet shown below has a specimen collected in Sonora as part of the survey for the International Boundary Commission of the United States and Mexico, on August 28, 1893. The specimen was collected by E. C. Merton in Guadalupe Cañon (a very famous birding area). (NOTE THAT THE CURRENT U.S.D.A COUNTY LEVEL RANGE MAP DOES NOT SHOW THIS SPECIES IN THE VERY SOUTHEASTERN CORNER OF ARIZONA.) **In his 1907 publication "*Mammals of the Mexican Boundary of the United States*", Bulletin 56 of the Smithsonian Institution, Edgar Alexander Mearns described Ernest C. Merton's role as "acting hospital steward. U. S. Army. Collected plants between the San Pedro River and Dog Spring (Monuments Nos. 98 to 55) from August 1 to September 23, 1893." (p. 6 and again at p. 130) Merton is referenced in other parts of the report as well:**

***"On September 27, accompanied by Hospital Steward Ernest C. Merton, I rode to the forks of Cajon Bonito Creek and camped there for the night, returning to Lang's Ranch September 28, after exploring a greater extent of the upper portion of the Cajon Bonito Valley than had hitherto been done. At this period the dreaded Apache Kid's band of Indians was present in the neighborhood. On September 24 by men obtained the skull of a puma which had just been skinned by these Indians, the puma's body being still warm when the soldier's found it. Steward Merton came upon the Indian camp in a canyon on Cajon Bonito Creek on the night of September 27, but fortunately avoided observation and succeeded in reaching my camp during the night, although a severe storm was in progress and the streams swollen."* (pp. 15 - 16)**

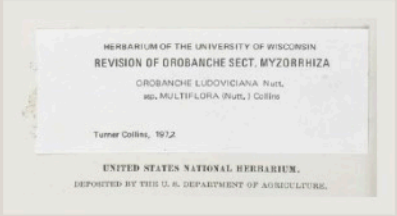
"No more were seen by me until October 3, 1893, when Hospital Steward E. C. Merton brought me another" (Colorado River Toad, Incilius alvarius, at that time described as *Bufo alvarius*) "that he had just caught at a spring situated between Monument No. 73 and Cajon Bonito Creek, in Sonora Mexico." (p. 114)

To his credit, Mearns, who is a "big name" in the natural history of this region seemingly was more than willing to give credit where credit was due. Note, for instance, that Mearns' collection sheet has Mearns name crossed out and Merton inserted.


THE UNITED STATES NATIONAL HERBARIUM.
INTERNATIONAL BOUNDARY COMMISSION, UNITED STATES AND MEXICO.
No. 2067
Orobanche multiflora Nutt
Guadalupe Cañon, Sonora
~~EDGAR A. MEARNS~~, Collector.
E.C. Merton
Aug. 28, 1893

There is little else known about Merton (that I have found). But for the willingness of Mearns to recognize the efforts of others he would be just another lost name in history.

(In January 2024, Dr. Turner Collins, brought the current Taxonomic determination in Flora of North America to our attention. In 1972 he had made the entry to the right on the specimen sheet shown below. In January 2024, he noted "My opinion changed as I studied the genus, and my current treatment of O. ludoviciana and O. multiflora is in vol. 17 of Flora of North America. They are definitely different species and can be distinguished easily by anther pubescence and corolla size. There is also DNA evidence to support the distinction . . . The type specimen for Orobanche multiflora is lost. I have searched all herbaria in the U.S. where such a type might exist, and none has been found. Kew has been searched by several different individuals on my behalf, and none was found. Of interest here, is that Nuttall's holotype for Orobanche ludoviciana is at the Philadelphia Academy . . . When Holmes & White published O. ludoviciana susbsp. (multiflora) as a new combination, they designated a lectotype from south texas . . . [but] Gamble collected the type speciment that Nuttall used in New Mexico somehwere near Santa Fe." [Personal Correspondence Collins/Barnes January 24, 2024])


HERBARIUM OF THE UNIVERSITY OF WISCONSIN
REVISION OF OROBANCHE SECT. MYZORRHIZA
OROBANCHE LUDOVICIANA Nutt.
ssp. MULTIFLORA (Nutt.) Collins
Turner Collins, 1972
UNITED STATES NATIONAL HERBARIUM.
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especially noteworthy for several other reasons. His acknowledgement that after all of that research, his initial determinations should be changed is something we should all aspire to. That is the process of science; I am not talking about scientific method or other methodologies here, I am talking about the recognition that with experience and time our knowledge grows and changes.

This exercise also highlights issues associated with changes in taxonomic determinations. Sometimes there are disagreements about what those determinations should be and as a result, different references will cite different findings. Sometimes there is simply a lag in the dissemination of information. In such cases, there may not be disagreements about the determinations, it is simply a matter of getting all references up-to-date, and that - as in changing a species name in a photo gallery on an obscure website demonstrates - can be a task.

HERBARIUM OF THE UNIVERSITY OF WISCONSIN
REVISION OF OROBANCHE SECT. MYZORRHIZA
OROBANCHE LUDOVICIANA Nutt.
ssp. MULTIFLORA (Nutt.) Collins
Turner Collins, 1972
UNITED STATES NATIONAL HERBARIUM.
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In the last two issues of the Black Range Naturalist James Von Loh shared his experiences with Long-tailed Tadpole Shrimp (Tadpole Shrimp) during the first few months of the summer. Here he continues his photo-documentation of other visitors at the pond.

Visitors to the Dripping Springs Visitor Center Pond (2023)

By James Von Loh

During the spring and summer months of 2023, three temporary pond events occurred when storm-water runoff was collected from the Dripping Springs Visitor Center, Organ Mountains - Desert Peaks National Monument. Temporary ponds occurred when monsoon rain fell in sufficient amounts to fill the bottom of a stormwater runoff basin (covering ~0.07 acre in terms of surface area and at depths of <1" to ~10").

Long-tailed Tadpole Shrimp, *Triops longicaudatus* (LeConte, 1846), populations emerged and completed life cycles in both the 2nd and 3rd temporary ponds of 2023.

Several pond-visiting sparrow species were not predators of Tadpole Shrimp during my visits to photo-document various behaviors, although each would be capable of capturing them. Here, I am presenting the sparrow and other bird species observed drinking water, perching, and bathing over a period of days in the 3rd ponding event.

Two Photos Above: Clay-colored Sparrow, *Spizella pallida* (Swainson, 1832) wades at the pond's edge to drink. 09/26/2023 and 9/29/2023

Bottom Left: House Finch, *Haemorhous mexicanus* (Muller, 1776). Perching on a small rock, it raises its head to swallow a beakfull of water from the dwindling pool.

Bottom Right: House Finch walks on shoreline mud and over the drying carcasses of Tadpole Shrimp to reach the small pool of water. 09/30/2023

Above and Right: Brewer's Sparrow, *Spizella breweri* (Cassin, 1856) perches near the pond in a Honey Mesquite, *Prosopis glandulosa* (Torr.). Birds nearly always perched prior to landing at the pond. 09/19/2023

Below: On 09/27/23.

Harley Shaw Noted: "During the late 1960s and early '70s, I was doing habitat studies on Merriam's wild turkey near the South Rim of the Grand Canyon in Arizona. Water was scarce in this dry ponderosa pine forest area, and wildlife was highly dependent upon rainwater catchments and earthen dam stock tanks. Except for short periods after heavy rains or after spring snowmelt, the area had almost no natural water sources. Part of my study involved regular checks of condition of catchments and stock tanks. One of the largest and most reliable stock tank was called Lockett Lake. Lake was a misnomer – it was a constructed stock tank, but it was bigger than most of the others in the area, so was given the status of 'lake'. It was shallow, taking up a wide, open basin, but turkeys regularly watered there. Part of my routine involved walking around the muddy edge and documenting turkey usage, which was consistent but moderate.

One day, however, the muddy border of the tank was a mass of turkey tracks, encircling the entire tank. The big birds had obviously been wading out into the water, something they didn't do when they came in to get a drink.

I quickly discovered that the tank was alive with small invertebrates that, at the time, I couldn't identify. You guessed it – it was a virtual irruption (a sudden increase) of a tadpole shrimp population and the turkeys were taking advantage of the situation.

I only observed this once during the 6 years or so that I worked in that area, but there was no doubt that the big birds savored the shrimp."

Lark Sparrow, *Chondestes grammacus* (Say, 1822), one of the largest sparrow species, was a regular visitor to the pond during September.

It was not just about food and drink as the bathing Chipping Sparrow, *Spizella passerina* (Bechstein, 1798) shown below demonstrates. September 30, 2023

Vesper Sparrow, *Pooecetes gramineus* (Gmelin, 1789), like the other species depicted in this article, seem to be attracted to the pond more by water than by food. They would often perch on small shoreline rocks and survey the pond for danger before drinking. September 2023

Shown on this and the previous page Western Tanager, *Piranga ludoviciana* (Wilson, 1811) were common visitors drinking from the pond. Some like the individual shown at the upper left on the previous page preferred to perch and drink from emergent twigs at the shoreline. 09/26/2023

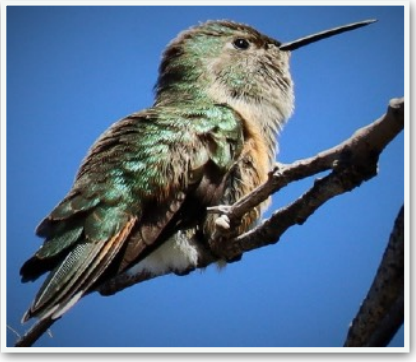
Previous Page, Center Left: Relatively large birds, they often waded in shallow water while drinking; however, I never observed or photo-documented them feeding on Tadpole Shrimp. Some did aggressively chase dragonflies, although I never witnessed a capture. 09/29/2023

Previous Page, Bottom Left: Western Tanager (near) size and coloration comparison with a Lesser Goldfinch as both drink water from the pond edge while standing on/among desiccating Tadpole Shrimp carcasses. 09/30/2023

All the rest: An adult flies in to feed its prodigy.

As always happens in photo-documentation surveys and studies, species are observed, but for whatever reason, couldn't be photographed or the images are too blurry to use. Gambel's Quail, *Callipepla gambelii* (Gambel, 1843) was one such species Rarely, a covey would rest in the shade of or roost overnight on the branches of small trees growing from the southern pond bank. They likely drank water from the pond and do have a varied diet that could include Tadpole Shrimp. Also of note is that I did not observe raptors hunting over this pond, surprising because of the number of animals using this site for water and forage.

Above: Rufous Hummingbird, *Selasphorus rufus* (J. F. Gmelin, 1788) perched in a small tree on the southern pond bank and made periodic flights over the pond to capture tiny insects (I did not observe them drinking water from the pond); it would not use Tadpole Shrimp as a food source. 09/16/2023



Right Top: Townsend's Warbler, *Setophaga townsendi* (Townsend, 1837) (L) and Lesser Goldfinch (R) size and coloration comparison (don't be fooled, the warbler is further away, and notably larger than the tiny finch).

Two Photos at Right Center: The Townsend's Warbler was a one-time visitor (09/30/2023), joining a small group of Lesser Goldfinch at the pond edge, to walk in the saturated mud to access drinking water and bath in the shallow pool among hundreds of Tadpole Shrimp individuals, which they did not use as a food source. 09/30/2023

Center left: Broad-tailed Hummingbird, *Selasphorus platycercus* (Swainson, 1827), perched in a small tree on the southern pond bank and made periodic flights over the pond to capture tiny insects (I did not observe them drinking water from the pond); it would not use Tadpole Shrimp as a food source. 09/30/2023

Bottom Left: Ruby-crowned Kinglet, *Corthylio calendula* (Linnaeus, 1766) actively hunted insects in small trees on the southern pond bank (I did not observe them drinking water from the pond); it would not use Tadpole Shrimp as a food source (10/01/2023)

Below: Lesser Goldfinch, *Spinus psaltria* (Say, 1822) nearly always arrived at the water's edge in small flocks or family groups, with plenty of activity to observe! Places with small rocks were consistently selected for perching (and for drinking if their beaks could reach the water). They would be unlikely to select Tadpole Shrimp as a food source. 09/28/2023

Below: Orange-crowned Warbler, *Leiothlypis celata* (Say, 1822) visited the pond edge to drink water (note droplet on beak), most often where twigs emerged from the water surface. I did not observe this species using Tadpole Shrimp as a food source. 09/28/2023

Top Next Page: Lesser Goldfinches would flock to the water.

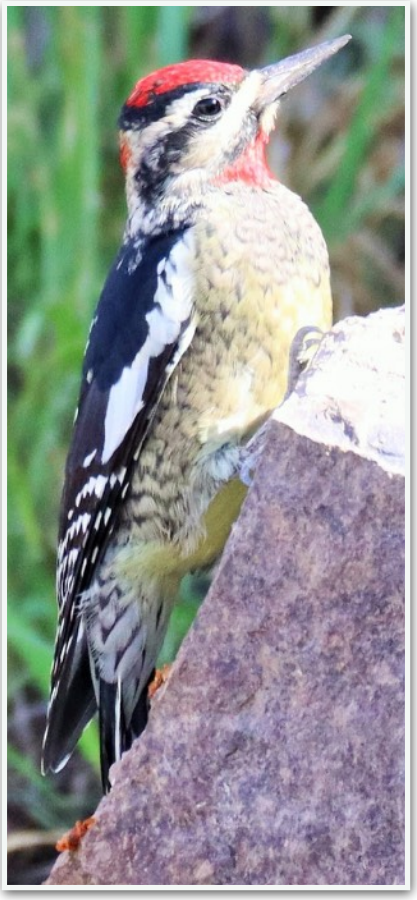
Above and Below: Orange-crowned Warblers would wade along the edge and also spend time perching on adjacent tree branches (Western Hackberry shown) and gleaned through the foliage for arthropods.

Center Right: Even with foreshortening, the Vesper Sparrow (back) appears huge when compared with the Orange-crowned Warbler (near). 09/27/2023

Following Page, Left Column (Top 4 photos): Yellow-rumped Warblers, *Setophaga coronata* (Linnaeus, 1766) spent most of their time gleaning arthropods from tree branches and leaves. They typically flew to water in small groups and would often drink from small pockets of gravel where, perhaps, the water was a bit clearer than the sediment-laden water in the rest of the pond. I did not see this species use Tadpole Shrimp as a food source. (09/27/2023)

Directly Above and Top Center: Say's Phoebe, *Sayornis saya* (Bonaparte, 1825) perched in small trees along the south bank of the pond and flew/ hovered over the pond to hunt insects; I would expect it to occasionally drink water, but doubt it would feed on Tadpole Shrimp. 09/29/2023

Center and Top Right: Red-naped Sapsucker, *Sphyrapicus nuchalis*,



perched on a rock anchoring the pond bank and hunted for insects on the small trees growing from the southern bank, and would occasionally fly to the pond edge to drink. They are documented feeding on odonates and arthropods, so possibly could use Tadpole Shrimp as a food source. 09/28/2023

Above: Northern (Red-shafted) Flicker, *Colaptes auratus cafer* (Linnaeus, 1758). Gordon Berman contributed this beautiful image of a flicker perching in a Western Hackberry tree growing from the southern pond edge in 10/2023. I had observed only one hunting in these trees and flying over the pond but never landing to drink water.

Left Column, Following Page: Mourning Dove, *Zenaida macroura* (Linnaeus, 1758) were common visitors throughout each day, drinking water from the pond and gleaning seeds from the bank. While hunting for seeds on the muddy pond shoreline it would be possible for them to pick up desiccating Tadpole

Shrimp carcasses, but I did not observe that foraging behavior. 09/26-30/2023

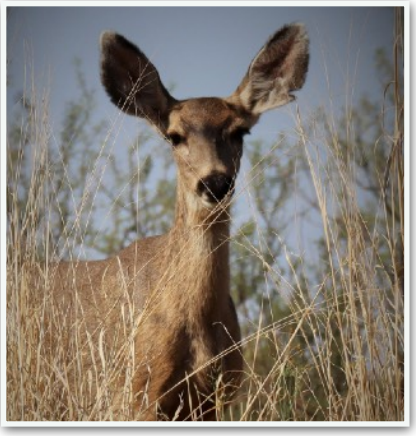
Mourning Doves always kept a wary eye on me as they drank from the pond; other dove species are also common in this area but I did not observe them at the pond. They commonly arrived in small flocks and drank water from the pond edge.

Above and Below: Loggerhead Shrike, *Lanius ludovicianus* (Linnaeus, 1766), occurred rarely at the pond, perching in the small trees established along the southern pond bank; they use the perch to capture a wide variety of food including lizard species and I consider them to not be a predator of Tadpole Shrimp. 09/29/2023

Bottom Center and Two at Top Right: Northern Mockingbird, *Mimus polyglottis* (Linnaeus, 1758) are common omnivores nearly always observed perching in small trees

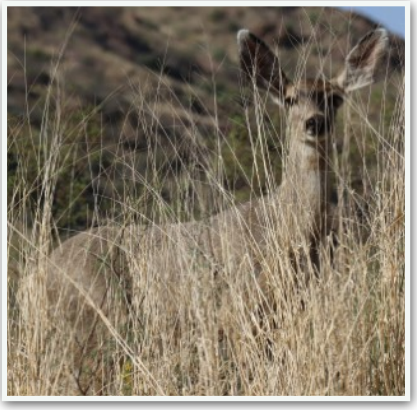
established on the southern pond edge. Typically they forage on small flying insects and drink water from the pond. They would be easily capable of capturing Tadpole Shrimp for food, but I did not observe them doing so. 09/27/2023

Above and Top Left of Next Page: Greater Roadrunner, *Geococcyx californianus* (Lesson, 1829) hunted around and drank water from the pond. I mostly observed them catching grasshoppers and believe it would be reasonable to assume that they use live Tadpole Shrimp as a food source, but I did not observe that behavior. 09/26/2023



Above and Next Two: Non-avian species also used the pond including the Mule Deer, *Odocoileus hemionus* (Rafinesque, 1817). They rely heavily on ponded water when it is available; their large tracks sink deep into the mud and the shallow water, accelerating evaporation and directly stepping on and/or burying living Tadpole Shrimp. 09/29/2023

Directly Above and Top of Center Column: They were expert at using the tall Switchgrass flowering panicles produced in 2022 as a screen when approaching the water to drink. Typically, they visit the pond in early morning and late evening hours. When a potential predator is present (me) they warn off others with a loud snort, foot stomp, and then bounce away landing all four hooves at once, clattering on the loose rock and gravel surface.



Directly Below: Medium-sized canid paw-print in drying pond mud shows claw marks and suggested to me a Coyote, *Canis latrans* (Say, 1823) visit; this species would drink pond water, forage in the area, and is fully capable of using Tadpole Shrimp as a food source. 09/30/2023

Directly Below: Reakirt's Blue, *Echinargus isola* (Reakirt, 1867) takes nutrients from a Tadpole Shrimp larval skin molt lying exposed on the shoreline, probably by wave action during a windy period. 09/24/2023

Most butterfly visitors to this temporary pond arrived individually or formed small puddle clubs to take nutrients, including minerals, from saturated soil and mud adjacent to the water.

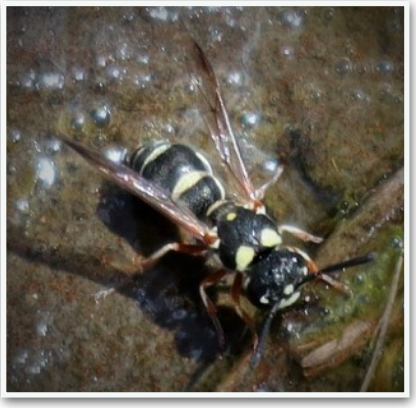
The recently dried temporary pond, filled with Mule Deer tracks, buzzed continuously with species of flies, bees, and wasps attracted to desiccating Tadpole Shrimp carcasses, vegetation/algae, and damp soil and moist mud.

Above: Bristle Fly, *Belvosia* sp. (Robineau-Desvoidy, 1830) forages from saturated mud surface as the pond dries. 09/29/2023

Below: Typical Flesh Flies, Subfamily *Sarcophaginae,* foraging from saturated mud while perched on a Tadpole Shrimp carcass lying on the drying/cracking former pond bottom. 10/01/2023

Above and Top Left of Next Page: Screwworm Fly, *Cochliomyia* sp. (Townsend, 1915) forages from saturated mud and on/among

Tadpole Shrimp carcasses lying on the drying/cracking former pond bottom. 10/01/2023



Above: Potter Wasp, *Parancistrocercus* sp. (Bequaert, 1925) taking water and nutrients from saturated plant material/algae on the moist pond bottom. 09/26/2023

Below: Golden Paper Wasp, *Polistes aurifer* (Saussure, 1853), taking water and nutrients from shallow water, algae, and mud, both as forage and to provide nest-building materials. 09/26/2023

Top Right and Center: Yellow-legged Mud Dauber Wasp, *Sceliphron caementarium* (Drury, 1773) appears to stand on its head to form and collect a large, smooth pellet of moist mud from the temporary pond margin. It then secures the mud pellet and prepares to fly to its den. 09/19/2023

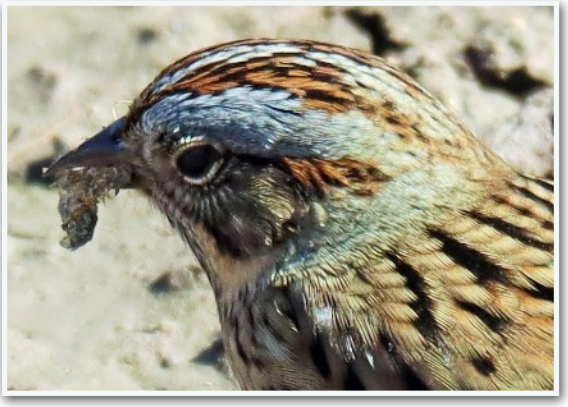
Next Page, Top Left: Thread-waisted Sand Wasp, *Ammophila* sp. (W. Kirby, 1798) rapidly hunts and forages on moist soil at the edge of a wallow. 09/27/2023

Next Page, Center Left: Tarantula-hawk Wasp, *Pepsis* sp. (Fabricius, 1804), large wasps to 2" long, crawled across and used short flights, to quickly search the damp and cracking pond bottom, presumably for moisture and possibly to forage. 10/01/2023

Directly Above: Western Honey Bee, *Apis mellifera* (Linnaeus, 1758), as the temporary pond surface dries and cracks, crawls deep into Mule Deer tracks to find saturated mud and nutrients. 10/01/2023

Bottom Row: Once your eyes adjust to the dark forms scurrying across the drying temporary pond surface many large, dark red, Barbatus Group Harvester Ants (*Pogonomyrmex barbatus x rugosus*) inspect the desiccating carcasses of Tadpole Shrimp, perhaps to forage individually but also to collect food for their colony. 10/01/2023

Next Page: Which brings us back to the birds and and a return to the role of Lincoln's Sparrow, *Melospiza lincolnii* (Audubon, 1834) which we explored in the last issue. It was attracted to the drying pond surface and scavenged desiccating Tadpole Shrimp carcasses as a food source, extracting them from moist mud.



And let us not forget the Chipping Sparrows, like the one directly above.

Editor's Note: This completes a three-part series centered around Long-tailed Tadpole Shrimp and the Dripping Springs Visitor Center Pond. As I worked with this material I was constantly reminded of Gilbert White's, *The Natural History and Antiquities of Selborne*. I came to that book, one of the first and greatest studies in the natural history of a specific locale, late in life and it had a profound effect on how I view the world. My congratulations to Jim on this series.

The Lichens Among Us – A Lichen Primer

By Nichole Trushell

Lichens have always fascinated me. Even as a child, I noticed the brilliant colors on granite boulders I climbed, the varied leafy decorations on bark, and the thread-like clusters on branches. When considering my focus for graduate school, I explored lichenology classes and research. I completed identification of over 100 species from all over Arizona and learned a great deal. But the *Cactaceae* ultimately won me over. However, knowing there is such fascinating diversity, lichens continue to hold my interest.

When considering ecological diversity, lichens are often overlooked. This is a sad reality given that there are over 3,600 species of lichens in North America alone, with around 14,000 species in the world. Found in ecosystems from the poles to the tropics, they are beautiful, abundant, and have a significant role in ecological succession. Bare open spaces in harsh natural environments may gradually convert to habitat for vascular plants and more complex communities by the activity of the lichens present. Lichens, with their included photosynthetic partners, contribute significant quantities of nitrogen to ecosystems. Lichens give nesting materials for birds (I have found them so lovely – in the lining of hummingbird nests) provide food for some ungulates, are habitat and cover for some insects, and they add organic matter to soils in the most extreme situations of life. With many species still unknown to science, lichens are certainly among those organisms that are under-appreciated by many naturalists, including professional biologists.

Lichens are truly unique. They do not categorize well into being a "plant." Lichens are small ecosystems made of different life forms, a fungus living together with an organism capable of photosynthesis: a green alga and/or a cyanobacterium (often erroneously called "blue-green algae"). We call these associates photobionts. None of these are plants from a biologist's point of view. The algae or cyanobacteria live within the fungus as structure, and provides the fungus with sugars made from sunlight. The whole is called a lichen thallus. Whether this is truly symbiosis, at least in all cases of lichens, may be questionable. As Trevor Goward, a lichenologist studying in British Colombia noted, lichens are "fungi that have discovered agriculture." The truth of the relationship is that algae or cyanobacteria are invaded and killed by the fungus, but their cells reproduce quickly – more quickly than they are destroyed.

A gathering of species -- with careful observation you will find at least 5 species of crustose and foliose lichens on this rock substrate north of Kingston. Photo by Nichole Trushell.

So, the idea of partnership, symbiosis, or mutualism often described for them (and many of us learned in school) may not really be true. The fungus is careful with its food source however, defending it from too much light and from drying out, and providing a great habitat for the photobiont to continue with photosynthesis. Most photobionts would not survive in a free-living state outside the lichen thallus – particularly not on the surfaces where lichens are found.

With so many species, the variations on the basic lichen theme are great. So how do we define this relationship? The International Association for Lichenology states that it is "an association of a fungus and a photosynthetic symbiont resulting in a stable vegetative body having a specific structure." That is not easy language for education.

Lichen Identification

Since I am writing this article as a primer, I am including basic information if you have interest in pursuing this topic further.

As I noted, lichens bring brilliant plashes of color to rocks, and adorn bark, dead logs, and even the surface of the soil. The thallus can develop branching that looks like tiny shrubs, appear as though it has miniature crinkly leaves, hang in long clusters from branches, or can grow like a crust on a soil surface, with no "leafy" look at all. Lichen colors range from black, white, and grey, to green and brilliant yellows, oranges, and reds.

The key features used in lichen identification are color, surface shape and texture of the thallus, and how the lichen reproduces. Some of these features are difficult to see with the naked eye, so a 10x hand lens is helpful. A dissecting scope is better of course. They have such interesting detail. As noted, color in lichen species often varies. Look at lichens in the light, compare wet and dry colors; descriptions of species typically use dry colors.

The colors of lichens are notable. Flowers are colorful to attract pollinators, but this is obviously not true for lichens. Many brightly colored pigments can be present in the thallus: usnic acid, yellow xanthones, pulvinic acid, and yellow, orange, and red anthraquinones are listed. The concentration apparently differs among populations. The lichens that have the deepest colors of yellow, orange, red or brown are those in the most exposed and dry habitats. So, light must have something to do with this -- the photobionts do need protection from solar radiation, with different colors being effective against different wavelengths. And obviously thallus color regulates temperature. Note that lichens growing in the shade are more typically grey or greenish grey. When these species are wet, they become greener; you are seeing through to the photobiont layer.

Categorizing the gross morphology of the thallus is the first lens to understanding lichens. However, note that the growth forms in lichens are not necessarily evidence of genetic relationships. Many lichens that look a lot alike are not related at all. In describing forms, the focus is the thallus – which is the "body" and bulk of what we see of the lichen. The reproductive structures are very small or obscure. Reproduction provides the most reliable characters for identifying lichens. This can either be sexual reproduction with what are termed fruiting bodies, or asexual reproduction, where finger-like vegetative outgrowths (isidia and soredia) break off to start new lichens.

Fruticose Lichens

These lichens may be erect or hanging (pendant), sometimes their thallus is flattened, but these do not have clear upper and lower surfaces. Many are highly branched and shrubby. There is layered structure but these are more three dimensional. Their support is typically tough with long, thick-walled cells. They attach to their substrate at a point (or sometimes a few points). Rhizines are not found, and cilia are rare. The genus *Usnea* has this growth form and they look similar to some members of the genus *Tillandsia* (particularly *Tillandsia usneoides* commonly called "Spanish Moss"). However, *Tillandsia* is an evergreen flowering plant in the Bromeliad family.

Foliose Lichens

These have a fairly flat thallus with an upper surface that is obviously different from the lower surface. Most have rounded or angular lobes that

A fruticose lichen *Usnea hirta* on rocky substrate in Lower Gallianas canyon. Notice the dense coating of isidia on the branches. Photo R. A. Barnes, July 11, 2024.

Photo by Nichole Trushell

Foliose lichens on rock substrate north of Kingston NM. The yellow-orange is *Candelina submexicana,* the gray-green lichen is likely *Xanthopamelia cumberlandia*.

look somewhat leafy. The actual shapes and sizes of the lobes may be referenced in lichen identification. The thallus expands outward from the center as it grows, so many become more or less round in outline. Foliose lichens are usually stratified; if you slice one from top to bottom with a razor blade, you will find obvious layers. The upper cortex in foliose lichens is well developed and thickened. Below this, the cortex is a green layer made of cells of the photobiont strung in a web of fungal hyphae. The next layer is the more loosely packed medulla which is usually the bulk of the thallus. Here the hyphae are threadlike and branched. This is usually white but can be colored as well. The last layer, at the bottom, is a lower cortex which typically has a structure similar to the upper cortex, but it can vary in color and texture.

Attachments to the substrate vary greatly too. Foliose lichens are usually attached by tiny structures called rhizines present over most of the lower surface. These are compacted strands of fungal hyphae. Those that are attached by a single stout connection are called umbilicate. These may or may not have rhizines, but the outer edge is always free of the substrate in an umbilicate lichen.

Some other useful terms for diagnostic features in foliose lichens:

Cilia: these are hair-like structures along the margin.

Cyphellae and Pseudocyphellae: cyphellae are sunken pits that are scattered on the lower surface of several genera. Another type of surface pore, pseudocyphella is smaller and is simply a hole in the cortex filled with white hyphae.

Pruinose and Scabrose surfaces: crystals and fungal cells on the surface can give a powdery or pruinose appearance, one that is rough and scaly is scabrose.

Umbilicaria americana **is an umbilicate, foliose lichen. It is growing here on a vertical rock face in a moist habitat of Lower Gallinas canyon. Photo R. A. Barnes, July 11, 2024.**

Tomentum: a cottony fuzz made of individual hyphae rather than strands like rhizines. It appears as a felty mat over the lower surface.

Crustose Lichens

These, like their name indicates, form a crust over their substrate. Their lower surface grows on rock or among the substrate particles. Some of these are the large, brightly colored patches that we find on rocks. Some are obscure, colored grey, brown or black, and require careful observation to see them. The structure of the thallus is stratified with upper cortex, photobiont layer and the medulla, but no lower cortex is present. The surface textures and colors vary greatly. The thallus may be thick, but margins are unlobed; sometimes they seem to fade into the substrate.

Squamulose Lichens

These are intermediate between crustose and foliose. The thallus consists of small, separate, lobe-like structures that have a cortex, photobiont layer and medulla. They lack a lower cortex and rhizines.

A crustose lichen found on rock substrate, east of Hillsboro. Likely an *Acorospora*. Photo R. A. Barnes, July 27, 2024.

How do Lichens Reproduce?

Because these are more than one type of organism, reproduction is complicated. At the time I was in graduate school it was termed "a mystery." Each organism can reproduce itself, but both must meet somewhere "hospitable" to create a lichen. Fungi produce spores by the millions, but a new lichen only forms if one of these spores finds the right photobiont, and this must be able to grow – requiring a specific habitat. And how does the fungus recognize it?

Most lichen fungi are ascomycetes. Their "fruiting" bodies are apothecia or perithecia. Apothecia are disk or cup-shaped fruiting bodies that have an exposed layer on the upper surface that produces spores. Perithecia are more flask-shaped and enclose the spore producing layer. They have an opening at the top. Given thousands of species, there are obviously a lot of variations for reproduction, but these are the basic forms. Note that identification of almost all crustose lichens is based on microscopic features of these fruiting bodies. So, for an amateur lichenologist, this can be difficult.

Given the obvious difficulties of reproduction with the small chances that a spore of a lichen fungus will germinate very close to the correct photobiont in the right location for growth, lichens have also adapted well to vegetative reproduction. Any fragment of a lichen that has both fungal and algal components could form a new lichen. Fragments reportedly seem to break down to undifferentiated fungal and algal cells before a new lichen begins. In many lichens specialized thallus fragments have evolved to facilitate vegetative reproduction: soredia, isidia and lobules are among these specializations.

The isidia and soredia are vegetative propagules unique to lichens. Isidia and soredia have specific detail that can be diagnostic. They can be seen with a hand lens – they are tiny at about .3-1.0 mm high. Isidia are fingerlike outgrowths from the upper cortex of the thallus and are scattered over the upper surface. These break free from the lichen thallus easily and can create a new lichen. Soredia originate in the medulla and erupt at a lobe as a powder - this is easily brushed off (masses are called soralia). These may be along the lobe margin or show as orbs on the surface or tips. Microscopically these are a few algae closely surrounded by hyphae.

Close view of apothecia, these are the cup-shaped reproductive structures (fruiting bodies) of the lichen fungus that have a spore producing upper surface layer. Photo R. A. Barnes, July 11, 2024.

Where Lichens Grow

Most lichens grow in areas that have abundant moisture and light. They typically do not grow quickly and thrive in situations where there is not much competition. Crustose lichens are the extreme; they grow very slowly, in a range of .5 to 2 mm per year. Most of these grow at their margins. Note that large patches of "map lichen" Rhiocarpon geographicum may be thousands of years old – determined by growth rate and radius. One in the central Brooks Range of Alaska has been estimated at over 10,000 years. I wonder what we might find as an estimated age if we focused on a measure of our local crustose lichens.

The fastest growing lichens are foliose or fruticose forms living in foggy or rainy forests; in these environments, they may increase significantly in size each year. Here in the dry southwest, growth of all lichen types is slow. Lichens can be photosynthetically productive all year however, if the thallus is moist and temperatures remain above freezing. This time is extended for those where rocks and lichen thallus are warmed by the sun.

Substrates where lichens grow vary and these depend on texture, ability to absorb moisture and retain it, and in their chemistry. Bark varies, dead wood varies (they may also grow on dead vegetation), rock chemistry

This photograph by Tom Lander was taken near Kingston, New Mexico. These foliose lichens are some of the faster growing communities but they may be quite old.

varies. A significant element for rock is the presence of calcium carbonate, such as our limestone. Communities of species that grow on limestone are very different from those that grow on a substrate rich in silicates such as granite or schist. Boulders can be so covered by lichens that the rock itself is obscured. Those rocks with high iron and magnesium or other metals also have a special lichen flora.

Lichens do break down rock. The hyphae of some lichens have been shown to extend many millimeters into rock. Those on coarse-grained granite can grow several millimeters into the rock. Lichens growing on very hard surfaces take advantage of planes and fractures in the rock and can lift up flakes and incorporate hyphae into the layers. Limestone is dissolved by the carbonic acid produced by the lichens' metabolism.

This ability to grow between crystals is how they participate in rock breakdown and soil building over time. Lichens that grow on soil are also specific to the soil chemistry and are significant soil stabilizers against erosion. "Vagrant" lichens are adapted to living on gravelly or sandy soils in arid areas like ours. Bodies of these can individually migrate. Crustose lichens may migrate by rolling with their small rocks, or by being moved by rain, gravity, animals, or even wind.

Finally, lichens can live on animals. Some insects even encourage this with strategies like sticky exoskeleton surfaces! This is a great camouflage against predators.

Photosynthesis, Water, Light and Temperature

Like all organisms, lichens need nitrogen for manufacturing protein and other organic compounds for life. Lichens often live on nitrogen-poor areas like rock and soils with low organics. Those with cyanobacteria have a ready source of nitrogen; these take atmospheric nitrogen and convert it to a useful form through nitrogen fixation. Green algal lichens must find their nitrogen in their source of water. There are also species of lichens that have evolved to use bird droppings, some have habitat close to farms, others live in an area of high wildlife activity to access their nitrogen!

As part of the amazing group of life forms that contain chlorophyll, lichen photobionts can combine carbon dioxide from the air with water, and with sunlight, to make carbohydrates - turning the sun's energy into chemical energy. This energy source powers all other life functions including growth, and releases oxygen for the rest of us. Lichen fungi do not have chlorophyll, but their association with the green algae or cyanobacteria (or both)

This crustose lichen, likely an *Acorospora,* is probably much older than the frutcose lichen on the previous page. Photo R. A. Barnes, July 27, 2024.

provides what they need. The organization of the photobionts within the lichen thallus maximizes photosynthesis – an organization that reflects that of a leaf. The photobionts make enough food for both themselves and the fungus; the carbohydrate passes to the fungus as sugar alcohols or glucose. These carbohydrates are also stored in the fungus as mannitol.

Water availability, temperature and light affect the growth process. As far as water is concerned, a dry lichen is a dormant lichen. Temperature tolerances depend on the habitat the lichen species is adapted to, but some lichens are found in the coldest and hottest areas of the earth. They are the dominant vegetation in the extremes of Arctic and Antarctic areas, on mountain tops, and in deserts. Most effective light availability depends on the species, but light is critical and determines the habitat of many. In general lichens with cyanobacteria as associates live in more shade than those with green algae. Lichens are typically sensitive to solar orientation as a result. Moving boulders to your home yard with beautiful lichens to cherish may prove unsuccessful. I know this from experience – even after being very careful trying to match their original orientation, most of my lichens have died on relocated rocks.

Lichens, because of their structure, have little way to conserve moisture. Some do develop thick outer layers. But evaporation occurs over the surface, so they dry quickly. However, they can absorb moisture directly from the air if the humidity is high. Many thrive in coastal fog deserts such as those in Baja and Chile. Because they absorb water and dissolved minerals through any part of their thallus, they have no need for roots. The minerals required are provided by rain or humidity, or by water that flows over the thallus on rocks or hillsides.

Lichens as Bioindicators

Since lichens are not plants, and have no roots or protective surface, they cannot filter what they absorb from their environment. If pollutants are introduced to an area where they live, these may accumulate in the lichen and can become toxic to them (and to animals that eat them) very quickly. As a result, they are excellent bioindicators. They thrive in clean environments. The sensitivity to pollution does vary among species – a few survive well with human-caused change.

One classic issue with the accumulative effect of toxin has been with atomic testing and nuclear disasters. Lichens that reindeer and caribou eat readily accumulate toxins, this concentrates more toxin in the meat, and then this is passed on to humans who eat the meat; the result is increased occurrence of cancers.

Lichens are very efficient at accumulating minerals as well. This has both negative and positive value. They can concentrate minerals that only exist as a trace, but they can also effectively absorb sulfates and metal compounds that are toxic.

Nitrogen Dioxide and Sulphur Dioxide

Nitrogen gas is harmless and makes up a large part of Earth's atmosphere. But when nitrogen is heated and combined with oxygen as it is in automobiles, nitrogen oxides result. Farms also emit nitrogen pollutants from fertilizers, farm machinery and livestock waste. These compounds can negatively affect human health. Some lichens will die in the presence of nitrogen, some others thrive.

Sulphur dioxide pollution comes from coal burning and industry. In high concentrations, sulphur dioxide can irritate the mucus lining of the eyes, nose, throat and lungs. This pollutant has killed many lichens in the past, but with less burning of coal there has been slow recovery.

On the positive side, lichens testing for metal concentrations can give information for mining, and testing thalli for pollutants is common and effective for pollution monitoring programs.

Lichens' Role in Ecosystems

Many look at importance through the lens of how it "helps" humans. Basically, lichens are not great food for humans, since we lack the bacteria that ungulates have to digest them. They have been collected by people for this purpose however, and also as use for dye. As noted, they are known as food for reindeer and caribou, lichens making up the majority of their diet.

There is one case from Montana where an analyzed pronghorn was found to have eaten terrestrial lichens.

However, looking at the bigger picture of how they help us, lichens have a significant role in ecosystems. They are colonizers. They are the dominant vegetation over about 8 percent of the planet's terrestrial surface. They can live on vast areas of the planet which are inhospitable to most flowering plants. Even at a growth rate of a few millimeters a year, if numbers are great, they can cover significant areas. Since they can withstand long periods of drought, are self-sufficient, are tiny and need little, they can colonize bare rock. They posses or produce chemicals that makes rock slightly more soluble speeding the weathering process. Weathered rock is the first step in soil formation. Soil formation is extremely slow, as is the general weathering process of lichens through the weak acids they produce. But carbonic acid formed by lichens in their metabolic activity is more powerful, and can eat away at rocks rich in calcium carbonate – such as our limestone. The breakdown of lichen thalli in extreme environments leaves precious decayed organic material. Living lichens also trap small particles of dirt that blow and accumulate fine materials. Eventually, they make homes for other species like mosses and hardier vascular plants with which they do not compete well. And moving up the chain, lichens are important habitat for a number of insects. They in turn for birds … and on up the chain. The nitrogen that lichens access via their photobiont provide them with nitrogen in a form they can use to survive. This nitrogen becomes available to other plants when lichens die and decay. Studies on this nitrogen input to ecosystems is ongoing.

I have been asked about the abundance of lichen on sick or dead trees. The answer is not that they have killed the tree. Their ability to hurt larger plant species has never been well documented. The reason for abundance on sick trees is the increased presence of light, which stimulates growth of the lichens.

As far as the role of lichens for me, I am inspired by their complexity, diversity and their importance. I have always been surprised and frustrated by lack of interest in them by most people I meet. I have always said that I would not live anywhere they do not – my reasons are my health, both physical and emotional. Their presence tells me about the quality of my environment, and they are also a critical piece of the beauty of the natural world around me, being another lovely highlight with their slow growing, varied and colorful presence in the natural world.

Because they prefer unpolluted landscapes, lichens are the essence of wildness. *"To find them in abundance is to find a corner of the universe where the environment is still pure and unspoiled."* ~ Irwin M. Brodo

Selected References and Resources

Plants of the Gila Wilderness - Lichens This is a fairly recent webpage and will likely grow.

iNaturalist app for photo ID. On many lichens you can correctly get to Genus.

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The Aldo Leopold Interviews

The New Mexico Humanities Council has sponsored the production of four interviews of Steve Morgan - channeling Aldo Leopold. Over the course of the four videos "Leopold" is interviewed by Henry Provencio (former District Ranger for the Wilderness District of the Gila National Forest), Dan Shilling (Lecturer, Director of the Arizona Humanities Council, and Author [including *Traditional Ecological Knowledge: Learning from Indigenous Practices for Environmental Sustainability*]), and A. T. Cole (author, restoration advocate, and owner/ operator of the Pitchfork Ranch - see articles in Vol. 7, No. 1 of this journal).

The videos are available on YouTube.

- Henry Provencio Interviews Leopold - Wilderness Protection 100 Years On
- Dan Shilling Interviews Leopold - The Indigenous Influence
- A. T. Cole Interviews Leopold - Practicing Land Restoration
- Dan Shilling Interviews Leopold - Practicing Land Ethics

Waterfalls of the Black Range

For the last two years we have been working on an article featuring the waterfalls of the Black Range. Publication has been delayed each year because of various access issues. We intend to publish this article in April 2025.

At this time we have material on the following waterfalls: Carbonate Creek, Mineral Creek, Middle Percha Creek, the "waterfall" at Wall Lake, a waterfall known as "Roundville Falls" (a photo but no information - anyone know this waterfall?), Drummond Canyon, and "Tall Canyon Falls" at head of Black Canyon, photo but no information.

If you have photos or information about these or other waterfalls in the Black Range, and are willing to share, please send them in (rabarnes@blackrange.org) to be included.

Bird Banding

In Vol. 2, No. 1 (January 2019) we published an article by Ned & Gigi Batchelder about their hummingbird banding experience and research ("The A-Spear Hummingbirds"). They used a feeder within a cage to capture hummingbirds for banding. It was an intriguing and informative process to watch. These photographs of a Black-chinned Hummingbird were taken at the banding session, on June 7, 2018, which eventually led to that article. In later issues the Batchelders shared other hummingbird banding experiences.

The next article describes a different technique for capturing birds to be banded.

Why Are We Bothering Birds by Banding Them?

By Kathleen Blair and Jan Richmond

Most wild animals are difficult, if not impossible, for humans to tell apart as individuals without some sort of identifying mark. They seldom let us get close enough to see details anyway. This is especially true if they roam around and migrate and consequently show up in different humans' spheres of observation not only in different neighbors' yards, but across whole continents. Still, to understand species life spans, behavior, habitat choices, migration patterns, and how all these variables are impacted by day to day, season to season, and year by year changes we must know which individuals are where and when. These are critical bits of information to help us conserve species into the future by making decisions that will help them, or at least do the least harm. How do you KNOW if it is the same robin coming back to nest in your apple tree each spring? Or maybe that bird's kids? Where did he go over the winter? Or is it some new, random passerby each year? Did something happen on the wintering grounds? Breeding grounds? Stopover spots along their migration path? Who shows up when new areas open? Who went where after the Black Fire, or when that new house took out that patch of trees? Answers to these questions can only be found by identifying individual birds and following their life choices. Ya gotta know who they are and where they came from. That is why biologists put little bracelets on birds, each with a unique code. Like chipping your pet. They can be recognized when found again.

Putting bands, ribbons, marks, strings and such on birds to mark individuals or send messages is not a new thing. There is a story that during the Punic Wars, in 200 BC, Roman officers tied colored ribbons to birds' legs and let them fly to send messages in battle. (Cornell 2024). Falconers banded their birds in the Middle Ages to identify them, Audubon tied colored treads to birds' legs to keep them straight in his yard, and, of course, there are the famous carrier pigeons of WW1 and WW2.

In 1902 Dr. Paul Bartsch, of the Smithsonian Institution, developed a scientific system for banding birds and started out with 23 Black-crowned Night Herons in Washington D.C. In 1904 one of those bands returned (Tautin 2003). In 1916, the Migratory Bird Treaty Act was signed between Canada and the U.S. to manage migratory birds jointly. Mexico is now also signed onto the international treaty. Birds do not recognize the imaginary lines humans call "borders". Although initially concerned with waterfowl, all migratory birds are now under its aegis. Since 1920, all wild bird banding in North America has been coordinated by the Bird Banding Laboratory under the U.S. Geological Survey and the Canadian Wildlife Service (USGS 2024). They collect

and analyze the data, make it public, issue the bands, and regulate training people on how to band birds safely, and how to take necessary data correctly, and then license them. You must present that license to purchase a band or mist net, after gaining permission for your project from the Banding Lab.

(Only livestock certified bands are available commercially for your personal domestic birds.)

Many banders are professional ornithologists or wildlife biologists and work for state and federal agencies. Others work with consulting firms, or are sanctuary personnel, professors, volunteers with various organizations, or are researchers - but not all by a long reach! Many are dedicated amateur birders that are willing to undergo the training and work under the supervision of someone doing approved research.

Since the Bird Banding Laboratory began keeping records about 100 years ago and up through 2003, an amazing 63,000,000,000 birds have been banded! Over 3,500,000 bands have been recovered (Tautin, 2003). Millions more have been sighted on birds by birders and reported. A representative of nearly every species found in North America has been banded. And, as the birds fly wherever they please, bands have been recovered from nearly every country and habitat in the world. Banding has taught us about migration patterns for different species and the great multi-species rivers of birds, the original interstates, we call the flyways.

Advances in technology have enhanced our understanding by the application of smaller and smaller, lighter and lighter, radio and satellite trackers as well as tiny cameras. Now it is common to easily take a small blood sample and get the birds' DNA, track chemical exposure, or even tell in which watershed they were living during their last molt or where they hatched and grew up, if they have been exposed to Bird Flu, or a hundred other questions. Amazing! These technologies and techniques have dramatically changed our ideas on the life spans, diets, and habitat selection of myriad bird species.

My (KB) first banding experience was in Rudy and Helen's backyard in Oklahoma. They had been banding the birds that visited their place since they first bought the house. We caught a Black-capped Chickadee that day that they had first banded 32 YEARS before, living in the same place! And one of the worst physical damages I ever received in a 40 year career in wildlife biology was from the male cardinal that was handed to me to release. He stood on my hand, leaned over, and bit the shit out of my thumb. He did not want to leave. He wanted to chew my thumb off. Now I know why they are bright red. That is so their victims' blood does not show.

If you have the opportunity to visit a banding station, you will get to see birds in the hand that you have only observed through binoculars. It can make picking out field markers much easier to understand.

On May 9, 2024 Ken Steigman shared a bird banding experience with us. During that event, we had 2 species of Empidonax flycatchers in the hand. The Hammond's has a tiny bill compared to the Dusky but up till then I had always questioned my id's. Now I see. I also got to see the difference between male and female MacGillivray's Warblers with the white under the chin of the female (see previous page). It was very much a hands-on learning experience that I look forward to doing again in the future. In total we had 17 species that morning in Las Cruces.

There is another consequence to bird banding - what E. O. Wilson called Biophilia. Love. Awe. Respect. As Babba Dioum said:

> "In the end, we will conserve only what we love; we will love only what we understand, and we will understand only what we are taught."

Banding birds teaches us, helps us understand, lets us love, shows us how to conserve. They are in our hands.

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Tautin, J. 2003. *One hundred years of Bird Banding in North America*. USDA Forest Service Gen. Tech. Tep. PSW-GTR-191. 2005.

Photographs

Photographs in this article are by Jan Richmond and were taken during our "bird banding experience" in Las Cruces.

Center and Lower Left: Wilson's Warbler, *Cardellina pusilla*.

Upper Right: Releasing a Northern Mockingbird, *Mimus polyglottos*.

Lower Right: Releasing a Hermit Thrush, *Catharus guttatus*.

Following Page: Banding a Ruby-crowned Kinglet. Bird bands and other material at the upper left, needle-nose pliers, measuring scales, and detailed identification guides (which include feather measurements, wing length data, etc.).

Other Tracking Technologies

Banding requires the capture and fixing of a band on a creature. The banded individual must be sighted, found (dead), or captured (live) at some future time to give two data points about its life (where it was banded and where it was relocated). In some cases additional information about the individual can be obtained when it is relocated and that the data can be compared to information gathered when it was initially captured.

Tags, like those placed on butterfly wings, have the same strengths and weaknesses as banding technologies.

Radio collars have all of the negative (intrusive capture) and positive attributes of bird banding but in one fashion or another provide fairly detailed information about the movement of the animal and/or its specific location at a particular time.

Remote sensing devices are now used to identify individuals which have been tagged (butterflies, birds, dragonflies - whatever a tag can be placed on). These devices record the presence of an individual, sometimes from miles away, and report the "sighting" to a database which is often available to interested parties. The prime example of this technology is the Motus Wildlife Tracking System.

Trail cameras, which are placed remotely and are activated by heat or motion have been used for several decades to monitor various species of wildlife. Databases of the images from such efforts can be enormous. We have used such material in articles in several previous issues of this journal. Associated with this technology are advancements in new software (aided by machine learning) which can identify the species in an image, reducing the resource required to log thousands of pictures.

Programs like "WildMe" have the ability to identify not only species but individuals of the species.

A Community of Images

Starting with the next page, we begin our continuing series on the images of natural history which have particular importance to us.

As mentioned in our last issue, hybrid submittals are welcomed. And our first "submittals" include one from Bob Barnes which is such a creature, a photograph by Véronique De Jaegher and a narrative by Bob Barnes.

All of us see "things" as we venture through nature. Gordon Berman takes us on a tour of the natural history of imagination, examples of a different way of seeing. (Editor: As an aside, Edvard Munch's "The Scream" was first exhibited in Germany, as Der Schrei der Natur - The Scream of Nature.)

When I talk with authors/photographers who may wish to contribute to this journal they generally want to know what the "rules and requirements" are and I reply that "I am more interested in your 'story' and how you want to tell it than I am about word count or image sizes, or really anything else about the editing process."

Véronique De Jaegher Mushroom in Railroad Canyon - May 2024

DISCUSSION (Bob Barnes): It always starts so innocently, "Do you know what this is?" Followed by, "Where did you see that?" This on May 6, Véronique had photographed a mushroom the day before when she and Linda King had found it in Railroad Canyon.

And that is how our community of observation occurs. As individuals, we can't be everywhere all the time. As a community we can greatly expand where we are at any particular time and if we share our observations then the collective experience is enhanced.

In this case, the answer was "In Railroad Canyon, on the right side of the trail, maybe at the fourth crossing above the campground." So quite naturally, on May 7 I headed up Railroad Canyon looking for one mushroom. One mushroom in a canyon - any chance? Any chance in hell? Of course not, and of course, I found it.

My initial take was that this mushroom was in the genus *Gyromitra*, one of the false morels. I submitted an observation to iNaturalist with the two photographs at the right. The limited response to the posting seemed to favor placing the mushroom in the genus *Morchella*, one of the true morels. It was suggested that it might be *M. prava* (Mes-7). On June 12 the observation (*M. prava*) was designated research grade by iNaturalist.

I know enough about mushrooms to know that I don't know anything about mushrooms and that a definitive identification might require a spore print and/or DNA analysis. Something I was not prepared to do on my outing, and which in fact, I have never done. This is how science (if we can call this little escapade "science") is done. An observation followed by a lot of research, mulling, consultation, and perhaps resolution.

Bob Barnes
Percha Box Riparian zone - April 2024

DISCUSSION: When I took this photograph I did not think too much about it. It is what it is, a bit of green in the desert, not overly pretty, not particularly striking. When I saw it later, however, I was struck by what it was.

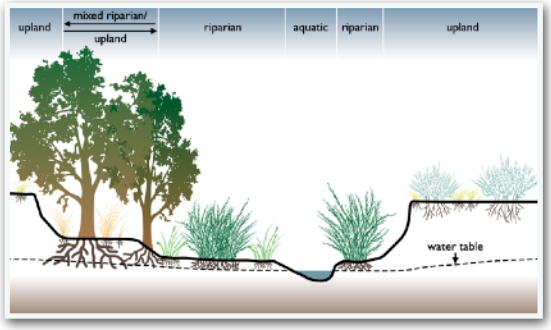
This image of a desert riparian zone is documentation of significant diversity. The diversity which water brings to a parched landscape. The image is not as striking as the August 7, 2015, photograph of the Lower Gila Box, near Redrock, east of the Arizona-New Mexico border, lower right, but it is just as telling.

Where there is water there is green, where there is not, the green is greatly diminished to nonexistent. The braided stream at the bottom of the image above drives this point home. (See Video.)

Riparian zones are areas of interface, between areas which are wet and those which are not. The plant and animal species found in communities with differing water access are often significantly different. For instance, plants adapted to more water often - but not always - have shallow root systems and those in areas with less water either have deeper root systems or more extensive shallow root systems (sometimes both). The U. S. D. A. graphic at the center right illustrates the types of communities which may be associated with access to water (the water table). In places like the Percha Box the relief of the valley greatly increases the effect of water access. The zone of interface is greatly diminished as access to the water table decreases dramatically in just a few feet. Access to water drives many other differences in plant morphology, and the differences in plant communities are often readily apparent (root systems are not necessarily obvious) because of that. Animal communities associated with these zones are also diverse. The relationships between species can be complex. Fish and amphibian species which are found in or adjacent to the stream often require that the water temperature be moderated by the shade of the vegetation along the stream banks, for instance.

Riparian zones like that shown above are often corridors along which animal - and plant - species move. As a result, the number of bird species found in Hillsboro is enhanced by the fact that there is a vegetative corridor between that town and the Rio Grande.

Let us not forget the human animal. In the west there has been a lot of fighting over access to water. And when access is gained, short-term monetary gain has led ranchers to allow their cattle direct access to streams and springs, destroying the golden egg in the process.



Gordon Berman
The Natural History of Imagination - Phantasms

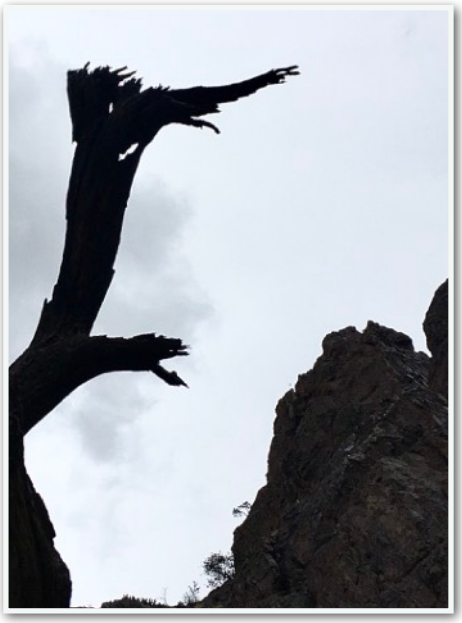
DISCUSSION: These phantasms remain in place from trip to trip, but the beholder's focus trips elsewhere, the image fleets, no next time.

Top Left: The Silhouette Snag of Dripping Springs

Bottom Left: Come, sit, have a bite, be a bite.

Top Right: No rush, I can wait.

Bottom Right: Cañón El Soldado de Soledad



Editor's Comment: Unstructured views. These submittals from Gordon Berman (this and following pages) are not what I had in mind when I made a general request for images with a natural history theme. When I looked at them, however, I was struck by how well they embodied the theme of "multiple ways of seeing" which recurs in this journal and how the unexpected can ring so true.

Gordon Berman
The Natural History of Imagination - Phantasms

Top Right: The sun warms me, the cane steadies me, the horizon beckons me, a smile leads me on.

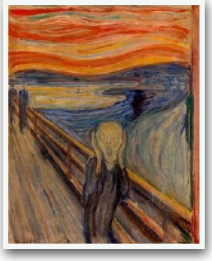
Center Right: Can't see anything but squawking anyway.

Bottom Right: The hand shadow puppet waits till nightfall.

Directly Below: Blink one eye if you get it.

Bottom Left: The Scream.

Editor: Edvard Munch created several versions of "The Scream". It was first exhibited in Germany, as Der Schrei der Natur - The Scream of Nature.



Gordon Berman
The Natural History of Imagination - Phantasms
A sotol fashionista

A Sotol fashionista flashes on a rocky runway.

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