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IN THIS ISSUE

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Unattributed material is contributed by the editor.

The North American Beaver

Want a beaver in your back yard? "Hell, yes." "Hell, no." That pretty well sums it up.

It may, however, be useful to have a more comprehensive and nuanced discussion of beavers, their role in the natural systems we also live in, and the arguments advanced by parties which are for reintroduction/ restoration and those against such efforts. How, for instance, do you view the photograph to the right from the east slope of the Black Range (September 2023)? Is this terrible destruction or is it the early work of a formative process?

First a little ground work. Just what is it that we are talking about? Here in the Black Range we are talking about *Castor canadensis*, North American Beaver. The other extant beaver species, *Castor fiber*, is found in Eurasia. Beavers have thick hair, and that nearly caused their extinction. Humans wanted pelts of that hair. They killed millions of individuals of this species to get their pelts. (A brief summary of beaver trapping in the Black Range/Gila is included later in this issue.)

Although up to 25 subspecies of North American Beaver were recognized in the past, there are no recognized subspecies at this time. (Some sources, U. S. Forest Service for instance, continue to recognize the full range (24) of subspecies. The issue is complicated by the reintroduction of beavers from widely varying populations into areas where there are existing populations.) Historically, the Gila River Beaver population was considered to be *Castor canadensis frondator*[1] (Mearns) or the Broad-tailed Beaver/Colorado River Beaver, and the population along the southern Rio Grande was considered *Castor canadensis mexicanus* (Bailey) or the Rio Grande Beaver.[1]

Although we delve into the natural history of this species throughout this issue, our primary purpose is to address the issues around the species' management and the arguments pro/ con surrounding their reintroduction in various areas. There is a lot written about the natural history of this species. Some sources which may be useful to those interested in a deeper dive into the natural history of Beaver are listed below.

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1. ***Mammals of New Mexico*, 1931, USDA Bureau of Biological Survey, Vernon Bailey.**

"Habitat and Forage Selection by the American Beaver (*Castor canadensis*) on a Regulated River in the Chihuahuan Desert", Isidro Barela and Jennifer Frey, *The Southwest Naturalist* 61 (4): 286-293, December 2016.

North American Beaver (Castor canadensis): A Technical Conservation Assessment, Boyle and Owens, February 6, 2007, Rocky Mountain Region, U. S. Forest Service.

Assessing Beaver Habitat on Federal Lands in New Mexico, Report for WildEarth Guardians, July 31, 2013.

NatureServe Explorer: Castor canadensis.

Historical Records

Karen Gust Schollmeyer (Archaeology Southwest) discussed early animal records from the Mimbres in Volume 3, Number 1 of this journal ("The Archaeology of Animals in Southwest New Mexico, AD 1000 - 1130"). An accompanying graphic at pp. 16-17 notes that archaeological evidence of Beaver from the Mimbres is very limited but present in numbers from the Gila/San Francisco drainages.

In the 1820's fur trappers (the Anglo-American Mountain Men) began to trap Beaver in the southwest in earnest. This group included people like the brothers James and Sylvester Pattie (James wrote a book[2]), Bill Williams (had a river and a National Wildlife Refuge named after him), Jedediah Smith (books and documentaries are about him and a muzzleloader's gun club is named for him), and Ewing Young (Kit Carson worked for him and a heritage oak tree was planted in his name). Most of these trappers sold their furs to the Hudson's Bay Company and the American Fur Company, since beaver pelts were not in high demand in the Spanish realm.

Spencer F. Baird reported on the Beaver in the *Report of the United States and Mexican Boundary Survey*, 1859. At page 41 he noted that the "abundance of this species on the Gila, but especially on the Colorado del Oeste, makes it a very prominent feature in the fauna of the country."

Albuquerque, and in 1909, E. A. Goldman saw some old beaver cuttings near Socorro and was told that there were still a few along the river. He also saw signs of them at Garfield and found them common in the Rio Grande near Las Palomas, and they were reported near Las Cruces. At Las Palomas he found where nearly all the willows had been cut over an area of about an acre, and many cottonwood trees had also been cut, while along the river banks were numerous fresh tracks and places where the beavers had worn the banks in going in and out of the water. The trunks of the cottonwoods lay where they had fallen but were stripped of a large part of the bark, while the smaller branches had been cut and carried away. At another place, about 5 miles below Las Palomas, he reported 15 or 20 acres of willow and cottonwood bottoms that had been practically cleared by beavers. In 1915, J. S. Ligon reported them as becoming abundant in places along the Rio Grande above and below San Marcial, where there were some complaints of their felling trees across the fences.

In such localities beavers live entirely in the banks of the rivers and select the deepest water for their operations. They are not

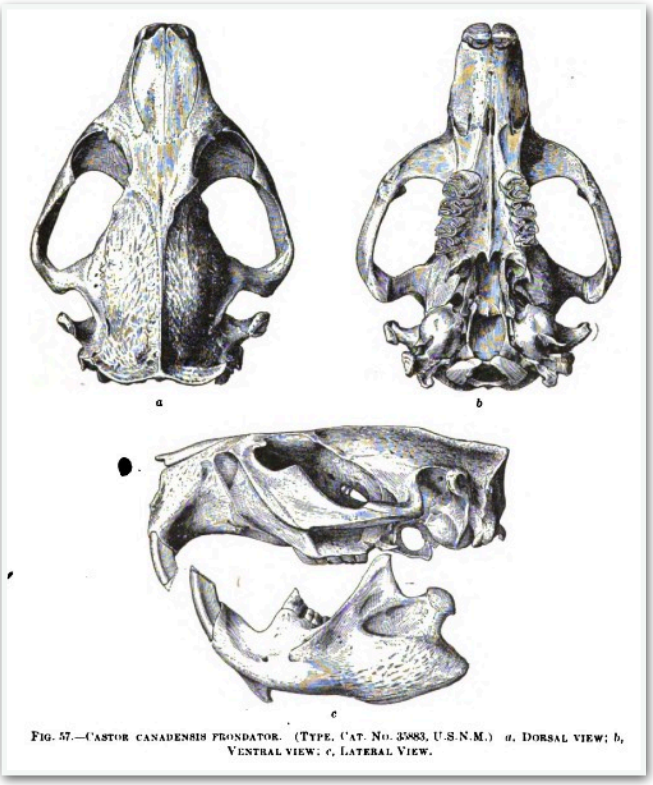

FIG. 57.—CASTOR CANADENSIS FRONDATOR. (TYPE, CAT. NO. 3583, U.S.N.M.) *a*, DORSAL VIEW; *b*, VENTRAL VIEW; *c*, LATERAL VIEW.

This was the first boundary survey. The expedition traveled across the range just south of Cooke's Peak and spent time at the copper mine (Santa Rita).

Edgar Mearns reported on the beaver found during the boundary survey of 1884-1887 in *Mammals of the Mexican Boundary of the United States*, Bulletin 56 of the Smithsonian, 1907. That survey was along the present border, so south of our immediate area. He referred to the Beaver found there as the Sonoran Beaver or Broad-tailed Beaver, *Castor canadensis frondator* (this area not being in the Rio Grande drainage). The diagram of the skull of this 'subspecies' is shown here (page 351 of the report).

Bailey[1] (1931) reported that "There are still a few beavers in the headwaters of the Gila where they were formerly exceedingly numerous" (p. 211), this referring to *Castor canadensis frondator*. He cites Pattie's[2] reports of killing at least 250 beavers in a period of a month, including 30 on their party's first night of camping on the Gila. In 1892, it was reported that they were still common along the "extreme head branches of the Gila" (Bailey, p. 212).

"In 1915 J. S. Ligon was told by J. J. Pitts, who settled in Apache Canyon in western Socorro County in 1883, that there were then two large beaver dams across the canyon, a distance of about 200 yards, backing up the water in deep, smooth ponds surrounded by dense growths of willows. All the beavers along this

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2. James O. Pattie, *The Personal Narrative of James O. Pattie of Kentucky,* 1831.

stream as well as along the Frisco River were caught by an old trapper from Texas in 1884 and 1885, with the result that the canyon is now a barren, boulder-strewn wash." (Bailey pp. 211-213)

Ligon also reported a "small colony of beavers on the East Gila River, west of the Black Range" in 1916. (Bailey, p. 213)

As for *C. c. mexicanus*, Bailey included the information at the top of the preceding page in his report (p. 215). Note especially Goldman's report that most of the beaver were building their dens in the banks of the Rio Grande and Barela and Frey's (referenced above) assessment of bank denning. Bank versus lodge den sites are discussed later in this issue.

"Willow tree cut by a beaver on the Rio Grande." 1910. William L. Finley - From the collection of the Oregon Historical Society

"Bank" Beaver work, Percha Creek, January 11, 2014 (above) and on east slope of the Black Range in September 2023 (below).

Interestingly, this is about the time that we begin to have a historical record which includes photographic images, see top center.

Beaver were never extirpated from this area, however. Their numbers were greatly diminished by the early trappers, and those numbers were further depressed by continued hunting, trapping, and cattle herding, but they managed to hang on in (generally) remote sites.

Personal accounts like the following attest to the resilience of the species:

"As a youngster, I used to spend a few weeks each Summer with my Uncle and Aunt who were the Caretakers of the Heart Bar, NM Game Department Ranch just above what is called the Doc Campbell Gila Hot Springs. This would have been in 1953/54/55. Back then the Clinton P. Anderson paved road did not exist. My Aunt Verna would meet my ride at Pinos Altos and she would take me into the Ranch in an old Dodge Power Wagon. The road into the Ranch required crossing the Gila River some 12/13 times with water running through the floor board each time!

One of my favorite activities was sitting on the river bank in the evenings and watching a family of Beavers going about their business. The family of Beaver I watched was just down below the Old Stone Ranch House and dug back into the bank of the river."[3]

Currently, there are Beaver workings at several sites in the Black Range, including Percha and Palomas Creek on the east slope and in Black Canyon on the west slope of the range. The numbers of individuals are not high, however.

Finding Beaver work when walking the stream courses of the Black Range is not expected but not necessarily uncommon.

The number of Beaver locations in the Black Range may be somewhat larger than that reported here because of the reluctance of some observers to report them, out of fear that others may take hostile action against the beavers.

That situation, deeply divided perspectives and in some cases significant animosity, is detrimental to a beneficial solution to the "Beaver question". Detrimental to all life in the Black Range.

We start with a bit of natural history, Beaver denning, damming, and foraging. It is from those activities and their ramifications that the disagreements flow - as freely as water over a beaver dam.

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3. Personal correspondence to the editor from Ted Harrington, dated August 1, 2023.

Two Types of Beaver Dens

The iconic image of a North American Beaver, *Castor canadensis*, den is a mound of sticks and mud in a pond. If you are in need of an iconic image, this is as good as any. However, Beavers also dig dens into the banks of waterways. We have examples of both denning behaviors in the Black Range.

The type of den a Beaver will build depends on the water level and water flow conditions at its chosen denning site. A "Bank Beaver" is not a different species or subspecies than a "Lodge Beaver". Same species, different behavior. Behavior driven by environmental conditions.

It is reasonable to conjecture that most of the Beavers in the Black Range would engage in bank denning because our streams tend to flow down steep gradients, exist in narrow canyons, and are subject to periodic high water events. However, the percentage of Beaver groups engaging in bank denning in the Black Range is not known. What is known is that both behaviors exist in the Black Range.

Example 1 - Bank Denning

Some sources assert that Beavers which build bank dens are at the mercy of the watercourse. That is, they have no control over the water level at their den site and are not able to ensure that the entrance to the den remains underwater. That assertion probably fits northern and eastern Beaver populations which choose to den in banks. If it were true in the Black Range there would be little to no bank denning in this area. Normal flow regimes in our streams fluctuate significantly here, with the dusty dry extreme being quite normal.

The Beaver site shown below and on the following page is along a section of stream which typically has some flow (often minimal, sometimes raging) throughout the year. Ponds do not naturally occur along this reach of water. In some locations, the bottom has been scoured more deeply, making for deeper sections of water. In the photo below, a Beaver has built a small dam to raise the water level in a section of stream.

This dam may seem diminutive to those who can not quite get that iconic image we spoke about earlier, out of their mind. Dams do not have to be long or high to be effective. To the degree that they balance resource input (how much work is required to build and maintain the dam, how much material is available to build the dam) with benefit (a sufficient water level to enable their activities) a Beaver's chance of survival is enhanced. Too much effort without an equivalent benefit is wasted energy and resource. That is a big negative. Especially along streams where habitat does not minimize the velocity and force of high water events, and the tendency exists for big events to wash out dams (and fill in depressions), a minimalist approach, one that assumes regular replacement costs, is efficient and effective.

"Bank" Beaver dam and pond, Percha Creek, January 11, 2014

And beavers have a tendency to be efficient and effective.

If a Beaver is able to locate large vegetation to cut and start the dam building process, it is a step ahead. Beavers are able to fell a tree like that shown below in a fairly short period of time.

Beavers will often place cut vegetation on the bank above the den site as shown in the bottom photograph.

Example 1 - Lodge Denning

For the last eight years (2015 - present) we have monitored a Beaver site in Black Canyon on the west side of the Black Range. On the following pages we include photographs from 2015 and 2023. The changes at the site are quite dramatic and the benefits of such a site are obvious (which does not stop us from pointing them out). We do not know what the Beaver population at this site is.

Percha Creek east of Hillsboro, March 30, 2018. American (Bank) Beaver tree work, small dam, and den.

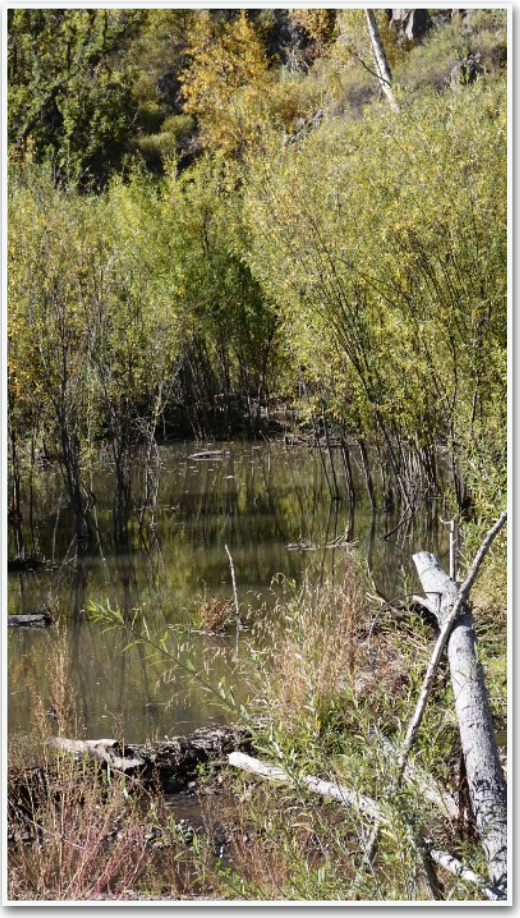
Beaver dam along the North Star Road, west slope of the Black Range, November 5, 2015.

Although not an exact replication of the photograph at the upper left, the photograph in the middle of this page is a view of the same area in late October 2023.

In eight years the saplings in and along the edge of the beaver pond have grown in stature and number. Whether a site be the location of a lodge den or a bank den, the initial dams are smaller, shorter in height and not as long. As the water level upstream from the dam begins to rise, additions are made to the dam, making it both longer and higher. As the dam extends away from the initial dam location its height is often not as great, because it only needs to be incrementally higher to back up water because the substrate is higher in these areas.

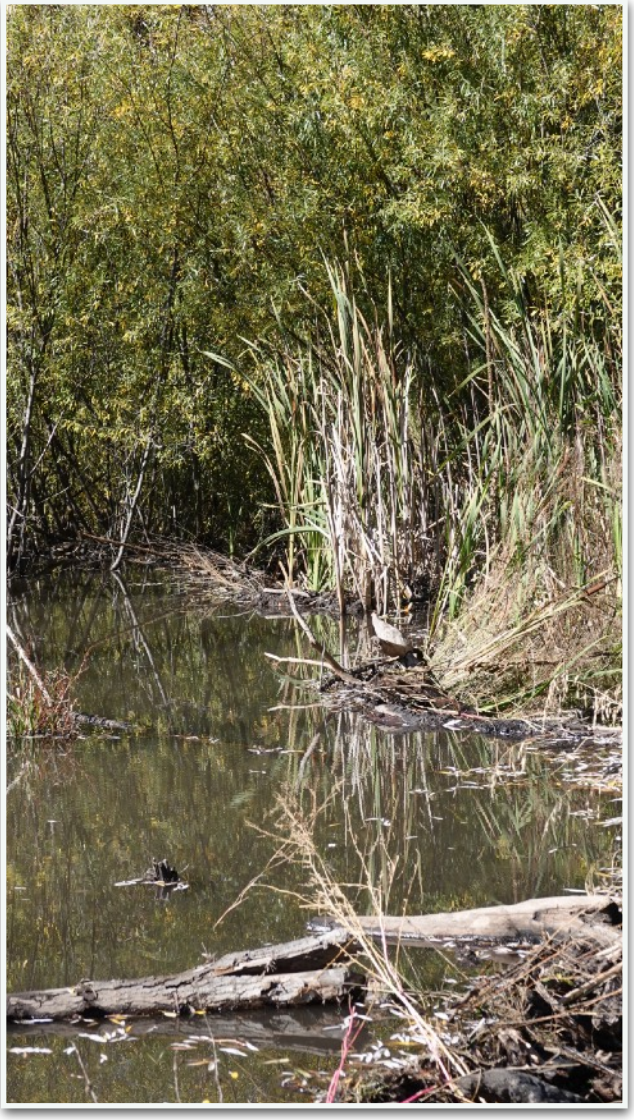
The lodge is visible as a dark area at the center of the middle photograph and in greater detail on the following page.

Some fairly large trees were felled by the beavers during their initial efforts at the site. As the years have progressed, it appears that the tree felling activity has shifted to focus on saplings as the beavers focus on dam maintenance - and to provide food. However, no tall - or large diameter - trees seem to exist at the pond site. Continued monitoring will focus on what vegetation is allowed to grow at the pond site.



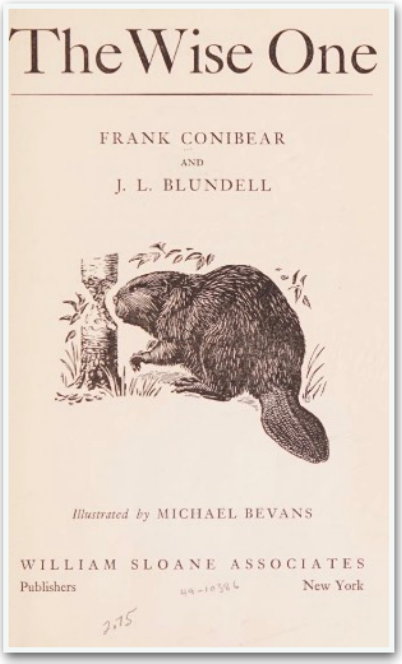
Above: Beaver lodge at Black Canyon site, October 2023.
Below: 'Freshly' felled saplings, October 2023.

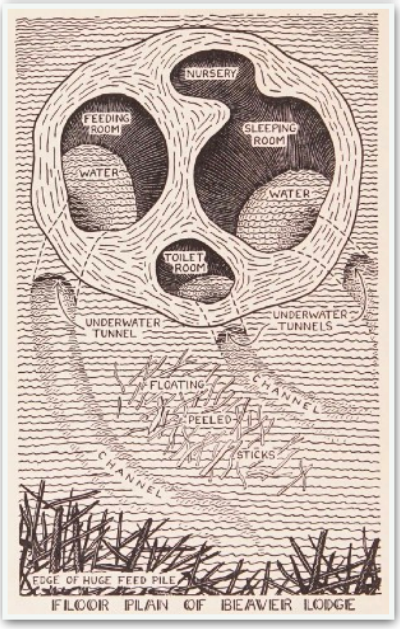
In October 2023, the pond area was quite extensive, as shown by the photographs on this and the following page. At this time the dam system extended across the watercourse of the canyon, enclosing all of the area which might be flooded in a high water event. The extensive vegetation which has grown up in the area slows the water which flows through the area and sediment in the water drops out of suspension. As a result, the general habitat is changed from a scoured channel to one which is more complicated with more diverse vegetation. Broad-leaved Cattail, *Typha latifolia*, is the common cattail of the Black Range and is the species which is found here.



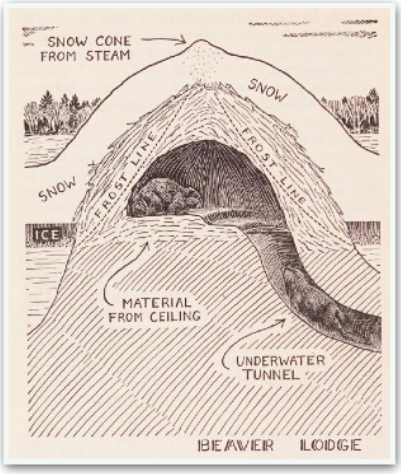
There is sometimes a wealth of source material to draw upon when researching a topic. In this case I ran across *The Wise One* by Frank Conibear and J. L. Blundell, William Sloane Associates, New York, 1949. I don't tout this book as a state of the art account of the natural history of Beaver, nor as a responsible cultural account of humanity. (It is a good thing to remind ourselves of the past, and this book is of its time.) It does, however, have a nice set of graphics depicting the dens of Beaver, shown below.

Conibear was based in the north, so forgive him for thinking that there is such a thing as mounds of snow and inches of ice.





One factor which may play a role in determining the type of den which a Beaver builds is the temperature



within the den. There are several factors which determine the temperature within a den. The temperature of the substrate is a significant factor, as is the moderating effect of the insulating mass above the chamber. (The heat generated by the Beavers also affects the chamber temperature.) In many cases, bank dens are cooler than those in lodges. This is another factor which may be significant in den site selection in our area.[1]

It is generally assumed that dens are used by family groups. However, Fischer et al. found that unrelated lactating Beavers shared a lodge in Arizona.[2]

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1. "Temperature in beaver lodges and bank dens in a near-boreal environment", R. Buech, D. Rugg, and N. Miller, *Canadian Journal of Zoology*, April 1989.

2. "Lactating North American Beavers (*Castor Canadensis*) Sharing Dens In The Southwestern United States" Fischer, J. W., Joos, R. E., Neubaum, M. A., Taylor, J. D., Bergman, D. L., Nolte, D. L., & Piaggio, A. J. (2010), *The Southwestern Naturalist*, *55*(2), 273–277. http://www.jstor.org/stable/40801017

Where Are the Dams?

Just knowing where beavers are building dams can be a lot more difficult than you might think. For instance, most studies of the effects that beaver activities have on the landscape are watershed wide. Some of those watersheds are very large. Some studies involve multiple watersheds. It can take a lot of walking to survey such areas.

Emily Fairfax and others (see citation and link at the end of this article) describe the new tools and efforts they have developed in the *Journal of Geophysical Research: Biogeosciences*.[1] Sarah Derouin (2023), summarized their study in "Mapping beaver dams with machine learning", *Eos*, 104, 15 June 2023. Eos is a journal of the American Geophysical Union (AGU).

Fairfax et al. developed the Earth Engine Automated Geospatial Element(s) Recognition (EEAGER) model to identify beaver dams using high altitude (including satellite) imagery and a neural network trained on images of known dam sites. EEAGER successfully identified known dam sites 63% of the time and identified sites not known to have dams, but which indeed had dam sites, 26% of the time. The study used images of 13,344 known beaver dam sites (mostly in Colorado and Idaho) and 56,728 images of locations without beaver dam sites. It performed best on images which depicted landscapes similar to those used in its training module.

These percentages, which are expected to improve as the neural network "continues its education", may not seem that impressive at first blush. Filters which are able to correctly identify unknown sites in more than a quarter of the cases (where it thought there were dams) represents an immense reduction in the survey workload. On December 13, 2022, Fairfax estimated that EEAGER "decreased the time needed to map beaver dams by about 80%".[2] In addition, many of the false positives turned out to be very close to other dams. False negatives were negligible.

1. Fairfax, E., Zhu, E., Clinton, N., Maiman, S., Shaikh, A., Macfarlane, W. W., et al. (2023); "EEAGER: A neural network model for finding beaver complexes in satellite and aerial imagery". *Journal of Geophysical Research: Biogeosciences*;128, e2022JG007196. https://doi.org/10.1029/2022JG007196.
2. Fairfax et al., "EEAGER: A model that detects beaver-created wetlands in satellite and aerial imagery"; presentation at AGU conference, December 2022.

Beavers, Wildfires, Flooding, Water Tables

Several sources are now touting the benefits created by beaver habitat, typically in flood control and in the development of natural fire breaks. These benefits are associated with the pond formed behind a beaver dam.

Chris Jordan, a NOAA fisheries biologist, notes: "Channel modifications, such as straightening bends to transport logs and barges, result in water being whisked rapidly downstream. . . . Beavers' networks of dams, canals, and felled trees do the opposite, slowing water down, which – like magic (except that it's physics) – restores river systems."[1]

Donovan discusses the creation of a more diverse ecotone and the resulting refugia which are often associated with beaver habitat creation.[2]

In the case of firebreaks, any claim that beavers create natural fire barriers in the Black Range may be problematic. Most of the canyons in the Black Range are steep-sided and narrow; this is especially true on the flanks of the range. As for the adjacent valleys, such claims may have merit. Narrow steep-sided canyons can not only be more difficult for beaver populations to alter but the barrier created is likely too narrow to prevent the spread of a forest fire, especially one which is crowning, and especially in windy conditions. In valleys adjacent to the Black Range beaver habitat may be a more effective fire barrier.

Duncombe[3] noted the findings of Emily Fairfax in her article: "Fairfax found that vegetation along sections of a river without dams burned straight to the river's edge. But for sections with a resident beaver, 'essentially, the plants don't know a fire is happening.' The channels dug by beavers acted like irrigation channels, said Fairfax, keeping vegetation too wet to burn, even during drought. In all, stretches of river without beavers lost 51% of their vegetation greenness, compared with a 19% reduction for sections with beavers."

For those who hate beavers, that firebreak is characterized as flooding. It really comes down to who has a right to exploit the land in question. Is it to be exploited for the greater good or is to be exploited for the personal gain of an individual?

For those who love beavers, the wetland created by beaver activity is valued in itself, because it tends to keep water in an area longer (than if it simply runs off) and raises the water table, and because it increases the natural biodiversity of the area.

Individuals who take a longer-term view of cost-benefit (regardless of whether they do so for personal gain or for the general good) will generally side with the "beaver habitat is good argument". Because establishing and maintaining beaver habitat forces change in exploitation regimes, those who have a short-term orientation see beaver activity as disruptive.

It should be noted, although obvious, that "flooding" is only flooding when it is damaging someone's goods or property, otherwise it is simply high water. If it is your goods or property which are being damaged your perspective is likely different than if it is not. It is for that reason that the establishment of beaver habitat may be more successful on public lands and on private properties which have long-term goals and values.

The Southwest of the United States is in the midst of a megadrought (see Volume 4, Issue 3, of this Journal - "Black Range Surface and Groundwater"). Efforts to retain what little water we get from the sky will be to our benefit. Just as check dams and other efforts to slow the transit of water from the Black Range are beneficial for us, enhancing our long-term water prospects by increasing volume and adding stability to a highly variable resource, the works of beavers could be very additive.

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1. Tripathy-Lang, Aika; "Scientists EEAGER-ly Track Beavers Across Western United States"; *Eos*, 3 January 2023.

2. Donovan, Robin; "Last Tree Standing"; *Eos*, 22 December 2022, which discusses refugia.

3. Duncombe, Jenessa; "Are Beavers Nature's 'Little' Firefighters"?; *Eos*, 13 December 2019.

See also: "Ecology, management, and conservation implications of North American beaver (*Castor canadensis*) in dryland streams", P. Gibson and J. Olden, *Aquatic Conservation Marine and Freshwater Ecosystems* 24(3) June 2014. DOI:10.1002/aqc.2432

Channelization

In constructing riparian zones, beavers build dams, forage on some of the riparian vegetation, and build channels throughout the riparian zone. At least in some cases. Observations made in the Black Range have typically found little to no evidence of channelization. The hydrology of the Black Range, characterized by small streams within narrow canyons flowing from the crest into the Mimbres, Gila, and Rio Grande systems, is not conducive to a lot of channelization. Bank lodges rather than dam lodges are the prevalent habitation type for beavers we have observed - although both types are present.

Prior to the great European trapping escapade, the beaver population in North America has been estimated at somewhere between 60-400 million.

Above and Right: Palomas Creek, East slope of the Black Range, June 7, 2018.

When the escapade was through, that population is thought to have been a few hundred thousand.

Prior to the colonization of the eastern part of Canada and the United States by Europeans, the rivers in that part of the world were not the restricted courses we see now but rather characterized by numbers of channels and beaver meadows. Straight rivers, which has become regarded as the norm in many quarters, occurred as the Europeans made alterations to the waterscape to build mill sites. The change of the historical landscape increased the number and severity of flooding events.[1]

It has been estimated that between 1834 and 1988, 195,000 - 260,000 km² were converted from wetlands to drylands.[2] It is assumed that much of these wetland habitats were beaver habitat. Wetlands received some protection at the end of that period, but reactionary court decisions have reversed those protections.

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1. **Leila Philip; *Beaverland - How One Weird Rodent Made America;* 2022; Twelve Books. Citing the research of Denise Burchsted.**

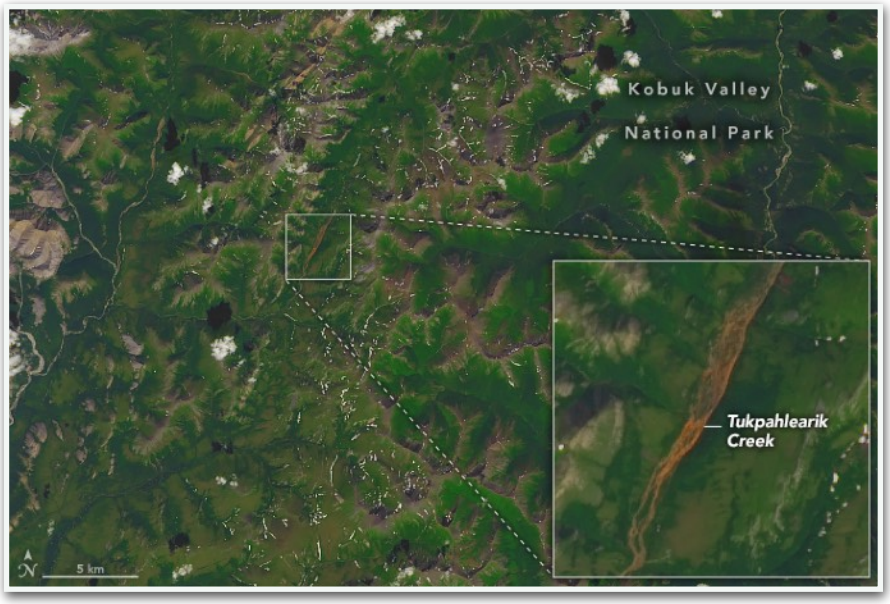
2. **Robert Naiman, Carol Johnston, James Kelley; "Alteration of North American Streams by Beaver"; *BioScience*, Vol. 38, Issue 11, p. 753, December 1988.**

Beaver Restoration and Reintroduction Programs

Organizations like the Methow Beaver Project provide information about and training in reintroduction and restoration projects.

On December 14, 2023, at the fall meeting of the American Geophysical Union (AGU), Neve Baker et al. presented a paper entitled "Ancient Sedimentary DNA Shows 5000 Years of Continuous Beaver Occupancy in Grand Teton National Park, Wyoming". They employed environmental DNA sampling (sedimentary ancient DNA [sedaDNA]) techniques to determine the presence/absence of American Beaver at several lakes in the Grand Tetons. From the paper's abstract: *"Vegetation metabarcoding revealed a shift in the plant community coinciding with beaver establishment in these two terminal lakes, with a decrease in conifer dominance and an increase in riparian taxa, as well as an increase in overall taxonomic diversity. Beaver establishment and vegetation regime shifts coincide with strong local and regional evidence for a shift toward higher winter precipitation and increased moisture balance. These larger-scale changes likely facilitated beaver arrival and contributed to the observed plant community changes. Continuous presence of beavers in Taggart Lake throughout late Holocene droughts suggests that under certain conditions beavers may be able to maintain wetlands through extended periods of climatic stress, providing refugia for plants and animals and buffering the effects of climate change at the local scale."*

Baker notes that "*We can use this going forward to understand where beavers were in the past, so we can know where we should put them in the future.*"



Everything In Its Place

Do American Beavers belong everywhere? In "Expanding beaver pond distribution in Arctic Alaska, 1949 to 2019" Tape et al., *Nature - Scientific Reports* 12, 7123 (2022), the authors report that "*Rapidly expanding beaver engineering has created a tundra disturbance regime that appears to be thawing permafrost and exacerbating the effects of climate change.*"

As human induced climate change increases the temperature of the planet, potential American Beaver habitat is created north of traditional habitat. Beaver move in, create wetlands which melt permafrost which releases more methane which increases global temperatures which....

Just as humans overestimate their capabilities, they tend to minimize their tendency toward error. The question is not "Can all the king's horses and all the . . . back together again?" It is, "Can they do it right?" The world is a complex place and the potential for unintended consequences is immense.

The NASA image shown above is from July 23, 2023. In an article in January 2024, Lindsey Doermann notes that *"Researchers suspect that thawing permafrost is also the cause of dozens of Alaskan streams turning orange. Along with the strange appearance of the water, they have found it tends to be higher in iron, lower in dissolved oxygen, and more acidic than nearby rivers that run clear.*

Tukpahlearik Creek is one such stream that has taken on a new hue."

The article includes a more detailed discussion of the ongoing process and various hypotheses about what is going on and its implications.

And What is Happening Along The Rio Grande?

A lot.

James Von Loh and Gordon Berman provided the following narrative and images.

Reporting on a beaver dam along the Rio Grande near Las Cruces, Von Loh notes that: "The dam on this short Rio Grande reach is perhaps 100'-long x 3'-4' high, backing up treated and

Request for Submittals/Information/Perspective

In a future issue we want to explore the issues, possibilities, and varying perspectives associated with the concepts of "reintroduction", "restoration", and "rewilding". We would love your help in exploring this topic.

released/disinfected wastewater; it is overtopped and receives impacts when inundated by irrigation/water compact flows from upstream reservoirs (bank-to-bank flows begin in early June and end in September/ October). The dam, pond, and associated plant communities provide perching/hunting/ sunning/breeding sites for many species of birds, insects, amphibians, fish, and turtles among other critters." (January 22, 2024)

The photographs and photograph captioning on this and the following page are by James Von Loh.

Top Right: Rio Grande Beaver foraging for and returning to den with fruiting stems of Curly Dock, *Rumex crispus* (L.). May 26, 2022.

Top Center: Full view of the harvested plant material and the Rio Grande Beaver body length while swimming on the pond surface.

Bottom Center: Rio Grande Beaver swims through floating mats of Duckweed, *Lemna* sp. (L.) used by several Odonate species as perching and egg deposition sites.

Right: Rio Grande Beaver drag marks where Rio Grande Cottonwood branches were pulled to the bank-full channel.

Top Right: Rio Grande Cottonwood tree trunks felled by beaver along the Rio Grande Recreation Trail (November 3, 2023). Rio Grande Beavers apparently are removed when such activity occurs along this, the Rio Grande Recreation Trail, but I do not know their fate.

Top Center: Heavy wire mesh wrapped around the trunks did not stop tree felling by determined Rio Grande beavers (November 15, 2023).

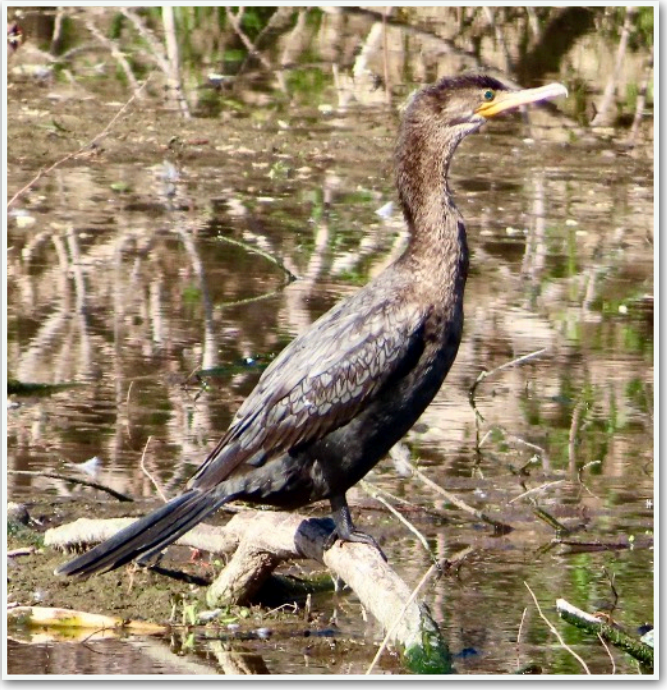
Bottom Center: Wastewater outfall volume and foraging duck species November 22, 2022.

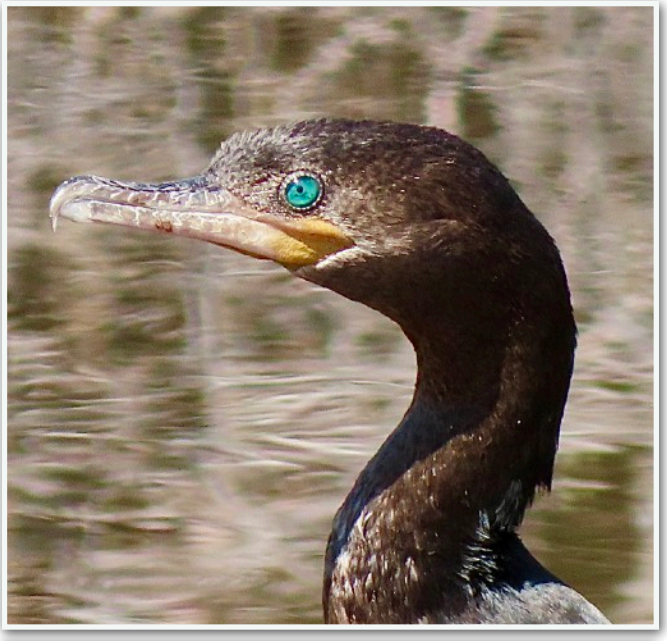
Bottom: Remaining Rio Grande Beaver dam (primarily Coyote Willow stem construction) following 5 months of overtopping irrigation/water compact release from upriver dams (November 2023).

Gordon Berman took the photographs directly below and at the top of the left column of the following page on October 22, 2023. They were taken along the roughly 2 mile stretch between the treated wastewater inflow channel above the I-10 overpass and the Calle del Norte Bridge in Las Cruces.

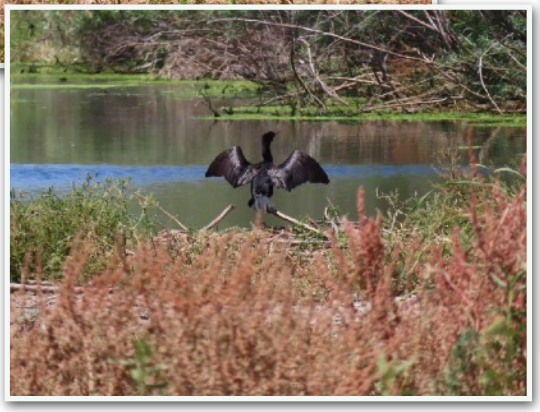
He noted that "Between late fall and early spring, there is no flow from upstream in the Rio Grande. The river is reduced to a meandering ribbon. Portions of the accessible dry river bed reveal a surprisingly rich (sometimes disturbing) habitat . . . During the fall to spring months of 2021-22 and 2022-23, the beaver dam spanned the flow, bank to bank, about 1/4 mile upstream from the Calle del Norte Bridge . . . On May 11, 14, and 31 of 2022 I observed a Neotropic Cormorant, *Nannopterum brasilianum*, at the Rio Grande Beaver dam site (photographs on the following page). This bird stayed at the site for at least 8 weeks."

Water. This species requires water. Without the beaver dam this species would not have been found at the site in Las Cruces during May of 2022.



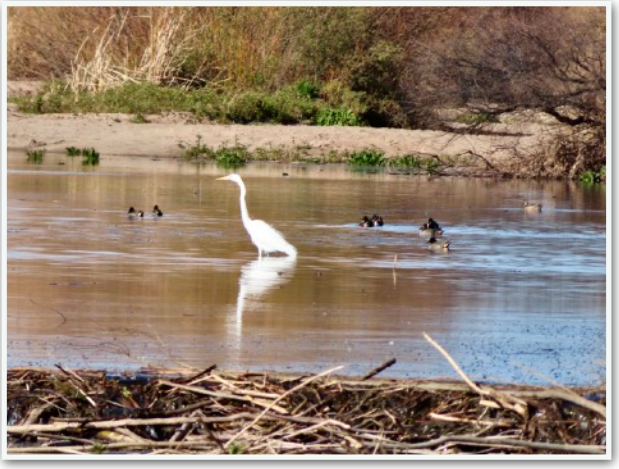


The Neotropic Cormorant was placed in the genus *Phalacrocorax* until 2014 when it was moved to the genus *Nannopterum* based on a molecular phylogenetic study. This species is found northward along the Rio Grande. The video at this link was taken at Bosque del Apache on January 17, 2012.



Above and Right: Beaver dam and pond, Rio Grande at Las Cruces. Photographs by Gordon Berman, May 31, 2022.

In addition to the Neotropic Cormorant, the dam and impoundment attracted Black-crowned Night-Heron (1/22/23), Great Egret (2/8/23), various waterfowl, and many other species. Photographs by Berman.



Accumulating large amounts of monitoring data has little value, unless it is done with a clear purpose in mind and with adequate planning for analysis and protection of the data. - Keeping Track Field Guide, "Project and Data Management", Harley G. Shaw & Christine Hass.

Tools of the Trade - Part 2 - Databases, Measurement Techniques, and Other Tools

Databases

There are numerous organizations engaged in determining the distribution of species, the population trends of those species, and changes in species behavior, usage of habitat, and in some cases genome. Nearly all of these organizations produce some type of material to ensure the data integrity of their database (including original submittal and things like changes in taxonomic determinations). The first sentence in the chapter of the *Keeping Track* field guide entitled "Project and Data Management" (see above) is a great cautionary statement. (The analogue cliche would be "Garbage In, Garbage Out".)

The requirements stipulated by organizations for submitted data can be strenuous and cumbersome, they can be virtually non-existent, and they can include various layers of review. All of this can be a real disincentive to an observer who encounters a bit of useful data but doesn't look for that sort of thing all of the time. If you are out and about a great deal, you might spend a significant amount of time feeding these various data bases.

Below we provide a listing of some of the organizations which gather data, and nearly all of these organizations have some provision for making the data they accumulate available for your research and study. How you engage with such organizations is a matter of personal choice, but selecting one as the primary benefactor of your data gathering (usually linked to your particular interest or area of study) and having a more general organization for the material you work with less often, has proven to be a useful compromise for many. A word of warning however: many of these organizations define North America as Canada and the United States. Some useful databases are:

eBird, a project of The Cornell Lab of Ornithology. This project comes with its own app which allows you to record bird sightings as you go along. Reports of your sightings, or the sightings of others, can be generated from the database. The app includes prompts which indicate that a proposed report may be suspect and the submitted reports are vetted.

iNaturalist. iNaturalist has a focus which encompasses all of natural history. Flora, fauna, fungi - all are included. Submittals are easy and assistance in identifying the subject of the submittal is built into the process. Vetting is accomplished in the first stage by seasoned observers and on a continuing basis.

BugGuide. BugGuide (Iowa State University) maintains data and photo documentation for an "online community of naturalists who enjoy learning about and sharing our observations of insects, spiders, and other related creatures." How much do they share? In 2020 the site covered 1.3 million described species. Many more now, all curated by experts. And remarkably, easy to use. "More than just a clearinghouse for information, this site helps expand on the natural histories of our subjects. By capturing the place and time that submitted images were taken, we are creating a virtual collection that helps define where and when things might be found. . . . We capture never-before-seen behaviors and we have photos of species that you won't find anywhere else on the web." (Website quote)

Butterflies and Moths of North America (BAMONA). As of October 2023, BAMONA was approaching 948,585 sightings of 8,948 species. It not only sounds comprehensive, it is. Perhaps best of all for us, Steve Cary is the BAMONA moderator for New Mexico. Among other things, Steve and Michael Toliver maintain the Butterflies of New Mexico website pages at the Pajarito Environmental Education Center. Submitting a sighting to BAMONA ensures local vetting, and the enhancement of local databases.

Is this a comprehensive listing? No, it is not even close. Have fun . . .

BISON-M

The BISON-M database is worthy of special mention. It is a database used by various organizations, including state agencies, to formulate policy and to make management decisions. Therefore, we all have a stake in its accuracy and comprehensive coverage.

The BISON-M animal occurrence database (https://bison-m.org/) of the New Mexico Department of Game & Fish, in partnership with Natural Heritage New Mexico (https://nhnm.unm.edu/), is a multi-faceted database targeted to the state with

All Species
Grant, Sierra

Taxonomic Group	# Species	Taxonomic Group	# Species
Amphibians	17	Birds	349
Coleoptera: beetles	24	Crustaceans	5
Ephemeroptera: mayflies	41	Fish	50
Hymenoptera: ants, bees, wasps	5	Lepidoptera: moths and butterflies	194
Mammals	109	Misc. Arachnids	6
Molluscs	67	Myriapoda: centipedes, millipedes, etc.	1
Odonata: dragonflies	78	Orthoptera: grasshoppers & crickets	75
Plecoptera: stoneflies	1	Reptiles	77
Spiders	30	Tricoptera: caddisflies	5

TOTAL SPECIES: 1134

filters for our geographic area. A primary goal of BISON-M is to provide the public and natural resource management communities with accurate and up-to-date information about the ecology, legal status, and county-level distribution of all vertebrates and many invertebrates in the state of New Mexico. The reports generated from this database are easy to use. The summary at the bottom of the previous page is the header for a report on Grant and Sierra Counties and was generated in a couple of seconds (you may choose to have the report generated in excel or as a .pdf). The database is multi-layered. For instance, it is possible to click on a species name (link) in the listing of species reported from a specific area (e.g., Grant County) and you will be taken to the "Species Page" for that creature. Species pages include summary data, taxonomic determinations, legal status, species distribution, habitat association, food habits, environmental associations … a lot!

Measurement Techniques and Basic Analysis

In "The Deer of Black Canyon" and "The Deer of Black Canyon - Stewart" (Black Range Naturalist, Volume 5, Number 3), we addressed several aspects of the Black Canyon (west slopes of the Black Range) deer population explosion and how wildlife agencies responded to the event.

To determine the size of the population and the effect it was having on the flora of the area, wildlife agencies used a variety of low-tech assessment tools, including pellet counts, visual survey, and exclusion zones (enclosures). These survey techniques remain useful tools. Here we discuss the pros and cons of each. As with any measurement or assessment system, the limitation of a study using it is the manner in which it was applied.

In assessing the effect of grazing (cattle) and browsing (deer) on the vegetation in Black Canyon, the Forest Service established three study plots, each 150 square feet in size, in the early 1930s. The study seems to have ended in 1938. Exclusion zones can provide valuable data about disturbances of various kinds. The length of a study and the size of an enclosure significantly affect the results of any study. Answers will vary with changes in either of the variables (temporal or geographic scope). In the assessment of Stewart's report (second referenced article) we noted a lack of rigor in describing (much less, trying to control for) variation in precipitation during the study.

An independent observer may find it difficult to establish a formal exclusion zone (which is traditionally fenced off with barbed-wire fences). Sometimes, however, natural features in the landscape will create an area where little or no disturbance is occurring. In the case of Black Canyon, deer were the primary subject of study. The study was developed to assess the impact of deer on the area. You may wish to investigate something else, like beetles. Careful consideration will need to be exercised in developing the parameters of a study which is using a fixed geographic area as a baseline variable.

Transect surveys are a regular tool in determining populations and their density. Establishing a transect survey is straightforward. Pick a route, mark spots along the route where regular measurements are made, and record observations over time. This tool can provide valuable information about how populations change over time. There are, of course, several variations in methodology which will affect the outcome. The most significant variable is the most basic.

Establishing the route can introduce all sorts of bias into a study. At the extreme, establishing a route through desert scrub is not going to lead to meaningful information about woodland bird populations. That may seem a bit absurd, but the idea that a route has to be associated with the purpose of the study is sometimes not implemented with the rigor that it should be. Most transect guidelines will state that the points along the track should be evenly spaced, and that an observation should be taken every 100 meters, for instance. A route established within these parameters will tell you something that is true. A route with observation waypoints established at particular points of interest (marshy areas along a route, for instance) will tell you something else that is true. Be aware of what you are really measuring when you set up a transect route.

Pellet counts, checking the number (and sometimes volume) of scat accumulations along a set route is similar to a transect and is subject to the same types of bias. (See later.)

All of these techniques were used in the survey of the Black Canyon, and the results from the individual studies were rather hotly debated - not the clear, definitive results that one hopes for when a study is established. As noted in the reference articles, the results were subjected to "analysis" by individuals who were strongly biased toward one answer or another.

Measuring an object in the field can be somewhat subjective if you find yourself without a measuring device. Kaaronen, Manninen, and Eronen addressed how humans solve this issue in "Body-based units of measure in cultural evolution", *Science*, 380, 2 June 2023, pp. 9948-954. The authors note that "*Many early standardized measurement systems evolved from body-based units of measure, such as the cubit and fathom, but researchers have rarely studied how or why body-based measurement has been used. We documented body-based units of measure in 186 cultures, illustrating how body-based measurement is an activity common to cultures around the world. Here, we describe the cultural and technological domains these units are used in. We argue that body-based units have had, and may still have, advantages over standardized systems, such as in the design of ergonomic technologies. This helps explain the persistence of body-based measurement centuries after the first standardized measurement systems emerged.*" Some of the measurement techniques they surveyed are shown on the following page (article excerpt).

If you have a need to determine the degrees of distance in the night sky you can do this easily and fairly accurately with your hand. The moon is about half a degree wide in the night sky. If you hold your hand at

Unit	Description and variations
Fathom (arm span)	Distance between fingertips of outstretched arms. Variations include, e.g., the fathom with closed fists.
Hand span	Distance between the tip of the extended thumb to the tip of one of any four other fingers on an outstretched hand.
Cubit (ell)	The distance from the tip of the elbow to the tip of an extended finger (typically the middle finger). Also sometimes measured to, e.g., the closed fist or wrist, or from elbow crease to fingertips. Other similar forearm-based units are included.
Arm length	Any units based on the length of an arm, typically from tip of outstretched fingers to one of the following: armpit, shoulder, or middle of chest (half-fathom).
Activity-based measures	Units of measure based on physical activity, such as a "day's journey" or "stone's throw" (linear measures) or a "day's worth of plowing" (measure of area).
Finger width	Width of one or multiple fingers (or fingernails), excluding the thumb (see "thumb width").
Hand width	Width of the palm (also known simply as the "palm"). Also includes the width of four fingers or the fist, or the circumference of the palm.
Pace	A pace, step, or stride.
Finger length	Length of any of the four fingers, thumb excluded (see "thumb length"). Includes the length of finger joints and combinations thereof.
Height	A person's height from the sole of the foot to the tip of the head, or to the tip of vertically extended arms. Also includes measures of height to other specified points of the upper body (e.g., navel, eyes, and forehead).
Foot	Inner or outer length of the foot. Also includes foot width.
Handful	Cupped hand (handful) or two cupped hands (double handful), a measure of volume.
Thumb width	The width of the thumb (including nail width).
Fistmele	Width of the fist with an extended thumb (similar to "thumbs-up" gesture).
Thumb length	The length of the thumb or thumb joint(s).
Hand length	The length of a hand, typically from the wrist joint or crease to the tip of the middle finger.
Arm thickness	As thick as the arm (or wrist).
Armful	As much as a person can carry in both arms (a measure of volume), or the circumference that the arms can surround.
Pinch	A small measure for volume measured by pinching the thumb against the tip of a finger (e.g., a "pinch of salt").
Leg length	The distance from the sole of the foot to the knee or hip.
Ring	Measure of circumference made by pinching the tip of a finger to the thumb (similar to the "OK" or "ring" gesture).
Leg thickness	As thick as (any part of) the leg.

arm's length and extend your small finger, it will obscure the moon. An extended finger is about a degree wide. Hold your hand at arm's length and extend your thumb and small finger as far to the side as you are able. Looking into the night sky, the distance between the end of the thumb and finger is about 25 degrees. The distance between your forefinger and small finger is about 15 degrees when they are extended as far as you are able to the side. The distance across a closed fist, extended at arm's length, covers about 10 degrees in the night sky (the distance across three fingers extended at arm's length covers about 5 degrees. A thumb covers about two degrees.) Such techniques are not limited to the night sky. For example, hold your thumb sideways at arm's length in front of an object which you know to be about 5 feet tall. Determine the height of the object relative to the width of your thumb. In this example, say your thumb is twice as "high" as the object (relatively your thumb is "10 feet high"). A thumb covers about 2 degrees of vision, which translates to a distance factor of 30. In this example, the object is 300 feet away (the object is known to be about 5 feet high, your thumb is twice as high, the multiple is 30 for a thumb - 5 x 2 x 30 = 300) since we are using feet as the unit, the object is 300 feet away. The multiplying factor for a fist (10 degrees) is 6. A degree of vision has a multiply factor of about 60. (Yes, the distance multiplying factor increases as the degree of vision decreases.)

Measurements of this type are accurate enough for almost any type of field work. Methods which are more precise do not necessarily produce greater accuracy. Think of it this way, precision is the degree to which the measurement can be replicated. Accuracy refers to how close the measurement is to the "true" value. Studies which characterize themselves as having a high degree of precision may not be accurately measuring the subject at hand. And in many cases, greater precision may obfuscate underlying truths. The pursuit of a lot of numbers on the right side of a decimal point may be less accurate than a more general statement if it obscures underlying variability - especially in those cases where variability is, in itself, the most important attribute to be noted.

Accuracy, or assuring that the likelihood that an answer is random is very low - or some would claim, non-existent, is the goal of many a study. It is only as good as the data set from which it is drawn, the type of analysis performed, the correct application of the analytic tool, and the correct (or responsible) interpretation of the resulting answer.

All of that to say, that under the right circumstance and in the right situation, a rule of thumb is as good as a super computer.

Do not be perturbed if you find yourself in a situation in the field where something needs to be measured and you are without a high-tech tool. All measurement is relative and all measurement indices are arbitrary. Select a method which can be replicated, and translated when you are back at the "lab", and you are set.

If you are involved in a "one-off" observation, the most important thing you can do is get it right. Take the time to assure that you are seeing what you are observing rather than seeing what you think you should see. To the extent possible, record the circumstances of the observation, at the time of the observation.

If you are involved in a mini-study, make sure that your study is structured properly, and that you have removed bias created by how you are going about your study. Thought beforehand will help assure an informed finding.

Other Resources

In addition to the databases referenced earlier, there are useful sites - sites which you cannot necessarily contribute to, or at least not easily, but which provide a wealth of public domain material for your use.

Images from space, of the Black Fire (top) and Silver Fire (bottom), are available from the Natural Earth site.

As are thousands of other images, many from our area.

Interested in the geology of a site like the Kilbourne Hole in the Potrillo Volcanic Field? Start with a view of the site from space (image at the upper right courtesy of Natural Earth), visit the BLM page on this area, or visit the Birding Travels in North America site for a more extensive narrative on the site, including video and photographs.

The point is, scour the web, visit popular and scholarly sites, mesh it all together and maybe you come up with something new.

You, as a careful and informed observer, are the most significant tool available for the study of natural history.

A Simple Method to Monitor Trends in Acorn Production

By Harley G. Shaw

Sampling acorn production is frequently important in studies of food habits of wildlife species or of the reproductive biology of oaks. Several methods involving collection of acorns in boxes (McCulloch et al. 1965); drums (Dickson, 1990); ocular counts (Koenig and Hohannes, 2005); (Koenig and Stanback, 2011); or seed traps (Goodrum et al.,1971) have been used to measure acorn production. These techniques yield estimates of both numbers and biomass of acorns, but they are time-consuming and relatively expensive. Construction or acquisition of gathering devices requires an outlay of funds. Placement of these devices requires considerable time, and their size and weight limit sampling to sites that are reasonably accessible by vehicle. They require considerable planning and rigor in their use, hence not available for spontaneous recording of isolated tree stands. Sample sites must be visited at least twice annually – once to position the devices, and once to gather acorns. Separating acorns from debris also requires time.

Placement of collection devices relative to tree crown is critical in acquiring representative samples. Disturbance or damage by humans, livestock, or wildlife during the period of collection can create sources of error. In many studies, the information desired does not merit such an output of labor and expense.

A second approach has been suggested by Graves (1979) in monitoring acorn production in California. He estimated acorn production visually, placing individual trees in 4 acorn abundance classes:

1. No visible acorns.
2. Acorns visible after very close examination. Maybe only one or two are observed.
3. Acorns readily visible, but they do not cover the entire tree and

the limbs do not appear to bend from their weight.

4. Acorns readily visible and covering the entire tree; limbs appear to sag from acorn weight.

Such visual estimates are much easier to use and can be carried out rapidly, but they do not provide quantification required for statistical comparisons, nor do they provide an opportunity for estimating biomass. They are also subject to observer bias.

The method described here was developed in an effort to enhance the speed and simplicity of counting acorns on trees. It provides a more precise quantification of acorn density than does Grave's approach, and, with additional effort, could be used to monitor relative acorn biomass.

Methods

In this method, acorn densities are determined using binoculars as an optical plot. Any pair of manually-focusing binoculars can be used. A relatively short minimum focusing distance is desirable, simply to keep the area of the optical plot at a small size. The glasses we used in testing the technique were a pair of 7X35 Redfield waterproof and a pair of Bushnell 10X50's. Steps used in sampling acorn densities were:

1. Set binoculars at their minimum focusing distance. Standing perpendicular to a flat surface (wall, road sign, etc.) move back and forth until the surface is clearly in focus. Measure the distance from this position to the surface.
2. Maintain this position and have another person mark the outer boundaries of the field of view on the wall. This will provide a measurement of "plot" diameter at the distance of minimum focus. This diameter can then be used to calculate the area of field of view [plot size = 3.1417 X (diameter/ 2) 2] for the specific set of binoculars being used. Depth of field is relatively shallow at such short distances, and, for all practical purposes, the glasses can be assumed to be focused on a plane.

Two Gambel Oak, *Quercus gambelii*, acorns.
Hillsboro Peak Trail, September 2, 2023.

3. In the field, step off a distance from the base of each tree being sampled, using a distance that approximates the minimum distance of focus. For my binoculars, which focused down to about 7 meters, ten steps from the base of the tree worked well. From this point, face the tree and swing the binoculars upward across the crown until a foliage surface is reached that is in focus (at the minimum focal distance).
4. Count and record all acorns in sharp focus in the field of view.

For our pilot survey, we sampled four plots on each tree, pacing outward along cardinal directions. Trees were selected by stopping at one-mile intervals along a forest road and sampling the nearest two trees from this point. We also placed each tree measured into Graves categories for comparison. All trees sampled were Gambel oak (*Quercus gambelii*).

Our counts were made in mid September during a year of moderate acorn production. The binoculars used had fields of 18 inches (7X35) and 32 inches (10X50). Data were converted to acorns/square meter.

We continued these surveys during late summer of each year from 1990 to 1995.

Results

This technique was easily and rapidly applied. With two individuals working, we sampled 30 trees in about 4 hours without hurrying. Where trees are being sampled in a small area, a much more rapid counting rate could be attained; much of our time was spent traveling the one-mile intervals between sampling points.

An average density of 10.58 acorns/ square meter was measured for the 30 trees. Densities ranged from 0-232 acorns/square meter for individual plots. Only 3 trees had mean acorn densities greater than 100/square meter, and these were all on bottomland sites with deeper and apparently better-watered soils.

Exactly one-half (15) of the trees were sampled with the 18" diameter field and one half with the 32" diameter field binoculars. When data from individual plots were placed into a frequency distribution, no particular advantage of either optical plot size was evident. Both sets of binoculars yielded data which had a strongly skewed distribution (figure 1).

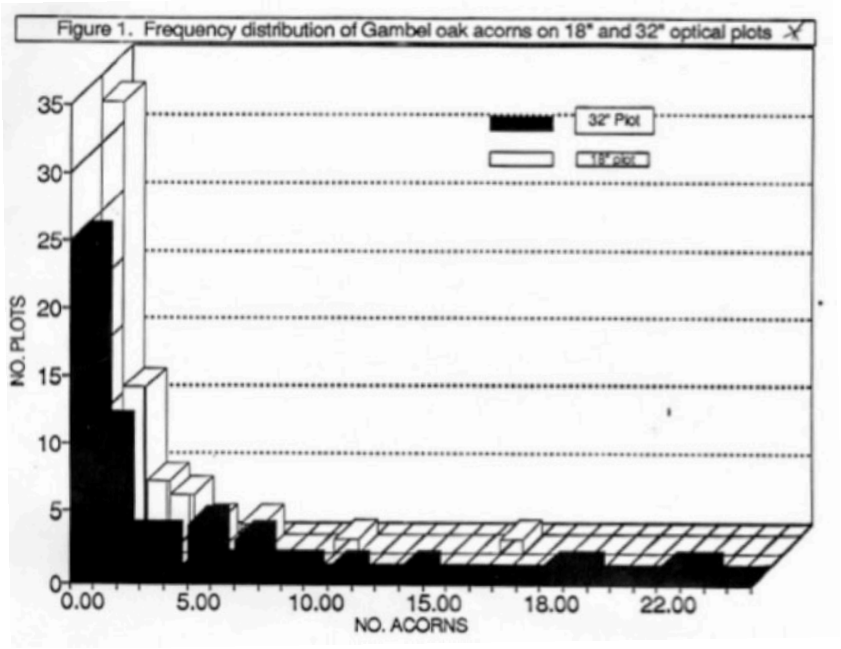
The Graves technique seemed to allocate an unduly high number of trees to category #2 in spite of apparent wide variation in acorn density in the trees sampled (table 1). At the level of acorn densities measured, 23 trees (77%) were placed in category 2. Only 3 (10%) were allocated to category 3, and no trees were laden with acorns heavily enough to be placed in category 4. Considerable variation occurred

between plots on individual trees, suggesting that an opportunity for misplacement of trees in categories exists, unless the entire tree is scrutinized carefully.

We continued making these surveys for 6 years (Table 2). Acorn production varied widely over this period, with near-zero production in 1994 and a high annual average of 24.47 acorns/square meter in 1991. Aspect of tree did not appear to have a strong effect, although the east side of trees often had the lowest count. I haven't attempted statistical evaluation of any of the observed differences, but I am confident that this approach provides a more sensitive resolution than the Graves technique, and would be a useful tool in monitoring acorn production over large areas and extended periods.

Opportunities exist for refinement of this method. A more formalized procedure for selecting trees and the portion of the tree to be sampled would increase objectivity of the counts. Collection and weighing a sample of acorns during the survey would allow comparisons of relative acorn biomass produced. Estimates of absolute biomass would not be available.

Use of binoculars with two sizes of field did not appear to create a serious problem in handling data. Overall data from the two plots provided a mean acorns/square meter of 1.1 for the smaller field of view and 8.2 for the larger. However, the observer using the binoculars with a wider (larger) field of view counted two trees on extremely good sites, which more than doubled the total acorn count for that observer. When these trees were eliminated from the sample, along with one similar tree from those counted with the small-field glasses, mean acorns/square meter was 6.6 for both data sets. Increased sample sizes would smooth such differences, although use of one brand of glasses providing a single size of field of view would simplify handling of data.



*Two extremely high counts for 32" plot are excluded (see text).

Graves Class	Number of Trees	Mean Acorns/ Square Meter	Range
1	4	0	0
2	23	6.6	1-104
3	3	59.5	12-122
4	0	0	0

Table 1. Comparison of acorn production estimates on Gambel oak using the optical plot and Graves methods of visual surveys.

Year	North	East	South	West	Average/ Year
1990	17.09	8.06	12.17	5.01	10.58
1991	29.23	16.75	26.98	27.91	24.47
1992	10.3	4.46	8.57	13.91	11.79
1993	1.33	3.65	3.46	2.53	2.74
1994	0.21	0.06	0.18	0.06	0.13
1995	14.6	20.06	17.8	17.46	17.48
Avg. Aspect	12.13	8.84	11.53	11.15	11.20

Table 2. Summary of Camp Wood Acorn Surveys 1990-1995 Acorns/square meter

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Literature Utilized

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Habitat Measurement
by Harley G. Shaw

Introduction

I've tried to imagine a situation wherein an individual who is not professionally involved in a wildlife management agency might want to assess an area as habitat for a species. Conceivably they might want to decide if an area would be suitable for establishment of a wild population or perhaps inquire into reasons a particular species isn't thriving locally. In modern wildlife management, technology has overwhelmed the field, and methods used include aerial photographs and other remote sensing data sources from drones, aircraft and satellites, large arrays of trail cameras, and monitoring by satellite of radio-tagged animals with telemetry units that may be able to record some elements of the habitat or of environmental conditions where the animal resides. All such high-tech methods are useful, no doubt, but they are expensive and normally require considerable training in their application. In general, they take the biologist away from the field and keep them in front of the computer downloading and interpreting large volumes of data. For an amateur naturalist wanting to study and enjoy surroundings, perhaps applying a modicum of measurement to help understand what they observe, simple observational tools may provide incentive to look more closely at one's surroundings and to evaluate what they are seeing insofar as it applies to particular species. What I describe here is a general approach that we used some 30 years ago to assess a couple of areas as wild turkey habitat. These were low-budget projects wherein the U. S. Forest Service and two state game agencies wanted a little more than just "drive around" expert opinions.

One of the areas was Boulder Mountain near Escalante, Utah. In that case, the ponderosa pine forest was infested by a bark beetle that was killing many trees, and a salvage logging program had been recommended by the U. S. Forest Service. Wildlife biologists wanted an evaluation of existing habitat and recommendations that might enhance the area for turkeys. In this case, the area was outside of historic wild turkey range, although efforts to establish wild turkeys had been modestly successful. The biologists were concerned on one hand that the salvage logging sale would cripple their efforts to establish birds and on the other hand, wondered if the logging effort might be planned in a way to enhance habitat.

The second area was the Bradshaw Mountain complex in central Arizona. This rugged mountain range had turkeys in small numbers when early naturalists first arrived, but the population had remained low and stocking turkeys from other areas hadn't led to permanently increased numbers. Another transplant had been proposed and U. S. Forest Service biologists wanted an assessment of the likelihood of success.

In both of these areas, neither funds nor time were available for intensive multi-year turkey research projects. The agencies wanted a quick, but data based, assessment. The approach we recommended kept costs low, put field personnel on the ground, covering the entire areas of interest systematically, and produced recommendations supported by crude quantification.

This approach, perhaps with modifications dictated by species of interest, could be used by anyone interested in evaluating habitat. It is essentially observational, requires no high technology or expensive tools, and will lead an interested observer to look closer at their surroundings.

Assessment of species habitat in an area may have several important components, including:

1. Review of history of the species and land use in the area of

Wild Turkey at the Black Range Lodge, Kingston, New Mexico. Photograph by Catherine Wanek January 2019.

interest. In many cases, determination of historic presence may require reading general history of an area, seeking incidental mentioning of the species of interest. However, in many cases suitably stated online searches can yield observations or leads to appropriate literature.

2. Review of existing literature on habitat requirements for the species of interest. Even as late as the 1990s, when we were doing the above turkey habitat assessments, such a review might require multiple trips to a university library to locate any existing technical papers on the subject. This is usually no longer the case. The tremendous amount of information for most wildlife species that has now been posted online will allow one to develop a fairly good overview of available literature in a few days' effort without leaving their own computer. At the time we did the above surveys, we used a recently-published set of Merriam's Turkey Management guidelines as a basis for our design.

3. Selection of habitat characteristics to be measured on the ground. This is discussed in more detail below.

4. Development of appropriate observational or measurement techniques.

Studies of wildlife habitat selection frequently are based on the measurement of sites where the presence of animals has been confirmed by direct observation, radio telemetry, or sign of use. In measuring these sites, biologists assume that the animal's presence was influenced by an array of habitat components existing within some radius around the location point. Very often, these points are compared with a sample of randomly-located points within a study area in order to identify those habitat characteristics which influence site selection. Depending upon the behavior associated with site selection (e.g. feeding, loafing, roosting, breeding, hiding) the relative importance of site

Assessments of canopy cover are influenced by the height of the dominant vegetation at the site, how dense the vegetation is, and many other factors. Southwest Canyon southwest of Kingston April 2023.

characteristics may change. This can be the most challenging part of such a project – doing the detective work to assess presence and, if possible, behavior of the species at sampling points.

We cannot simulate the senses of a given wildlife species when we assess its habitat, and so are limited to our own visual evaluations of habitat characteristics. Measurement of these sites usually includes, at least, overhead canopy cover, horizontal cover, vegetational structure, and ground cover within some radius of influence around the point of animal activity or random point. Such measurements are often time-consuming, and compromises must be made regarding necessary precision and accuracy and time or budget constraints for a habitat assessment project.

Canopy Cover

Any measurements made should relate to the habitat requirements of the wildlife species being addressed. One important structural feature is tree canopy cover. Canopy may provide thermal cover (both warmth and shade), escape cover from avian predation, and interception of precipitation. Canopy cover may also correlate with other habitat components such as tree basal area, mast production, herbaceous ground cover or horizontal visibility.

Canopy cover has been defined as the proportion of the sky concealed by plant crowns when looking vertically upward from a ground surface (Gysel and Lyon 1980, Emlen 1967). Many different methods of measuring canopy cover have been developed and compared, most of them based on an ocular or instrument-assisted vertical observation (Emlen 1967, Robinson 1947, Vales and Bennell 1988, Lemmon 1956, and Vora 1988). Since we completed our surveys, a host of other papers has been published regarding canopy cover measurement. One short and readable paper has been posted by M. L. Huynh of Northern Arizona University: "Assessment of various methods of canopy cover estimation that yield accurate results with field repeatability." This is undated, and does not indicate if it was published elsewhere.

During our assessments of habitat for wild turkey in Utah and Arizona, we began to question the usefulness of techniques for measuring only canopy cover directly overhead rather than entire canopy within a radius of the site. While these methods can be precise, the area represented by a single point measurement is small, hence a large sample is required

to accurately represent a larger area. For extensive habitat surveys, these methods become prohibitively time consuming and require additional equipment to be purchased. Vertical cover is emphasized by these methods, hence they do not account for canopy cover toward the horizon. An animal, however, is potentially affected by all the obstruction of the sky across a hemisphere around a given point. This "hemisphere of influence", which extends to the horizon in all directions from that point, is relatively easy to envision subjectively and probably more accurately represents the area to which a given animal responds than does cover straight overhead.

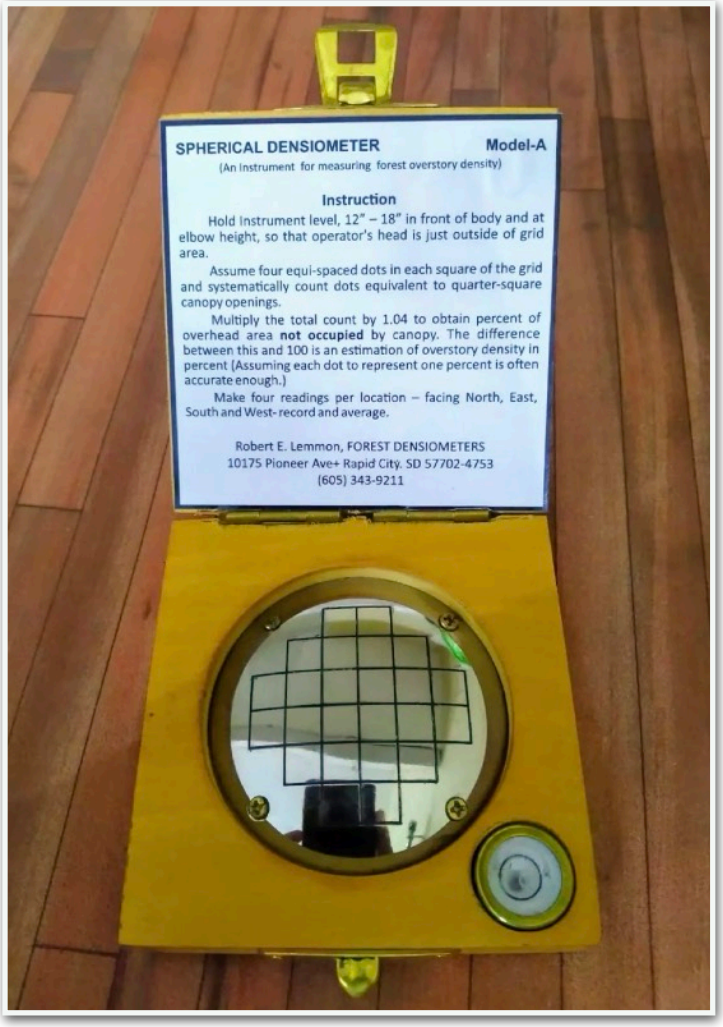
Of the most commonly-used methods for measuring canopy cover, the spherical densiometer provides a wide angle of measurement, but it does not provide horizon to horizon coverage. For the present, only fish-eye cameras or ocular estimates assess the entire visible dome at a given site. The method described here is an ocular method for "hemisphere of influence". It is henceforth called the quarter ocular estimation method (QOE). Because we were concerned about the precision of this method, as compared with the spherical densiometer, we ran a series of tests comparing the two methods in different forest and woodland stands.

Our objectives were to:

1. Evaluate individual observer variation for the quarter ocular estimate method compared with the spherical densiometer.

2. Determine if the two techniques yield significantly different estimates of canopy cover.

3. Assess the relative values of the two techniques in representing actual habitat traits influencing wildlife.



Methods

Ocular estimates and spherical densiometer readings were made during the summer of 1992 by a mixed team of experienced and inexperienced observers at nine points in different forest structural situations. Experienced observers included three who had used the method on several hundred points in assessing wild turkey habitat. Inexperienced observers included an array of interested volunteers, most of whom had no previous experience in field biology.

Among the volunteers were one high school student, two librarians, two housing contractors, a nurse, and several college students. Different people attended these measurement sessions at different times. The forest types measured were:

PJ opening - center of opening (approx. 30 yards across) in a stand of mature *Pinus edulis* (Colorado Pinyon) and *Juniperus deppeana* (Alligator Juniper).

PP/PJ - uneven aged mixed stand of *Pinus ponderosa* (PP - Ponderosa Pine), *P. edulis*, and *J. deppeana*.

PJ edge - edge of large opening in stand of mature *P. edulis* and *J. deppeana*. Site center was approximately 25 yards from the edge of the opening in all directions.

Mixed Conifer opening - center of small opening (approx. 15 yards across) in uneven-aged stand of *Pseudotsuqa menziesii* (Douglas Fir) and *Abies concolor* (White Fir).

PP opening - open, uneven-aged stand of *P. ponderosa*.

PP interior L.S - even-aged stand of pole-sized (6-8" dbh) *P. ponderosa* on relatively level slope.

PJ interior - stand of mature *P. edulis* and *J. deppeana*.

PP interior HS - even-aged stand of pole-sized *P. ponderosa* on 30% slope.

MC interior - interior of uneven-aged stand of *P. menziesii* and *A. concolor*.

At each sampling point, measurements were made by each observer in the four cardinal directions using ocular estimates and a spherical densiometer. Since the spherical densiometer does not read percent canopy cover directly, it is unlikely that any bias was introduced by using the two methods consecutively. Individual measurements were kept confidential until all observers had recorded readings for both methods.

Ocular estimates were made by visually defining a quarter of the

visible sky in each of the four cardinal directions. The instructions provided to the observers were as follows:

1. The observer stands facing north, south, east, and west at the sample point.

2. While looking upwards, the hands are raised above the head with straight arms, bringing the hands together.

3. The arms are brought down slowly and symmetrically at a 90-degree angle.

4. The downward motion of the arms is stopped at the horizon and the arms are brought together at the level of the horizon, defining a quarter-hemisphere. The horizon may be higher or lower than the observer, depending upon terrain. It is defined as the level at which all sky is obscured.

5. This procedure is repeated as many times as necessary to carefully observe the canopy cover in the quarter-hemisphere defined by the arm movements.

6. The percentage of the quarter-hemisphere that is covered by stems and foliage is estimated. The small holes between leaves are not considered unless they are thought to be large enough to afford visibility to the ground from the air. The idea here was that, in the case of turkeys, ability to detect and react to an incoming raptor would affect their reaction to canopy cover.

7. Repeat for the remaining three directions. The four estimates are averaged to obtain a single value for the sample point.

Spherical densiometer measurements in the four cardinal directions were made at the same sample points by the same observers. The spherical densiometer was placed on a tripod one meter high and leveled. Values obtained in each direction were averaged to give a single value.

Mean, standard deviation, and coefficient of variation for each type of method were calculated for each site. A coefficient of variation between observers was calculated for each technique at each site.

Finally, a correlation between site canopy estimates for the two methods was calculated. This regression line was then compared with a hypothetical relationship (y = x) to describe the nature of the differences between the methods.

Results

In open sites there tended to be greater variation between individual observers when using the spherical densiometer than when using the ocular quartering method. This was due to the fact that the densiometer provided a much lower reading than did the ocular estimate technique in areas with low canopy cover, hence even slight differences in readings provided by observers yielded very high coefficients of variation. Also, the densiometer was mounted on a tripod at a set height (3 feet), while observers varied in tallness. This added an element of variation to measurements.

Paired observations for observers were plotted against each other and a linear regression of .93 (r-squared -- .872) was calculated on a total of 79 data points. The linear regression (y = .65x + 23) reflects the tendency for the ocular quartering method to yield higher estimates of canopy cover than the densiometer at low canopy densities and to yield slightly lower canopy measurements than the densiometer at high canopy densities.

Discussion

The ocular quartering method provides a measure of the canopy cover within the "hemisphere of influence" for a particular sampling point and may be a useful tool in large scale habitat surveys. The method is rapid and requires no field equipment. It may more accurately represent the canopy cover an animal sees when using a site than measurements with the densiometer.

Variation between observers was similar between the ocular estimation method and the spherical densiometer, even though a much larger area of the sky was sampled using the ocular method. Some variation between observers using the spherical densiometer was probably due to tallness of observer and minor differences in stance. Variation between observers using the ocular estimation method seemed to be due primarily to individual differences inherent in estimations.

There were some problems encountered with the ocular estimation method which could be resolved if the technique were refined. For instance, the "horizon" is the baseline for the measurements, but its location is sometimes difficult to determine, especially in densely wooded areas, high slope areas, or hilly areas with multiple horizons visible from a sampling point. Another problem with the method is that "holes" in the canopy of a certain size are not included in the overall measurement. The effect of these "holes" on measurements may vary with vegetation type, and may be greater in very dense canopy.

In areas of sparse canopy cover, the ocular quartering estimates are higher than the readings obtained using the spherical densiometer. This is because the ocular quartering method takes into consideration vegetation nearer the horizon than does the densiometer. From this standpoint, the ocular estimate represents the hemisphere of influence affecting terrestrial species (such as the turkey) better than does the densiometer.

The lower measurements yielded by the estimate method at higher canopy cover levels reflect the ability of this method to consider openings in the canopy all the way to the horizon, perhaps reflecting the total canopy within the hemisphere better than the densiometer. This whole-sky comparison is very interesting because it suggests that in open areas, most of the cover is fairly horizontal while in areas with a lot of canopy, most of the holes are fairly horizontal. This makes me wonder if horizontal openings or closures in these extreme areas might not be an especially important habitat component. If the regression formula were used for interconversions

between the two methods, it seems that conversions from SD to OQ would not be very valid because you are assuming things about the horizontal cover component that may or may not be true - i.e., since the OQ method is measuring a greater area, OQ readings cannot be predicted from SD readings. Conversions from OQ to SD, however, do seem valid. - in range where .95 interval overlap exists.

Overall, the ocular quartering method appears to be a very simple and useful tool in wildlife habitat assessments. We suspect that if a large number of points were sampled with the densiometer within the total hemisphere of influence viewed by the ocular estimate, the values of the two methods would converge at the extremes. Unless extremely high precision is required, the added labor is probably not justified. Also, because both methods yielded similar variability due to observers, the added sampling effort seems difficult to justify. Finally, it should be noted that our densiometer measurements were made with the instrument on a tripod and leveled. The commonly-used method of hand holding the densiometer would significantly increase individual variability. Thus use of this tool may do little more than give the observer a sense of using an objective technique, which may be a false sense of security.

Smaller or tree-dwelling creatures might require another approach. Certainly, some understanding of the animal being studied is important in designing assessments of any kind.

Horizontal Cover

A second measurement we recorded was horizontal cover. This, simply stated, was the distance at which a turkey might detect a predator on the ground. We called it the visibility distance. It was based upon an application of an ancient backwoodsmen's notion of a "sight". The "sight" was a means of describing the distance between two points along a woodland trail. The idea was simply that you looked ahead and determined the most distant point before the forest became a solid wall that blocked further vision. Walking to that point was one "sight". You then looked ahead and selected the next most distant point that you could see. In this application, it was a crude but useful measurement that provided a simple means of describing distance between two specific points. Crude though it might be, counting "sights" allowed a hiker or horseman to know when he was nearing his destination. It was not an actual measurement in yards or miles and applied only to the route being described.

In applying the concept to habitat assessment, we tried to be a bit more rigorous. Using the same plot center from which we measured canopy cover, we estimated the distance in yards beyond which we could no longer see along each of the four cardinal compass directions. These

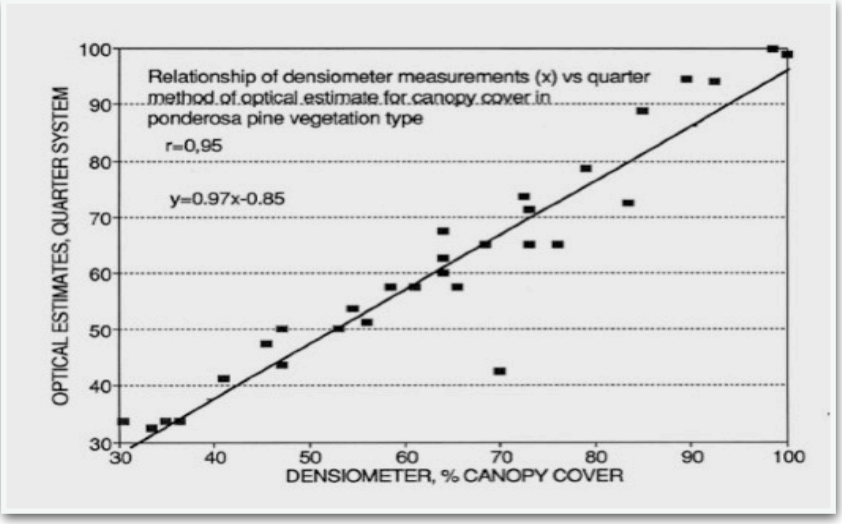
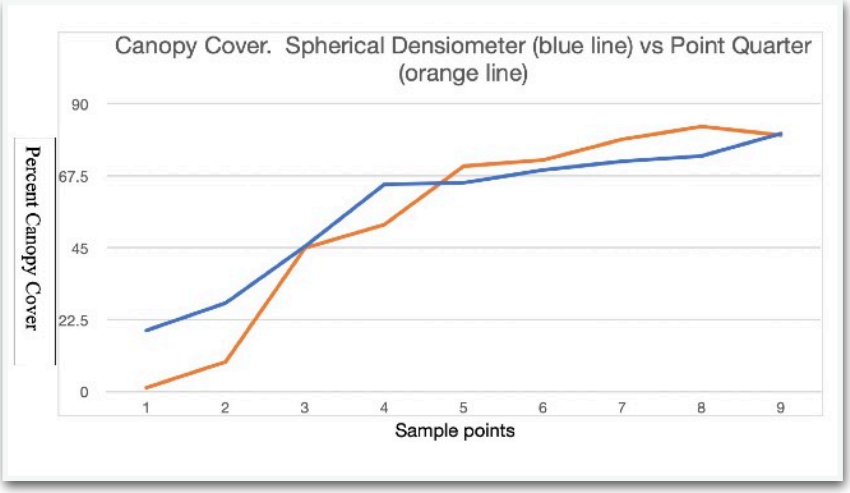


Table 1. Sperical Densiometer versus Point Quarter (Ocular estimate) estimates of canopy cover. Averages of all observers.

Habitat	Densiometer	Point Quarter
PJ opening	19.1	1.2
P/PJ	27.7	9.3
PJ edge	45.4	44.9
MC opening	64.8	52.2
PP opening	65.3	70.5
PP Int. LS	69.3	72.4
PJ Int.	72	78.9
PP Int. HS	73.7	82.9
MC Int.	80.7	80.2



numbers compiled and averaged provided an index of relative cover density for the area being evaluated. Some precision to the method can be added by use of a rangefinder to assess "sight" distance. Or if two people are working together, one can walk along the cardinal compass reading until they can no longer be seen by the person at the site center, then pace back to get the estimate of distance.

Ground Cover

Perhaps the most difficult site characteristic to evaluate is herbaceous ground cover. Precise estimates of herbaceous foliage normally require line transects with small (1 square meter or less) plots used to estimate foliage density and height. Greater precision can be gained by clipping and weighing foliage in known-sized plots. Such tools can be applied by the amateur naturalist, but become labor intensive. Weighing of foliage requires drying ovens.

A tool that requires less labor and time is known as the Robel pole. It is simply a long pole marked off in 5 or 10 cm segments that allow an observer to record the percentage of the pole covered by herbaceous, grass, or short shrub vegetation at a given distance. (See U. S. Forest Service image to the right.) Unfortunately, we found that the ground cover in the two areas where we surveyed turkey habitat was too sparse to give us any readings on the pole. As a result, it served mainly as a walking staff, and we resorted to simple estimates of percentage of ground covered on the site.

Basal Area

A final measurement we made was basal area of trees. To do this, we used a standard timber survey technique that requires an inexpensive angle gauge (see top right). Inexpensive gauges can be purchased for this purpose. I discovered that the width of my little finger at arms length was the equivalent of a 10 factor angle gauge.

I merely stand at the site center, turn in a circle, and count all trees that

appear wider than that finger and multiply by 10 to estimate basal area of a site.

Any such measurements as these require a certain understanding of the species for which habitat is being assessed. When assessing habitat for turkeys, we also recorded all turkey

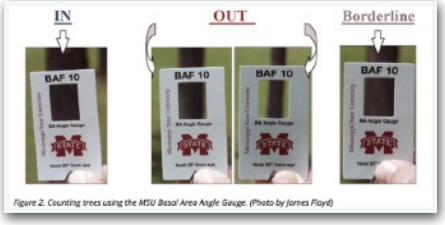


Figure 2. Counting trees using the MSU Basal Area Angle Gauge. (Photo by James Floyd)

sign observed while we were on the transects, including tracks, areas of scratching, droppings, feathers, and, rarely, nests. Active nests would occur only in late spring, early summer; old, abandoned nests were extremely difficult to find.

In addition to the measurements described here, we made a subjective evaluation of each sample site as potential brood range, feeding area, nesting habitat, roost site, and escape cover.

See also: Comparison of five canopy cover estimation techniques in the western Oregon Cascades.

Pellet Counts
by Harley G. Shaw

Earlier in this issue we referenced the use of pellet counts to estimate wildlife populations and habitat use. In that context, attention was paid to bias in the study structure and application of the count techniques. Pellet counts have been - and remain - important tools in wildlife management.

I based my M. S. thesis on pellet counts – they were about the only tool for assessing deer habitat use at the time. I ran many miles of pellet group transects on the Three Bar Wildlife Area, the Beaver Creek Watersheds, and the North Kaibab.

There was a time in the 1960s and early 70s that most of our time was spent running pellet counts.

I think it is still a legitimate tool for curious naturalists. We normally used a 100 square foot circular plot. Center points of plots were located with

stakes and flagging. Plot radius was determined with a pole 5.65 feet long. Pellets were counted and cleared twice yearly, providing a running estimate of deer numbers or, if preferred, a simple index of density. Personally, unless an agency can afford expensive capture/recapture studies, I think pellet counts done well still provide an adequate index to ungulate populations. They've always had the stigma of "counting shit", and many businessmen, lawyers, politicians, and other image oriented "scholars" tend to discount them. But like many such simple techniques, they get you out on the land, looking, and provide statistically tested numbers.

Don Neff's paper on pellet group counts is still cited in ungulate survey literature. He and I worked closely together on the Beaver Creek Watershed studies in Arizona.

Neff, Don J., "The Pellet-Group Count Technique for Big Game Trend, Census, and Distribution: A Review" *The Journal of Wildlife Management*, vol. 32, no. 3, 1968, pp. 597-614. *JSTOR*, https://doi.org/10.2307/3798941.

Many "traditional" techniques have been superseded by technology in agency-level studies today but they remain valid and when properly applied accurate. The thought behind a study is generally more important than the technology which is used.

Issues of Technique and Knowledge
by Bob Barnes

In "Statistical Ritual Versus Knowledge Accrual in Wildlife Science" Fred Guthery noted that "I hypothesized that statistical ritual has supplanted knowledge accrual as the *sine qua non* of wildlife science. Under the hypothesis, I deduced occurrence of 1) significance testing of the obvious and inconsequential, 2) quantitative debasement of research problems, and 3) publication of papers that largely lacked information but were methodologically impeccable. Articles in past and recent wildlife literature fit the deductions and supported the hypothesis. Thus, wildlife science is operating inefficiently because quantitative formalities are supplanting ecological information in technical articles. This problem can be corrected by a change of mindset in authors, referees, and editors. The change entails less emphasis on quantitative ritual and more emphasis on information that aids in understanding and explaining nature and managing wildlife." (Abstract, *The Journal of Wildlife Management*, 72(8):1872-1875; 1 November 2008)

This is not an insignificant issue and one which is somewhat contentious. It is about gaining knowledge. A counter argument was presented in "Create a culture of experiments in environmental programs - Organizations need a better 'learning by doing' approach", Ferraro et al., *Science*, 18 August 2023, Vol. 381, pp. 735-737.

In this article Ferraro et al. posit that "An understanding of cause and effect is central to the design of effective environmental policies and programs. But environmental scientists and practitioners typically rely on field experience, case studies, and retrospective evaluations of programs that were not designed to generate evidence about cause and effect. Using such methods can lead to ineffective or even counterproductive programs. To help strengthen inferences about cause and effect, environmental organizations could rely more on formal experimentation within their programs, which would leverage the power of science while maintaining a "learning by doing" approach. Although formal experimentation is a cornerstone of science and is increasingly embedded in nonenvironmental social programs, it is virtually absent in environmental programs. We highlight key obstacles to such experimentation and suggest opportunities to overcome them." p. 735

Identifying "nonenvironmental social programs" as a benchmark is unfortunate, given the generally dismal success rates in research on social behavior, but the gist is useful. There is an implicit bias against regulatory controls, see the graphic on page 736 which indicates that pollution would decrease more if we relied more on self audits and less on increased inspections - despite the historical record. This apparent bias is bothersome because it hints at an underlying agenda. There remains an unfortunate truth about humanity and capitalism (or other economic models) - if you make a regulation people will try to increase their monetary gain from the start by gaming the system. If you do not regulate, humans will do as they wish.

A more robust experimental structure is useful but not a panacea.

Both arguments suffer from a pendulum effect; the extremes rarely get it right. However, and this is a big "however", the extremes often contain a grain of truth, often a very insightful truth. Throwing out the extremes without utilizing the "truth" is counterproductive.

Ferraro et. al. identify "Four conditions when experimentation pays off:

- Pre-Change Ambiguity - When theory and experience alone cannot unambiguously predict the expected impacts of changes in program implementation.
- Post-Change Ambiguity - When estimating counterfactual outcomes in the absence of a change in program implementation is challenging using traditional approaches.
- High Implementation Cost - When a change in program implementation is unlikely to pass a benefit-cost test, or cost-effectiveness assessment, without medium or large impacts.
- Generalizability of Results - When the lessons learned from experimentation are generalizable beyond the context in which the program change was implemented."

This listing is a start but its strengths and weaknesses become obvious in various implementation schemes. Science is not pristine. Science is done by humans.

Ferraro et al. end their article with one of those grains of truth: "We recognize that experimentation is not the only way that a scientific lens can be applied to improve our understanding of program implementation. Experimentation is best viewed as part of a mixed-methods approach to generating evidence rather than as a substitute for more traditional ways of gathering evidence. Experimentation should, however, be a regular feature of programs, not a rarity."

I think that Guthery would add that the experimental framework should be done right and the structure should be designed to explore meaningful insights.

We have explored these concerns in previous issues. See: Volume 1, Number 1, July 2018, "Lore Versus Science and Natural History", and Volume 3, Number 1, January 2020, "Two-eyed Seeing", for specific discussions, but the issues are routinely addressed in this journal. In a sense this is nothing more than the arguments about applied versus pure science.

The National Science Foundation is betting that knowledge discovered through observation, as opposed to "western" experimental structure, can be integrated into western knowledge schemes. See - "Can Indigenous knowledge and Western science work together? New Center bets yes", *ScienceInsider*, 25 October 2023. The University of Massachusetts (Amherst) Center for Braiding Indigenous Knowledges and Science (CBIKS) "is about recognizing that Indigenous knowledge systems carry tremendous information and value, and it's shortsighted to think that current research practices founded on Western knowledge systems are the only or 'right' approach" (Sonya Atalay, CBIKS Director and UMass Amherst Provost Professor of Anthropology). Northern Arizona University is a partner in CBIKS. Their thematic working group in the southwest will address "ethics".

As in all things, a variety of approaches can be more fruitful than a more restricted approach.

Red Velvet Mites

Many readers know about Justin Schmidt, or at least have heard about some guy in Arizona who lets things sting and bite him. Justin Schmidt is an adjunct scientist at the University of Arizona, in the Department of Entomology. In addition to getting bitten a lot, he has studied Red Velvet Mites for more than thirty years. On 10 August 2022, he published "Big, bad, and red: Giant velvet mite defenses and life strategies (Trombidiformes: Trombidiidae: Dinothrombium)" in *The Journal of Arachnology* (50[2]: 175-180), in which he outlined what he has learned about the natural history of these creatures.

Before we get into some of the juicy parts, I should note that this is not an article about some far-away exotic creature encased in the stuff used to cover your grandmother's sofa. You can see these mites shortly after a monsoon rain anywhere in the Black Range. The photograph above and those in this Black Range photo gallery were taken just east of Hillsboro. Sometimes they are found in such profusion that it is a bit unnerving.

As a young lad in Tennessee I was once bitten by a Red Velvet Ant (not a Red Velvet Mite) what we called a "Cow Killer", *Dasymutilla occidentalis*. These parasitoid wasps (not really ants) can pack a wallop. Since then I have always had an aversion to velvet things. To bring things back around, the wallop of a Red Velvet Ant is ranked at 3 or 4 on the "Schmidt's Sting Pain Index". (Yes, Justin Schmidt's Pain Index and yes, "4" is as high as the index goes - thus my excellent memory of the event.)

Schmidt set about discerning why these mites had so few predators. For the right sized predator they could be a morsel. They are the largest mites in the world (prior to eating a large meal; some others can grow larger when engorged). Schmidt notes in his study abstract "*Of the 12 species of insect predators and 11 species of other arthropod predators offered mites, only the larvae of antlions were possibly meaningful predators.*" And, generally, antlions were unsuccessful in their predation. Also from the abstract - "*When sampled by the author, a velvet mite produced an exceedingly bitter, astringent, and spicy taste that endured in the mouth for about an hour. Overall, velvet mites appear to have no meaningful predators, likely because of their enormous suite of highly effective defensives: red aposematic coloration, aposematic odor, a tough puncture-resistant integument, unpleasant tasting chemicals on the integument, and exceedingly distasteful internal compounds.* " (Underline added by the editor of this journal.) In an interview with the University of Arizona Press he described the experience: "*I put in on the tip of my tongue and then used my incisors to just kind of break it up a little bit. I chewed for, oh, just a couple of seconds, and immediately it just exploded with flavor. I still don't know how, but the flavor immediately spread from the tip of my tongue to the back of my throat. I spit it out and hawked that stuff out. It was astringent and kind of a sharp, unpleasant, spicy flavor. It was like mixing quinine with habanero.*"

A Little About Larvae
by James Von Loh

At all stages of their lives, damselflies and dragonflies (*Odonates*) are predators, primarily of other arthropods but also of each other! Humans most often encounter and observe them in the colorful, adult form when energy/behavior is directed towards migrating to and from suitable habitats, hunting to maintain health and vitality, and reproducing (mating and ovipositing). However, much of the Odonata life cycle occurs underwater as nymphs/larval stages (instars) that after hatching from an egg may require a few weeks to a few years to mature. (Up to 4-6 years have been recorded, due to hibernation in cold, temperate climates.) Ten to twelve or more molting events occur as the nymphs become larger and emerge in observable immature forms which grow into the colorful adults. (All photographs in this article are by the author.)

Viewing a small retention pond near the Dripping Springs Visitor Center of the Organ Mountains allowed me to photo-document some stages and behaviors of larval feeding, emergence, and transformation to the flying, immature form. Several dragonfly and damselfly species mated and deposited eggs in this pond during the 2022 monsoon season (Spot-winged Glider, Twelve-spotted Skimmer, Flame Skimmer, Red Saddlebags, Common Whitetail, Variegated Meadowhawk, Plateau Spreadwing, Familiar Bluet, Mexican Forktail). The most common emerging larvae/immature *Odonates* I observed were Spot-winged Gliders (large dragonfly), Variegated Meadowhawks (small-medium dragonfly), and Plateau Spreadwings (medium-large damselfly).

Odonate larvae are carnivorous and are among the top predators in the aquatic food chain; examples of prey captured and consumed include water beetle and mosquito larvae, damselfly and dragonfly larvae, worms, tadpoles, small fish, etc. Larvae are equipped with a lower jaw that is both flexible and extendable, contains hooks and sharp teeth, and can be rapidly "launched" at passing prey; this form of ambush hunting is efficient and effective.

Above: A large dragonfly larva captures a smaller dragonfly larva that had reached its final instar (note the thickened exuvia/larval skin) and was ready to emerge. Based on size and commonness, I believe these to be Spot-winged Glider (L) and Variegated Meadowhawk (R) dragonflies.

All Odonate larvae can breathe by sucking water into their abdomens, through internal gills (larvae can also eject the water forcefully to propel themselves for a quick escape). Damselfly larvae are mostly slender and elongated with leaf-like external appendages known as caudal lamellae (function as external gills to breathe). The photograph below shows the caudal lamellae of a Plateau Spreadwing damselfly final larval instar as it emerges from the water. Note that at this stage, these external gills have ceased to function and the larval damselfly is breathing air on its own.

Above: Caudal lamellae, attached to the exuvia, drying in the warm temperature and light wind of early morning as an immature Plateau Spreadwing damselfly works free from this thickened skin.

Right: Dragonfly larvae are typically robust and can be quite large, almost caterpillar-like when viewed. Here a large larva is shown with its abdomen opened at the water surface to suck in water and air and pass it through internal gills; the shiny, whitish area looks like an accumulation of bubbles. I believe this large larva to be of a Spot-winged Glider dragonfly.

Predation

Above: A dragonfly larva (L) feeds voraciously on a smaller dragonfly instar (R); its rolling, diving, surfacing, and sideways motions churned and rippled the water, attracting me to this portion of the retention pond, where I collected the image series.
Far Right: At times, the large larva would feed below while elevating its abdomen tip vertically to the water surface to take in water and air through the internal gills.
Bottom Center: The head and thorax area of the small larva are thoroughly ripped apart at this feeding stage.
Bottom Right: About half of this small larva has been eaten from inside the relatively thick skin (exuvia - shown in more detail on the following page).

Abandoned dragonfly exuvia. The immature dragonfly emerges through the thorax area - behind the head but in front of the wing bases where the white, thread-looking connective tissue is exposed.

When ready to emerge as immature (soft-bodied teneral) damselflies and dragonflies, the final larval instars climb from the water, often onto an emergent plant stem or twig. At this stage they no longer use the larval (external/internal) gills and are capable of breathing air. The larval skin is ruptured as the immature damselfly/dragonfly pumps bodily fluids throughout to expand its head, thorax, abdomen, and wings; it will be ready to fly after the body cuticle and the wings air-dry and harden, usually after an hour or more. The empty skin remains attached to the anchoring substrate, e.g., leaf/stem/twig/etc.

Bottom Center: I believe exuviae of this relatively small size were produced by Variegated Meadowhawks.

Above: A pair of large exuviae that I believe were abandoned by Spot-winged Glider immatures.

Below: This abandoned exuvia is being examined by a Long-jawed Orb-weaver spider, perhaps as a place to hide and capture visiting scavengers or maybe to feed on organic material left behind following emergence.

Right: The narrow, elongated exuvia to the left was abandoned by a Plateau Spreadwing damselfly and the wide, compact one to the right by a dragonfly. Note, it is not clear to me that this dragonfly larva completed a successful emergence.

Emerging from the exuvia is an elaborate and fascinating process. Starting at the lower right and continuing on the following page the efforts of an immature Plateau Spreadwing are documented. At the lower right it is still encased within its larval skin and has climbed out of the pond onto an emergent grass fruiting panicle. Note its four wing bundles bulging on the thorax area.

Climbing out of the water, this Plateau Spreadwing is preparing to emerge from its exuvia.

Above: Plateau Spreadwing immature (soft-bodied teneral form) emerges from its exuvia as it expands in size by pumping body fluids into the wing and body/abdomen segments.

Left: Plateau Spreadwing soft-bodied immature form, posing for "selfie" with its former self. Air-drying of its cuticle and wings may require over an hour.
Above: Plateau Spreadwing immature takes its first flight to hiding cover while completing the drying/ maturation process.

Left: Variegated Meadowhawk soft-bodied immature form, posing for "selfie" with its former self. Note that air-drying of its cuticle and wings may require over an hour.

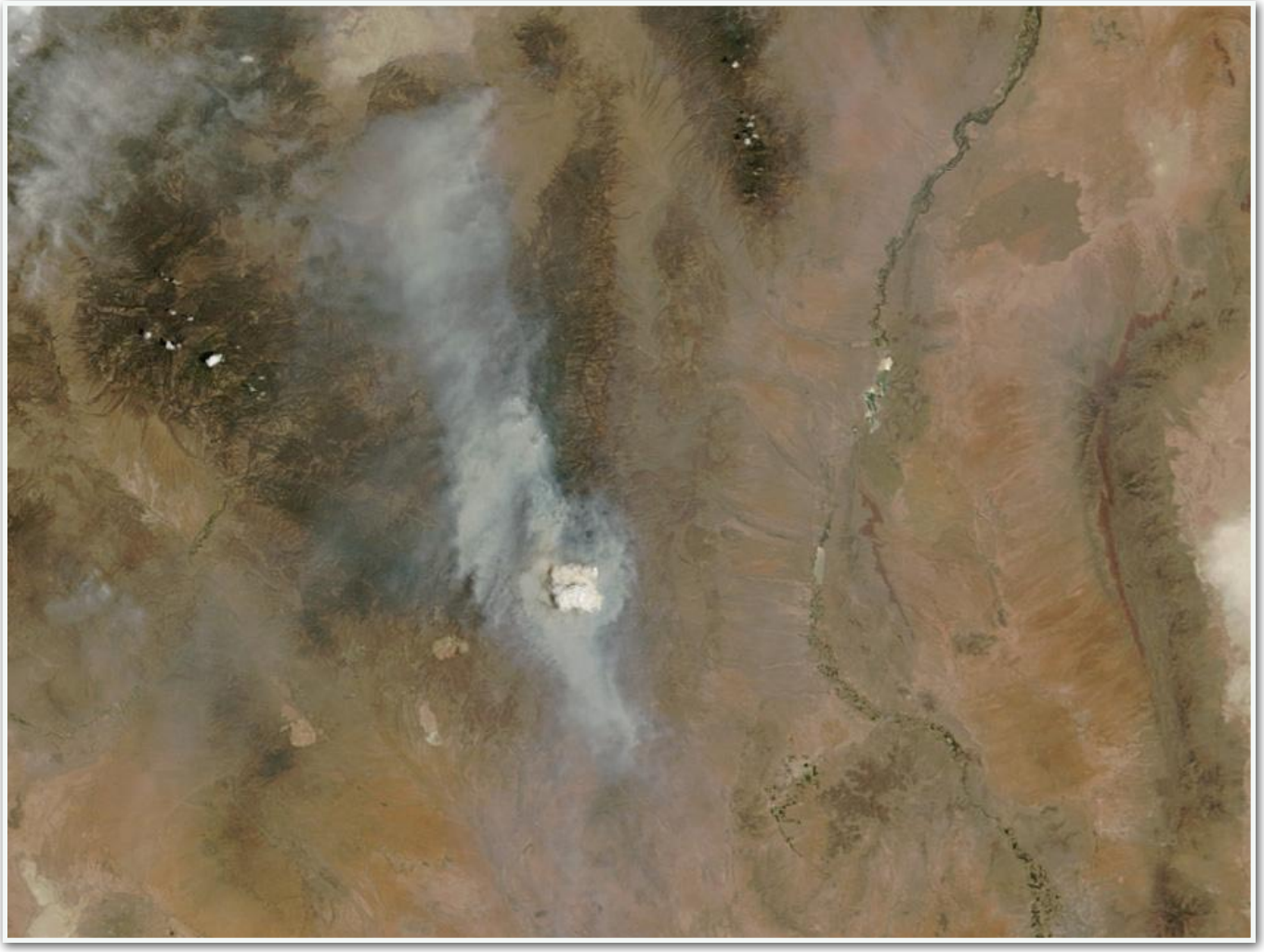
Bottom: Variegated Meadowhawk immature has nearly completed expanding its body and wings through pumped fluids and is air drying prior to flight to more protective cover.

Above: Variegated Meadowhawk immature takes its first flight to hiding cover while completing the drying/maturation process.

Right: Abandoned exuvia, likely of a Spot-winged Glider, remains attached to grass stem, at the water surface.

Below: Spot-winged Glider immature has nearly completed expanding its body and wings through pumped fluids and is air drying prior to flight to more protective cover.

"Paulson, Dennis. 2009. *Dragonflies and Damselflies of the West*. Princeton University Press; Princeton, New Jersey, was used as a reference in developing this article.



Black Range Weather Pyrocumulonimbus Clouds

On June 12, 2013, NASA took the image above with its Aqua Satellite, using its Moderate Resolution Imaging Spectroradiometer (MODIS) equipment. The image is of a huge Pyrocumulonimbus cloud forming over the Silver Fire. In the weather world, these clouds are abbreviated as pyroCbs. Pyrocumulonimbus clouds form when significant heat forces the air to rise dramatically. In this case the heat was generated by the fire. Volcanic eruptions often create sufficient heat. Once the air rises sufficiently it cools and water vapor condenses.

Because of the intense heat of the fire this cloud rose to about 6.5 miles above the landscape. As the air rose it carried smoke and small debris into the atmosphere, higher than is the case with normal cumulus clouds.

Once in the "upper" atmosphere those pollutants are dispersed over a wide area. On June 13 the air in much of the southeastern United States had "elevated concentrations of particulate matter", from this event.

The air at the top of this cloud had a temperature of about -50°F., roughly 20° F. warmer than normal cumulus clouds.

Climate change is creating more intense fires and those fires are spawning more and more pyro-cumulonimbus cloud events. In 2017 such an event in British Columbia created a plume which remained in the atmosphere for eight months. The Australian fires of 2019-2020 created plumes which remained in the atmosphere for fifteen months. The study of these clouds only began in earnest in 2013. Prior to that time it was thought that they were very rare. We now know that they occur every year, averaging about 50 events per year. But, as of September 12, 2023, the Canadian fires of 2023 had spawned 135 such events.

"Data Chat: Dr. David Peterson - For meteorologist David Peterson, Ozone Mapping and Profiler Suite (OMPS) data are crucial for studying pyrocumulonimbus events", Earth Data (website), August 28, 2023.

The interview referenced immediately above provides significant insight into how the study of pyroCbs events has developed, what the dynamics of those events are, and some of the implications of what may be a developing trend.

The image above shows smoke (the gray color) traveling far afield from its Australian point of origin (January 2, 2020). (Image from the interview.)

Odonata - The Skimmer Family
by James Von Loh

Skimmers comprise the largest Odonate family and are typically the species a casual observer will see when visiting likely habitats (Paulson 2009). Skimmers exhibit nearly every dragonfly color, some species have complex patterns and many display diagnostic wing colors and patterns. Obvious family characteristics include; large eyes that touch in the middle, the foot-shaped anal loop, male and female hindwings are similar, typically males are brightly colored and females duller, often brown, and males typically have a longer, tapered, and pointed abdomen, while female abdomens are thicker, blunt, or truncated (Paulson 2009).

Most Skimmers are "perchers" except for some genera of tropical origin which are "fliers". Perchers feed from a stationary site (e.g., leaf, stem, twig, rock, etc.) flying up to capture small flying insects (sallier-style); but perchers also spend time flying when conducting sexual patrols. Fliers rarely perch, instead flying incessantly to feed by diving down on small flying insects (hawking-style) and conduct sexual patrols; they perch by hanging vertically on leaves and branches (with their head pressed against the perch) in dense vegetation to "sleep" in the hottest part of the day and at night when it is cool.

Whitetails (*Plathemis*)

Whitetails are stocky skimmers of muddy ponds and slow streams that spend much time perching on rocks, logs, and other flat sites (Paulson 2009). They have striking wing markings, and males have very heavily pruinose abdomens.

Plathemis lydia (Drury, 1773) Common Whitetail

Small, quite active skimmers that may be observed along lakes, ponds, and slow streams, including those constructed by humans. Occurrence in Doña Ana County is well within its wide principal distribution (AZ, NM,

Above and Below: Gordon Berman collected amazingly clear close-up images of a female Common Whitetail in Soledad Canyon, which he graciously shares. She is perched on a rock to warm and to hunt small flying insects. Her eyes and face are brown and her thorax is brown to brownish-tan with two white stripes (turning yellow at the end) on the side. Her abdomen is brown with white to pale yellow spots (outlined in black) along each side (forming lines on S2-S3 and extending diagonally on S4-S8). Her wings each have three equidistant black marks that differ from those on the male's wings.

TX, eastern CO to MN and southern Canada to the eastern US coast; also non-desert CA, OR, WA, ID, and southern MT and BC; and in eastern Mexico to Nuevo Leon). The NM flight season is July-September (Paulson 2009); however, I have observed them in October and November along the Rio Grande, and Gordon Berman documented one in April 2023 within Soledad Canyon. I have observed them hunting along the Rio Grande bank and within a runoff retention pond at the Dripping Springs Visitor Center parking area; they used dried stem perches, rocks, and logs and branches exposed above the shallow flow. It can be a challenge to collect images of them due to wariness, and typically males are present, without females.

Female perched on leaf litter behind a linear stand of Spiny Chloracantha, *Chloracantha spinosa* ([Benth.] G.L. Nesom) along the Rio Grande bank to find protection from a cold November wind. Note her wingspot pattern; her nearly uniform brown face, eyes, thorax, and abdomen; and the pale yellow rows of spots on each side of her abdomen. She was nearly invisible, even at close range.

Male perches on dark rocks to warm in the sun, hunt for small flying insects, and likely is displaying to attract a mate. Note he holds his wings slightly "drooped" forward on this perch.

This somewhat enlarged photograph illustrates the male's evenly dark brown face and eyes, dark brown thorax, and the uniformly pruinose, white to pale blue abdomen.

Male perched on a low twig is short and stocky; however, he appears very large when compared to the male Desert Firetail, *Telebasis salva* Hagen, 1861, a small and slender damselfly often observed in the same habitat.

Right: The wings of the male have wide black crossbands nearly to the tip and a narrow black rectangle at the wing base; behind the basal wing spot is an area of white on mature individuals. Note the intensity of his pruinose, white abdomen color on this cloud-dimmed day.

Male perches high and horizontal on a branch, providing a rare ventral image. He's hunting for small flying insects, defending and patrolling around his territory, and likely is displaying to attract a mate. Note the extent of the orange from wing base to mid-wing, orange along the leading wing edges, and his entirely orange body.

King Skimmers (*Libellula*)

King Skimmers are large, conspicuous, and often have distinctive colors and wing patterns, these dragonflies are quite common, ranging across the Northern Temperate Zone and also extending south into mainland American Tropics (Paulson 2009). They are perchers, salliers, and often fold their front pair of legs behind their head when perching. Most North American species fall into distinct species pairs or trios and are similar to one another, making identification challenging.

Libellula saturata (Uhler, 1857) Flame Skimmer

The Flame Skimmer is a common large and robust, bright orange skimmer with extensively orange wing bases. Occurrence in Doña Ana County is well within its principal distribution (all of NM and the southwestern US from central TX to OR and ID; also in uplands of Mexico to Oaxaca). The NM flight season is March-November and I have observed them during the months of June, July, August, September, October, and November locally. They occur within a broad habitat selection including ponds, lakes, slow streams, and adjacent uplands, and perch/hunt along the Rio Grande banks, associated irrigation ditches, in the retention pond at Dripping Springs Visitor Center, the constructed La Mancha Wetland, and in the canyons (Achenbach, Soledad, Fillmore, etc.) draining the Organ Mountains.

Enlarged view of male's head and thorax illustrates his red-orange face and eyes, orange thorax and wing bases, and orange legs as he perches against a Soft-stem Bulrush, *Schoenoplectus tabernaemontani* ([C.C. Gmel.] Palla) stem.

Above: Male perched on a branch with his abdomen at a downward angle is warming in the sun. He is likely displaying to attract a mate and hunting for small flying insects. Note nearly any opportunity to photograph this skimmer, at any angle, will usually result in a memorable image/series.

Below: Male exposes the white dorsal midline of his thorax while hanging from overnight perch and warming in the morning sun. Note the dark, elongated orange-red spots at each wingbase.

Above Left: Male exhibiting typical horizontal perching style for this species as he hunts small flying insects and likely displays to attract a mate.

Above Right: Male perches horizontally on a twig, facing into the wind blowing across the Rio Grande, while hunting small flying insects and likely displaying to attract a mate.

Above: Ventral view of a pale brown-colored female, in her typical perching form on a branch, i.e., hanging with abdomen pointed down (likely to avoid overheating in bright sunshine) while hunting for small flying insects.

Above: An enlarged view of the most common female face and thorax illustrates her brown face and eyes and pale brown thorax and legs.

Below: "Some females may have a bright orange body and much orange in the wings, similar to males" (Paulson 2009).

Above: Female perches on a Cocklebur (*Xanthium strumarium* L.) stem; early afternoon lighting enhances her wing color pattern along each leading wing edge. Note her abdominal widening at the S8-S9 segments; this flange aids in depositing eggs in water.

Upper Left: Female in dorsal view, perched by hanging from a twig, illustrating the white mid-dorsal line on her thorax and the extent of coloration along the leading wing edges. She avoids sun exposure by lowering her abdomen while hunting small flying insects.

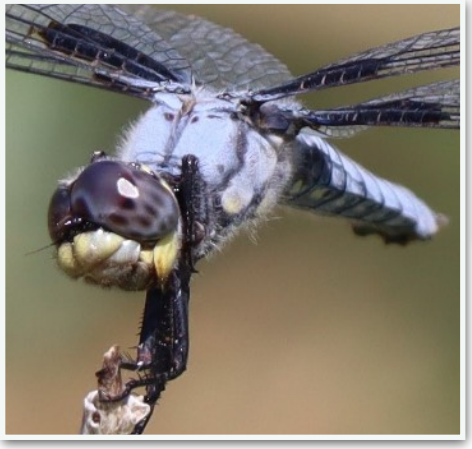
Middle Left: Following mating, female deposits fertilized eggs by tapping her abdomen tip into the water and releasing several of them with each tap. While she is ovipositing, the male flies back and forth over her and challenges competing males and possible predators.

Bottom Left: The egg-laying female (typical tannish-brown form) landed about a foot from me following egg deposition into the near-bank water. She was resting/sleeping with her eyes pressed on a dried stem while the male continued to fly around her, perhaps for her protection or just as likely for an opportunity to re-mate.

Above: Three groups of eggs were deposited by this female tapping her abdomen tip into the water, to release and spread eggs while she flew steadily back and forth along a canal bank. Note how eggs in the water are effectively highlighted/reflected in angled sunlight.

Libellula nodisticta (Hagen, 1861)
Hoary Skimmer

The Hoary Skimmer is large and has two dark spots on each wing that are smaller than in other, similar species. Occurrence in Doña Ana County is south of its principal distribution (northwestern NM to southern WY, then west to CA, OR, WA, and southern BC; also in uplands of Mexico to Michoacan). The New Mexico flight season is June-August. Occurs along marshy, slow streams, ponds, and/or seeps and springs; observed hunting from dried stem perches along the Rio Grande bank and in the large arroyo draining the Organ Mountains. I observed individuals only twice in June and August of 2022.

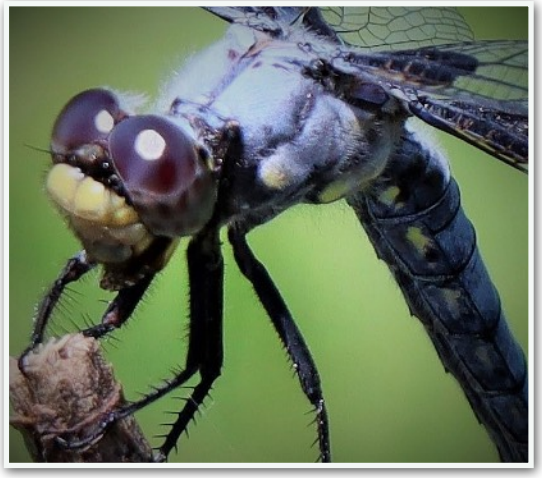


Top Right: In bright sunshine, the Hoary Skimmer droops its abdomen downward to minimize exposure and overheating (Paulson 2009).

Top Left: Perched and hunting for small flying insects from a stem; this image shows the male's face, upper thorax (note heavy pruinosity resulting in medium blue color that extends to abdomen and yellow spot at the bottom, basal wings (note the diagnostic black spot on each wing base), and black legs. His eyes are grayish to lavender (in frontal view they appear dark reddish-brown), and face is yellowish (note postfrons, antefrons, postclypeus, anteclypeus, labrum, and mandible in open display).

Bottom Left: The same male perched along the Rio Grande, with abdomen pointed downward. His diagnostic wing spots, larger black on basal portion and small black spots on the wing nodum are prominent. Note that his entire thorax and abdomen are pruinose, bluish, and powdery as is the wing base at the edge of each large black spot.

Below: Ventral view of another male hunting from a high perch along Arroyo Trail of the Organ Mountains. Note the wing spot distribution and size - the nodal spot is larger.

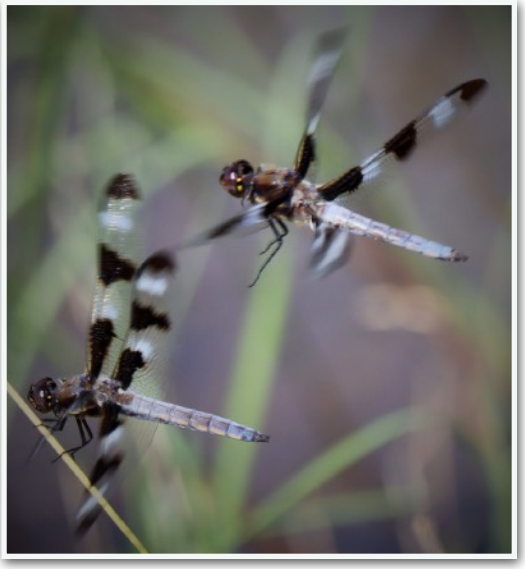


Above: The male turns his head to study each potential prey fly-by; the yellow spots of his lower thorax are prominently displayed. Note the dense, cilia-like hairs that cover his thorax and define, in part, his "hoary" whitish-blue color/appearance.

Right: A more frontal view of the male's yellow-colored face illustrates a darker eye color, mostly lavender, his yellow thorax spots and lateral yellow spots on the near abdomen segments (S1-S4).

***Libellula pulchella* (Drury, 1773)**
Twelve-spotted Skimmer

The Twelve-spotted Skimmer is a large and striking skimmer with three big black spots on each wing. Occurrence in Doña Ana County (DAC) is well within its principal distribution (all of New Mexico, most of the contiguous United States except for the Great Basin/Mojave Desert/w Sonoran Desert; it has not been recorded in Mexico). The New Mexico flight season is June-October. I have observed several locally during August and September. Occurring along lakes and ponds with emergent vegetation; in Doña Ana County, it has been observed perching/hunting and/or mating and egg-laying along the Rio Grande bank and in a retention pond at the Dripping Springs Visitor Center of the Organ Mountains. Large and beautiful, Twelve-spotted Skimmers are only occasionally observed and of those observations, nearly all are perching males.



Preceding Page - Top: Male (one of the two shown preceding page bottom) appears to have won this perch where he hunts small flying insects and likely displays to attract a mate. Note the three black spots on each wing and additionally, two white spots per wing.

Preceding Page - Bottom: On a small retention pond near Dripping Springs Visitor Center, two males challenge one another for a prime perch/territory of emergent Green Sprangletop, ***Disakisperma dubium*** ([Kunth] P.M. Peterson & N. Snow) stems. This perch was used to mark territory, hunt for small flying insects, and possible displaying for mate attraction.

Top Right: A post-mating female overflies the small retention pond to locate ovipositing (egg-laying) sites, typically within 1-5 feet of the pond edge. Note that females have three black spots per wing, equalling twelve-spot(ted) common name, but that there are no white spots as occur on male wings. The female face, head, and thorax are colored like the male's except her thoracic stripes are all yellow; her abdomen is brown dorsally with continuous yellow stripes on each side.

Middle Right: Over appropriate habitat (shallow water with an algae bed at this site), the ovipositing female would hover near the water surface and tap her abdomen tip into the water to deposit eggs. She continued flying and ovipositing many times over a 20-30 minute time period.

Bottom Right: Male perches on grass stem to hunt for small flying insects. Note his abdomen is mostly whitish-blue (pruinose) but underneath, on worn spots the base color is brownish, similar to the female's abdomen color.

Following Page Top: This male perches on Curly Dock, ***Rumex crispus*** (L.), fruiting stems emerging from the Rio Grande and hunts small flying insects while likely displaying to attract a mate.

Following Page Inset: An enlarged view of the male head and thorax illustrates that his face and eyes are dark brown and his thorax is brown with two pale stripes (gray above and bright yellow below) on both sides.

Following Page - Bottom Left: Perching low on a Silverleaf Nightshade, ***Solanum elaeagnifolium*** (Cav.), stem along the Rio Grande bank, this male is hunting for small flying insects. Note that in late afternoon sunshine, collecting images into the sun produces backlighting and also reflects off impurities floating in the water, producing a sparkling effect.

Following Page - Bottom Right: Perched on a Switchgrass, ***Panicum virgatum*** (L.), stem within a dense stand, a male presses his face/eyes forward to rest/sleep. Note the brownish area of his abdomen, likely exposed by a female during mating(s) (she clasps his abdomen when in the "mating wheel" configuration).

Libellula luctuosa (Burmeister, 1839) Widow Skimmer

A big and showy species with dark wing bases unique to this skimmer group. Occurrence in Doña Ana County (DAC) is well within its principal distribution (entire west coast from WA to CA, most of AZ and NM, east to LA and GA, northeast to MN and east to southern Canada; also south in western Mexico to Baja California and Durango). The New Mexico flight season is May-November. Locally, I have observed them during the months of June, July, August, and September. Occurring along lakes, ponds, and pools within slow streams (with mud bottoms) and at farm ponds and created habitats; uses sites with much vegetation in both open and wooded areas. Locally, they have been observed perched/hunting from shoreline vegetation along the Rio Grande bank, associated irrigation ditches, and in the nearby restored wetland/pond (La Mancha Wetland). This skimmer is uncommon to occasional in DAC, usually is observed as an individual male, and is difficult to approach as it is quite wary.

Preceding Page

Top: Male perches by hanging from a Southern Cattail, *Typha domingensis* (Pers.), leaf where he appears to be resting/sleeping. His large size and striking wing patterns (smoky-black wing bases bordered by white patches) along with the pruinose/pale blue thorax and abdomen are diagnostic.

Bottom: The only female I've photographed, perched high on a Coyote Willow, *Salix exigua* (Nutt.), twig over the Rio Grande. Her wing bases are dark, smoky but not black like the male's, and the dark wing-tip spot is diagnostic. She would periodically leave the perch to capture a small flying insect and is likely displaying to attract a mate.

This Page

Top Right: Male perching on a twig over the water and hunting for small flying insects while likely displaying to attract a mate (a typical observation); females are rarely observed.

Middle Right: Male perches on a stem by hanging while occasionally capturing small flying insects.

Lower Middle Right: Male perches on stem by hanging and perhaps is displaying to attract a mate while feeding on small flying insects.

Bottom Right: Male rests/sleeps in the shade of Johnsongrass, *Sorghum halepense* ([L.] Pers.) leaves, exiting occasionally to patrol his territory and to hunt for small flying insects.

Bottom Left: An enlarged view of the female's head and thorax illustrates her brown over green eyes, light brown-yellowish face, and her dark brown thorax with large tan spots low on the sides.

A male Roseate Skimmer perches on a Coyote Willow twig and examines overhead the small flying insects and other dragonflies moving through his territory. This prominent perch allows him to display to attract a mate, as well.

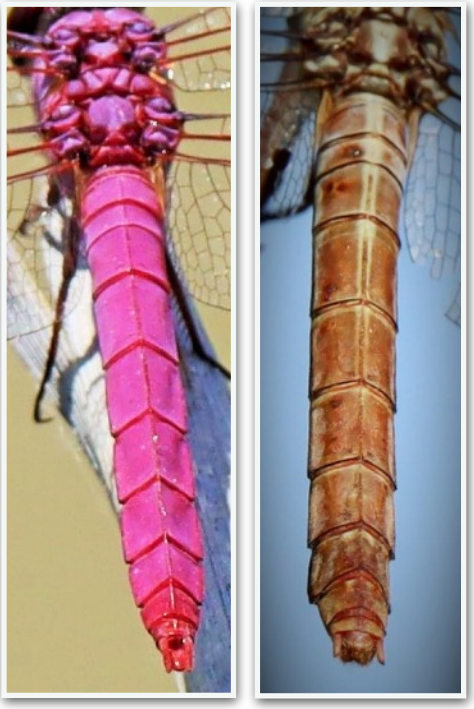
Tropical King Skimmers (*Orthemis*)

Much like King Skimmers in shape and size, these large dragonflies replace the temperate species in the New World tropics (Paulson 2009). Their presence at ponds of lower western latitudes show the tropical affinities of these latitudes. Males of most species are red and the females are brown. Wing venation is similar, as well, with many antenodals and wavy distal veins. They also perch with front legs folded up behind the head and usually with wings and abdomens level as do King Skimmers. Mating pairs are uncommonly seen because copulation occurs briefly in flight; males guarding ovipositing females sometimes present to watchful naturalists.

Orthemis ferruginea (Fabricius, 1775) Roseate Skimmer

A large, rosy-purple skimmer of southern states. Occurrence in Doña Ana County (DAC) is well within its principal distribution (southern CA and NV to southern AZ and NM, and east through TX, OK, AR to VA, and south to Costa Rica). The New Mexico flight season is March-October). Locally, I have documented this skimmer in May, June, July, August, September, October, and November. Individuals occur within a broad habitat tolerance based on mud bottoms for larval habitat. Habitats include ponds, ditches of all sizes, stock tanks, slow-flowing streams, and marshes; observed perched/ hunting, defending mating territories, mating and egg-laying along the Rio Grande banks, associated irrigation ditches, and in the retention pond at Dripping Springs Visitor Center.

The male abdomen is red; pruinosity (whitish coating) results in it reflecting pinkish-red (right center). The female abdomen is distinct from the male's, with dull reddish-brown color, and a white double midline stripe below thorax. Note that old females can become dull and even somewhat purplish-pruinose in color (Paulson 2009).



Top Left: Using a dried Johnsongrass stem to perch while hunting small flying insects, this male droops his abdomen downward, possibly to reduce overheating under the hot sun. Note his wings are unmarked/clear and the veins are reddish-colored.

Bottom Left: Male perches low over the Rio Grande, horizontally on a branch to warm in the sun. Note his facial iridescence from this angle.

Top Right: Perching horizontally on a Cocklebur stem emerging from an irrigation canal, male hunts small flying insects, defends and patrols his territory, and is likely displaying to attract a mate.

Middle Right: Enlarged image of the male face, eyes, and thorax illustrates his metallic, dark red-violet face (whitish-yellow on edge), dark red over grayish-lavender eyes, and his purplish thorax overlain by matte pruinosity.

Bottom Right: Mature female with some wing-tearing perches by hanging vertically from a Tamarisk, *Tamarix ramosissima* (Ledeb.), twig to sleep overnight and warm in the morning sun. Note, I had a difficult time observing females until searching shortly after sunrise along Coyote Willow tall shrub stands facing the sun, where I found them sleeping against branches and sunning to warm for hunting when small flying insects began their flights.

Following Page - Lower Left: Image of female face, eyes, and thorax show her dull brownish face, eyes reddish-brown above and tan below, and thorax brown with a complex pattern of pale yellowish stripes and black markings on the sides (also extend ventrally).

Above: Female perches on a Honey Mesquite, *Prosopis glandulosa* (Torr.) twig and hunts small flying insects along the Rio Grande. Note that her abdomen has a distinct bright reddish-brown color and is shiny, indicating little pruinosity.

Below: Male seems to show interest in this Tachinid Fly (*Tachinidae*) as they share a Three-square Bulrush stem perch over the Rio Grande.

Above: Perching on a Coyote Willow twig to warm in the sun and begin hunting small flying insects, female scans upward for insects and potential mates. Her abdomen shows little pruinosity, indicated by the shiny surface - compare with thorax).

Long-tailed Tadpole Shrimp, *Triops longicaudatus*, A Curious Crustacean

by James Von Loh

Long-tailed Tadpole Shrimp (LTS), *Triops longicaudatus*, (LeConte, 1846) is an odd-looking arthropod of seasonal, freshwater ponds. I have observed and photo-documented LTS locally (2021 and 2023) in the stormwater retention pond which receives runoff from the Dripping Springs Visitor Center, Organ Mountains-Desert Peaks National Monument (DSVC). Some of the other seasonal ponds supporting LTS in Doña Ana County are in Las Cruces (near Griggs Avenue and North Reymond Street, ~3,900' elevation and near Chile Canyon Loop Trail and the Prehistoric Trackways National Monument (~4,500' elevation) (iNaturalist.com 2023). (Editors Note: LTS are also found at various stock ponds along the eastern slope of the Black Range (photographs not included in this article).

The stormwater retention pond (photo middle right) appears on USBLM Built-In Plans in 1993 and on As-Built Plans in 1994, so at this writing it is ~30 years old (Andres Montoya, USBLM Facility Manager, Personal Communication via e-mail to Craig Severy [USBLM Volunteer] and Jim Von Loh, 09/14/2023). The pond may fill fully (as occurred in 2021 and 2022) or partially (as in 2023) usually during monsoon rainstorms (July - September) and when full, has an ~3,000 square-foot surface area (ranging from edge shallows down to an ~16-inch water depth in pools). Because the pond is a recently constructed, lined structure, I ask: "How did LTS become established during the past 30 years"? In the future, I hope to learn more and determine whether their introduction was natural/mechanical/human:

- Were eggs carried by birds, e.g., muddy feet/beak/feathers, or can eggs pass through a bird's digestive tract and remain viable? Are other wildlife species, or possibly cattle that graze in the area, providing transport?;
- Were eggs transferred on muddy boots, clothing, or construction equipment following previous work in another seasonal pond;
- Were LTS purchased from a vendor and introduced (eggs and/or adults) as this and other species of tadpole shrimp have some popularity as aquaria pets; or
- Were adults and/or sediments with eggs perhaps captured and/or excavated and transported purposely by humans to inoculate the pond?

(Editor's Note: In our next issue the author reports on his findings.)

Above: The Stormwater Retention Pond is at full storage height as the monsoon season begins (July 24, 2021). Photograph by Gordon Berman.

Below: Stormwater Retention Pond (~3,000 sq. ft. in size) is the angled rectangular structure on the left side (~5,650' elevation); it receives runoff and sediments collected from the developed area of DSVC (Source: *Google Earth Pro, 05/27/2016, accessed 09/2023*).

The Long-tailed Tadpole Shrimp, at first sight, resembles a miniature (~one-three" long) Atlantic Horseshoe Crab, *Limulus polyphemus* (Linnaeus, 1758), which occurs along the Atlantic Coast (if you attended college zoology laboratory exercises during the 1960s-70s, you and your lab partner probably dissected one). Generally, they are widespread in southern (west-central) Canada, much of the USA (including Hawaii), Mexico, southern South America (Argentina), Galapagos Islands, in the Caribbean, and on other Pacific islands (including Japan and New Caledonia) (Wikipedia, 2023).

Individual LTS each have three eyes (Latin: tri "three" and Greek: ops "eyes" make up the genus name) on the top of the head and two long tail filaments attached to the trunk (Latin: longi "long" and caudatus "tailed" comprise the specific epithet). Each is characterized by a rounded, shield-like carapace (olive green-to-dark brownish in color) with the three eyes at the front median. The carapace of crustaceans is a fold of the body wall of the fifth head segment (Table 1). Additionally, adults have a long, thick, highly segmented body and two elongated tail structures (cercopods) that may be as long as the entire body.

Structurally, LTS are complex and difficult to describe; see Table 1 on the following page for a detailed description.

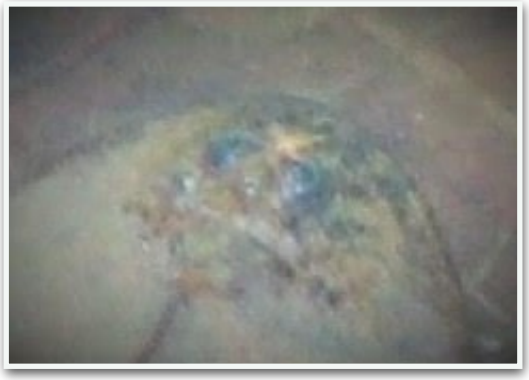
Top Left: Long-tailed Tadpole Shrimp dorsolateral view (July 15, 2021) illustrating the prominent carapace with three eyes, partial trunk with extended appendages, and 2-parted "tail".

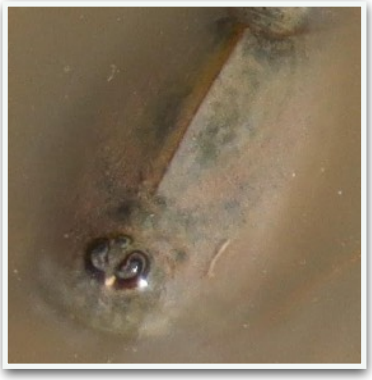
Middle Left: Female LTS ventral-lateral view (July 15, 2021) with carapace, complement of appendages exposed along the trunk, an egg sac filled with mature eggs, and "tail".

Immediately Above at Left: LTS, enlarged dorso-lateral view. Wikipedia has the most comprehensive species discussion, from distribution to behavior, morphology, anatomy, physiology, etc. - along with sketches and images. I have combined my local images and field observations into applicable information mostly from this reference.

Top Right: Enlarged lateral view of the lower thorax and abdomen/telson of a female LTS also carrying an enlarged egg sac. The 11th segment appendage is modified to form the egg sac. Note the many appendages attached under and exposed below the carapace. Also note the tiny white orbs floating in the water; they may be eggs of LTS and/or species of damselflies, dragonflies, etc.

Middle Right: When washed of grayish-colored pond mud using clear water, contrasted over a white background, and photographed under full sunlight, local LTS are a dark brown color (image collected September 3, 2023 about an hour before the pond surface dried completely, at around noon).





Far Left: Dorsal head enlargement allows the eye distribution to be observed, as a small triangular group with two larger eyes to the sides and a small round one (naupliar ocellus) farther back.

Center: Three eyes (triops, two are large and oblong, the other small and round) located at the front of the carapace. Note also the small, narrow, and elongated crest on the dorsal carapace surface.

Body Feature	# of Segments	# of Appendages/Limbs	Technical Notes
Head	**5 (*3 Anterior and 2 Posterior*)**	**0 (*The carapace of crustaceans is a fold of the body wall of the 5th, posterior, head segment.*)**	**Ventrally, the mandibular groove lies at the division between three anterior head segments and two posterior head segments (only the opposing mandibles, with strong brown teeth, are well-developed). The more posterior, cervical groove, identifies the head/trunk (anterior thorax) division.**
Trunk	**32-50**	**76-88**	**Trunk segments/appendages are separated below under *Anterior Thorax, Posterior Thorax, and Abdomen*.**
Anterior Thorax	**11**	**22 (Called thoracopods or pereiopods.)**	**The first pair of legs are elongated and have a sensory function: all remaining appendages aid in feeding, respiration, and locomotion.**
Posterior Thorax	**16-25**	**54-66**	**Segments are not well-separated and therefore form rings (think millipedes); each ring may contain up to 6 fused segments with 6 pairs of appendages. These appendages move spent feeding and respiratory currents away.**
Abdomen	**5-14**	**0**	**Last abdominal segment is fused (pleotelson) to the tail (telson).**
Tail	**n/a**	**2**	**Two long, multi-segmented cercopods emerge from the telson.**

Table 1. LTS Body Structure Summary. (From Wikipedia)

Image Enhancement

The image at the bottom of the preceding page is the same as that at the middle right on the page before that. In the case of the preceding page, the image has been brightened. The integrity of an image does not have to be diminished to increase its usefulness; in this case brighting the image increased the apparent depth of field and enhanced the detail.

LTS are most active in a cool temperature range (around 68 degrees F) which is not common during the Chihuahuan Desert summer, when I have observed pond populations. Typically observed behavior includes scratching for food in mud, gravel, and detritus on the pool bottom (benthic habitat) and straining for food at the water surface (lentic habitat) as illustrated herein. They are incapable of catching and eating prey larger than themselves but can break up plant roots, algae, dead tadpoles/fish/etc. when hunting and scavenging.

This ovipositing, female Common Green Darner, *Anax junius,* (Drury, 1773) shown below would be much too large for LTS to capture and process as food (see individual LTS upper left and right of the dragonfly's wings); however her eggs (white orb at abdomen tip) appear sufficiently small to serve as a potential food source (and if they hatch, perhaps her initial larval instars, as well) (September 2, 2023). Note that other damselfly and dragonfly species photo-documented depositing eggs into this lentic/benthic habitat included: Familiar Bluet, *Enallagma civile* (Hagen, 1861), Variegated Meadowhawk, *Sympetrum corruptum* (Hagen, 1861), Common Whitetail, *Plathemis lydia* (Drury, 1773), Flame Skimmer, *Libellula saturata* (Uhler, 1857), Twelve-spotted Skimmer, *Libellula pulchella* (Drury, 1773), and Spot-winged Glider, *Pantala hymenaea* (Say, 1839).

Above: Washed individual (September 3, 2023), between one and two inches long, enlarged and brightened during image processing. Note the reddish hue under the carapace area where the appendages are located. Note also, the slender, curved appendages protruding from under the carapace; they perform a sensory function.

Below: Ventral display of reddish-colored organs (July 15, 2021), including inward-facing lobes, gills, and narrow, elongated food gathering appendages. Note that the LTS legs are white and the cercopods are dark; there are no appendages on the abdominal segments.

LTS collect food particles by straining the water with hairs on appendages located under the carapace and attached to the head and thorax. Captured food particles are transferred to the mandibular groove located lengthwise on the underside of the body, held together with a sticky secretion, and swallowed by a tiny (~2 mm wide) mouth situated on the carapace underside.

LTS are equal opportunity omnivores, eating algae, insects, organic debris, very small fish (fry) and tadpoles, worms, and even their smaller siblings (cannibalistic). Tadpoles of a few toad species are locally common in any water source of several days/weeks duration, and when examined, tadpoles exhibit a superficial resemblance (shape, color, eye placement, tail length, and habitat preference) to LTS. Representative tadpoles from a shallow pool at the La Mancha Wetlands Restoration Project adjacent to the Rio Grande levee near Mesilla are shown upper right (August 28, 2022).

The LTS use their forward appendages (2nd to 10th pairs) to stir sediment, then swirl the muddy water into a wide food-groove located mid-ventrally. Inward facing lobes at the base of the legs guide food forward to the mouth for ingestion. When feeding, fine silt and water escape easily while large food particles are torn into smaller pieces by blade-like, inward-facing lobes (endopods) at the end of the legs.

The LTS to the right appear to be foraging by filtering from or ingesting from grass stems, at mid depth in a deeper pool, while the one shown below (July 15, 2021) is likely foraging on algae and associated aquatic fauna attached to a submerged rock.

Above: This Long-tailed Tadpole Shrimp is resting and/or foraging from or on a submerged grass stem, July 15, 2021.

Left and Above: A mystery appeared while I photo-documented individual Long-tailed Tadpole Shrimp on the pond surface; it concerned the behavior being performed. Some individuals appeared near the surface, with their ventral side exposed, and motion associated with them created concentric rings. My initial opinion was that these individuals were foraging for food at the pond surface and using their appendages to "sweep" particles towards their mouth, which created the energy for rings to form. Concentric rings emanated from the LTS moving its forward appendages as it actively foraged.

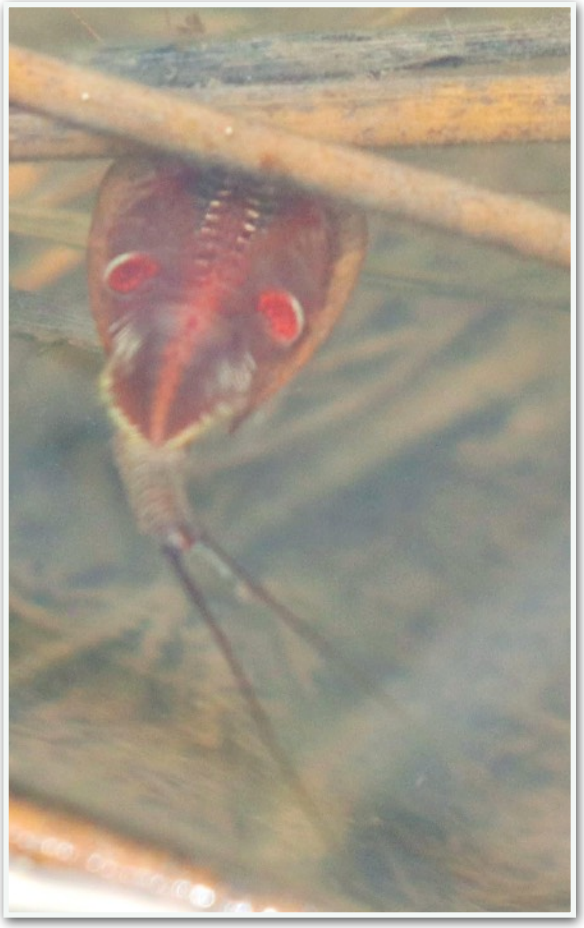
Above: Two "vortexes" appear to have formed near the posterior carapace of this sub-surface Long-tailed Tadpole Shrimp, along with emanating concentric rings; appendages are likely moving spent feeding and respiratory currents away from the LTS.

Below: Concentric rings occur around this individual and the abdomen/tail portion is arched downward from the body, perhaps for stabilization.

Reproduction

Three or more reproductive strategies may be used by Long-tailed Tadpole Shrimp populations. They reach maturity in approximately two to eight days following emergence from eggs (and may lay eggs following sexual reproduction in this timeframe); however, this strategy is rare, as populations are highly male- or female-biased. Parthenogenesis (development from unfertilized eggs) is the most common LTS reproductive strategy. Some populations, however, consist of hermaphrodites which fertilize each other. Because populations may use different reproductive strategies or combinations of strategies, in the future they may evolve into separate species or subspecies (to be determined by future morphologic and genetic analyses).

In females, the eleventh pair of legs is modified into egg sacs (brood pouches), where the eggs are carried for several hours. The eggs are released in batches, have a thick shell, and can withstand freezing temperatures as well as drought, enabling the population to survive seasonally. The eggs, up to 200 per individual mature LTS (California Department of Agriculture, accessed online October, 2023) have to dry out completely before being submerged in water again in order to hatch successfully; they may remain in a state of diapause for up to 20 years. These eggs may have helped LTS and related species to survive the various natural disasters and mass extinctions to date.



Above: This individual has developed two egg sacs, attached near the base of the carapace on the ventral surface (July 15, 2021). Note that eggs have not yet matured (or if matured, they have been released into the pond and the sacs are emptied).

Below: A single egg sac with maturing eggs is present on this LTS (July 15, 2021).

Above: The visible egg sac from this individual (perching and possibly feeding from a submerged grass stem) is filled with apparently mature eggs ready to release into the pond (July 15, 2021).

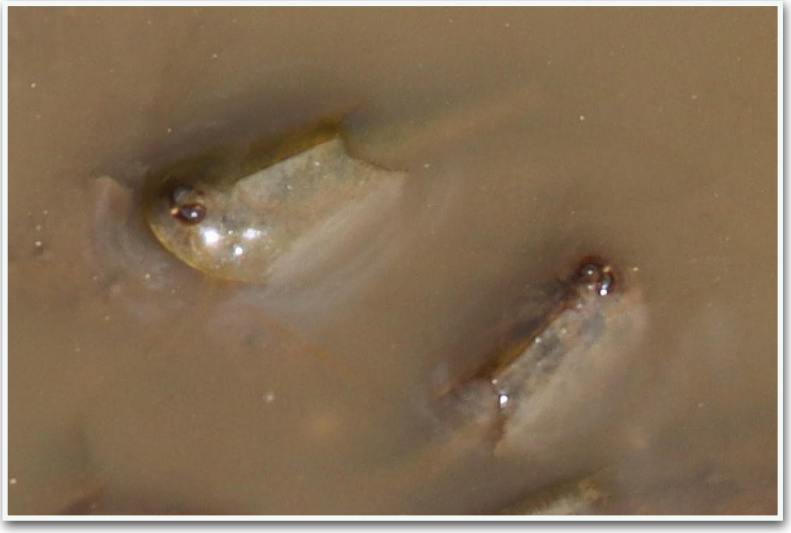
Below: An enlarged view of the egg sac with eggs nearing maturity, positioned adjacent to the carapace (segment 11) and to the modified gills on the ventral side of the highly segmented trunk/abdomen.

Emergence

Long-tailed Tadpole Shrimp emerge from eggs when sufficient rainfall occurs to fill temporary ponds; offspring were in suspended development (diapause) within the eggs, perhaps for many years. Upon hatching as orange-colored, six-legged larvae (metanauplius), they feed on small invertebrates. A series of larval growth stages (instars) follows with the number of segments and appendages increasing throughout, and the color changes to grayish-brown; the transformation to an adult largely occurs in two days. The mature individuals, in turn, lay eggs at about eight days. Mature/adult LTS die as the pools dry (as occurred for the 2023 population, on September 3rd) or may live between 20-90 days if the pooled water persists at viable depths (as occurred for the 2021 population and for any individuals that emerged during 2022).

Middle Right: Individual LTS surfaces in water just deep enough to provide cover (September 2, 2023).

Below: Individual LTS with ventral surface exposed to the hot air as its dorsal surface rests on the bottom mud of the shallowest pond margin (September 2, 2023).

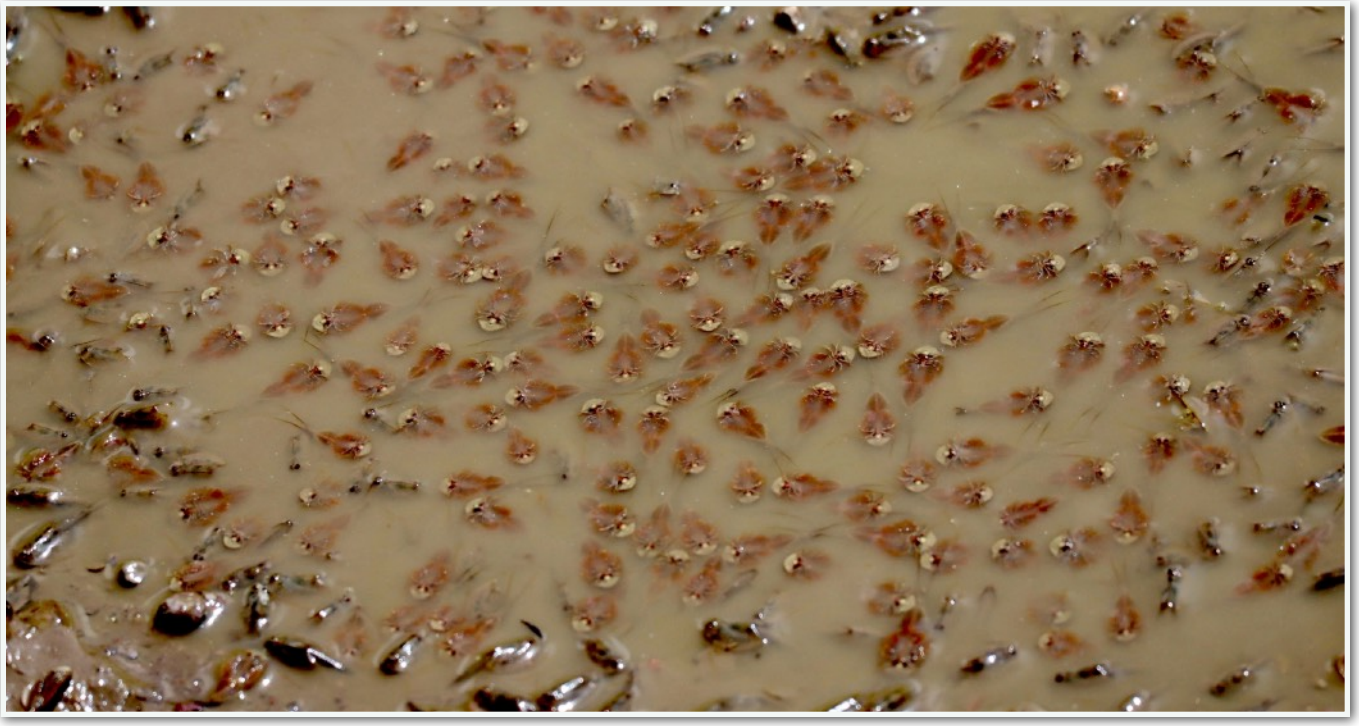


September 3, 2023

Left: At this stage the water is becoming too shallow to immerse the LTS entirely, exposing their dorsal surface.

Center: The last remaining shallow water pool (not much more than fluid skim over mud) reveals a portion of the large number of LTS present at this site.

Below Left: Shallow water rapidly turns into liquified mud around noon. Note that these TLS retain their dorsal surface in an upward orientation.



Below: Oxygen depletion, shallow water temperature (air temperature near 100° F at noon-time), and rapid evaporation place the final stress on individuals of this LTS population, resulting in them floating ventral side up in shallow water. Note possible scavenging beginning as a fly lands on a carcass.

Predation

LTS and their eggs and larvae represent a large, potential food source for several local and migrating wildlife species, ranging from invertebrates to amphibians, reptiles, birds, and mammals. During my photo-documentation visits for LTS behavior, I observed some bird species capturing and consuming them; I also observed insect and amphibian species which likely would prey on them if encountered. Ironically, because LTS are cannibalistic, perhaps the most efficient and effective predators of them ARE them!

Above: I sometimes encounter LTS floating and exposing their ventral surface; they seem to have portions of their soft ventral tissues/appendages removed (perhaps some foraging by another LTS). Note that this view/condition makes it easier to examine LTS legs and head, thorax, and abdomen structures under the carapace.

Below: An example of some of the soft tissues, in lateral view, that occur on adult LTS (July 15, 2021).

The Giant Water Scavenger Beetle, *Hydrophilus triangularis* (Say, 1823), image top right, occurs rarely within this pond but is an effective predator and capable of capturing/consuming crustaceans, tadpoles, etc. This individual was photo-documented during spring, at a time when the water was probably too cold for LTS larval emergence from eggs. However, the eggs could represent a food source if encountered.

Woodhouse's Toad, *Anaxyrus woodhousii* (Girard, 1854), photo above, hides and hunts from thick grass at the pond edge and if a female, may deposit eggs (September 9, 2022). Note toads are capable of LTS and other invertebrate/small vertebrate predation but were not observed/photo-documented engaged in the behavior during this time period.

Savannah Sparrows, *Passerculus sandwichensis* (Gmelin, JF, 1789) were photo-documented (image below) wading in

the pond while taking water, hunting, and feeding on LTS on September 2, 2023. Note that they eat mostly insects, primarily beetles and grasshoppers, in addition to spiders and snails, and glean a variety of seeds. They used exposed rocks to perch, take water, and locate prey. They waded slowly in the shallow, silty water, while hunting, drinking, and capturing prey. In the last photo of the preceding page, a Savannah Sparrow has captured an LTS. It is grasped tightly in the beak tip and then manipulated and compressed for ease in swallowing (reminding me of wrapping spaghetti around a fork) - shown in the two photos below. The whole process taking place in under a minute.

Lark Bunting, *Calamospiza melanocorys* (Bonaparte, 1838) (pictured at the bottom left) was photo-documented wading in the mud and pond water while drinking, hunting, and feeding on Long-tailed Tadpole Shrimp on September 2, 2023. Note that they eat mostly insects, primarily grasshoppers, in the summer and glean a variety of seeds in other seasons (USDA-FS-AH688). In the photo below, a Lark Bunting has located an LTS in the shallow muddy water.

Brown-headed Cowbirds, *Molothrus ater* (Boddaert, 1783), were using the open crown of a Western Hackberry growing near the pond edge on May 22, 2023 when the male was displaying to attract a mate. Later in the year (August 26) they foraged in the liquid mud for LTS (below).

Scavengers

Following the demise of a population en masse, nature's clean-up crew typically arrives to consume and transform the biomass for their own survival. On September 2, 2023, sufficient water remained to keep the LTS alive; however the water (up to 3" deep) was superheated under bright sunshine at 100° F (air temperature), and dissolved oxygen was likely diminishing rapidly. Within 24 hours this water was no more than a sheen over liquified mud, and individual LTSs were exposed, a few dorsally, but most with their ventral side up. I wondered if they could be revived in cool water at this stage and scooped a few into a white strainer lid, poured fresh water over them, and watched most swim around normally (they became my photographic subjects for "cleaned" specimens beginning this article).

I had a brief thought about: "exactly when does a predator become a scavenger", while photo-documenting the Brown-headed Cowbird hunting for food in the mud, on September 3.

Above: On September 2, 2023, visitation along the pond edge and waterline was easily observable as upland animals sought drinking water, lush forage, and possibly invertebrates. The largest tracks were of ungulates, likely Mule Deer, *Odocoileus hemionus* (Rafinesque, 1817) and the smaller hooved tracks may have been of fawns or possibly Javelina, *Dicotyles tajacu* (Linnaeus, 1758). Among these tracks were Coyote, *Canis latrans (*Say, 1823) and different sizes of bird tracks. So, I then envisioned possible Long-tailed Tadpole Shrimp scavenging scenarios: 1) the pond as an arena for circling and flapping vultures and ravens; 2) grunting and growling as javelinas and coyotes arrive; 3) nocturnal squeaks as mice emerge to nibble; 4) scurrying as beetles and ants arrive; or 5) perhaps a flock of small mixed-species birds.

September 3, 2023
Brown-headed Cowbird Scavenging

Top Left: Wading through liquid mud and eyeing some cue (movement, color, shape, etc.) possibly from an exposed Long-tailed Tadpole Shrimp.

Upper Middle Left: Several exposed LTS.

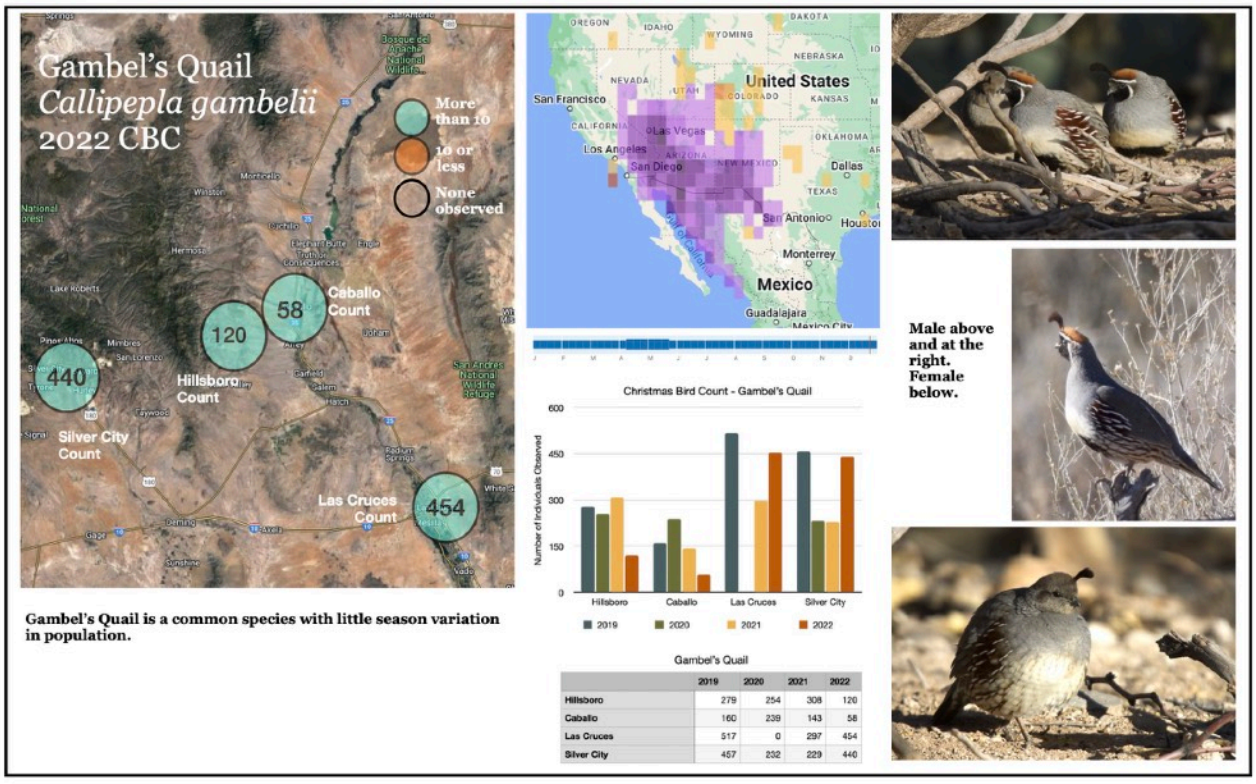
Lower Middle Left: The cowbird selects and captures an LTS; it is unknown if it is alive or dead.

Bottom Left: The cowbird then orients the crustacean for ease of swallowing.

But none of my scenarios happened, as the end for these LTS was more like "Shake 'n' Bake" - without the "Shake". By September 9th there was only the "Bake".

By September 9, the Long-tailed Tadpole Shrimp, *Triops longicaudatus*, completely desiccated, were lying atop cracked adobe; I was surprised that there had not been more complete predation/scavenging of this available food source as the surface water evaporated completely. And, if nature is wise and wishes LTS to persist, only their eggs will survive the summer of 2023.

And because nature is nature, and this is New Mexico, an isolated monsoon rainstorm refilled the pond to the point that 90% of the bottom was covered, "...on September 14th (and provided me ANOTHER Long-tailed Tadpole Shrimp population to photo-document) - see the next issue of this Journal. Photograph by Gordon Berman.



Gambel's Quail is a common species with little season variation in population.

Gambel's Quail

	2019	2020	2021	2022
Hillsboro	279	254	308	120
Caballo	160	239	143	58
Las Cruces	517	0	297	454
Silver City	457	232	229	440

Black Range Exchange Website - And CBC

The unofficial results are in for the 2023 Hillsboro Christmas Bird Count; the full results are reported later in this issue. We are using the results of that count as part of a project on the revamped Black Range Exchange Website ("the Exchange") and invite discussion of that proposed natural history project.

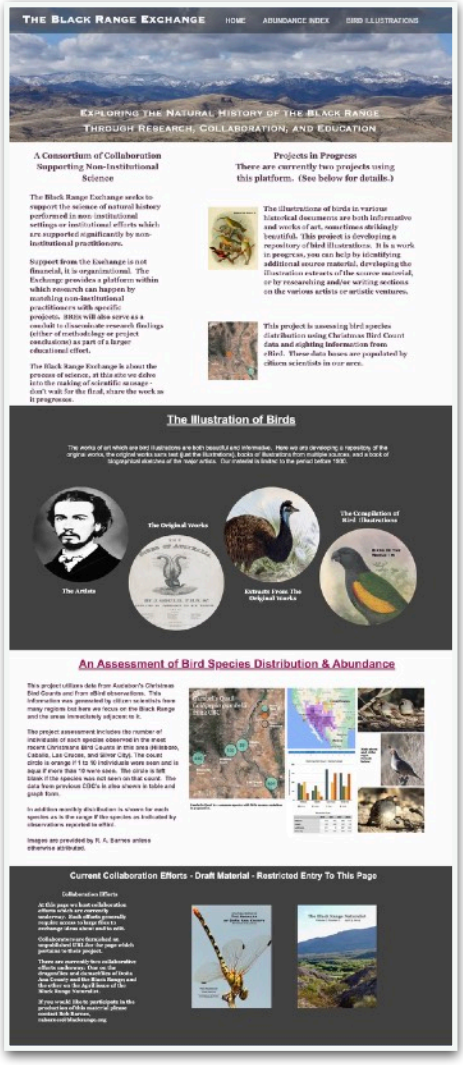
Whereas the Black Range Website hosts material on both the cultural and natural history of the Black Range, the Exchange focuses on specific ongoing natural history projects which are not limited to the immediate area of the Black Range.

There are currently two projects hosted on the Exchange. One is a multiyear project meant to gather historical depictions of bird life together in one set of documents. The other is a proposed project to describe the results of the Hillsboro Christmas Bird Count by recording the most current results and comparing those results to all previous Hillsboro counts. For the period 2019 to whatever date is current we also propose to compare the Hillsboro Count results to those of the three closest Christmas Bird Counts (Silver City, Caballo, and Las Cruces). 2019 is the year the Hillsboro count started. More general geographic distribution information and seasonal population variability will also be posted (this data from eBird).

An example of the species accounts proposed for the project is shown above. If you have ideas, comments, or wish to participate in the project please let us know at rabarnes@blackrange.org.

The Exchange is also being used to coordinate the publication of various components of the Black Range Website, like The Black Range Naturalist and various other publications. The projects currently undergoing draft review are listed on the home page of the Exchange website, at the bottom. To see material undergoing review you must be participating in the production of the project.

As more projects reach the draft review stage we will post the subject matter being covered on the Exchange. If you have substantive comments or material on the subject, and wish to participate, you will be given a link to the draft and invited into the review process.



Yellow-headed Blackbird *Xanthocephalus xanthocephalus*

These photographs were taken by Asa Porter Jr. (Deming/Hillsboro) at a feed lot in Deming. In Hillsboro this species is uncommon - they tend to like a bit more water. Apparently, they like feed lots in November. It goes without saying that the subject of this article is the white bird with a yellow head. It is a Yellow-headed Blackbird, like the others to its right.

In the January 2022 issue of this journal we discussed feathers. Part of that discussion centered on the color we perceive when we look at a bird's feathers. Sometimes that color (hue) is created by pigmentation (the feather contains pigments of a color) and sometimes the color is created by how the feather refracts light. For example, hummingbird feathers refract light in such a way that sometimes they are brilliantly colored, sometimes they appear drab. There is more going on when we see a blue bird or a white bird (see the January 2022 issue), but this is the crux, in a very general sort of way.

The yellow head of the bird shown here results from the xanthophores (from carotenoids) in its feathers, a yellow pigment. Melanophores (melanins) are responsible for the black and brown color in feathers. Pigmentation from melanin appears to be mostly absent from this bird.

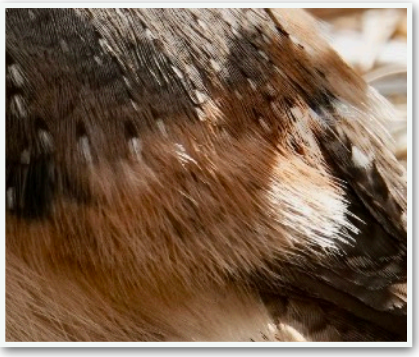
Albinism. Don't go there. It is a rabbit hole. In short, it depends entirely on the definition which you choose to use for the term. Common arguments surround terms like "partial albinism". Some argue that albinism is whole-body and is either present or not. Nothing in between. Others take issue with that definition, arguing that a body part can be described as albinistic. Again, don't go there. In this bird, melanin is not present in some of the feathers. Call it what you wish. Of note is that mutations which affect the uptake of carotenoids are fairly rare (yellow head) while those which affect the uptake of melanin are much more common (white body).

In "Albinism in the Great Gray Owl (Strix nebulosa) and Other Owls", Alaja and Mikkola argue that: *"Albinism is derived from a recessive gene which inhibits the enzyme tyrosinase. Tyrosine, an amino acid, synthesizes the melanin that is the basis of many avian colors (Holt et al. 1995). Albinism in birds has been separated into four categories: 1. Total albinism – a simultaneous complete absence of melanin from the eyes, skin, and feathers. This is the rarest form. Gross (1965) reported 7 percent of 1,847 cases of avian albinism examined as being of this type. 2. Incomplete albinism – when melanin is not simultaneously absent from the eyes, skin, and feathers. 3. Imperfect albinism – when melanin is reduced in the eyes, skin, and feathers; and 4. Partial albinism – when albinism is localized to certain areas of the body (Mueller and Hutt 1941). Partial albinism may result from injury, physiological disorder, diet, or circulatory problems. This type of albinism is most frequently observed. It is important to note that white plumage is not necessarily proof of albinism. Adult Snowy Owls (Nyctea scandiaca) are primarily white, but have their feather color derived from a schemochrome feather structure which possesses little or no pigment. Light reflects within the feather structure and produces the white coloration (Holt et al. 1995)."*

(Northern) Rock Wren
Salpinctes obsoletus obsoletus

There is a great deal of variation within the population of individuals which some humans lump into species. Sometimes that variation is due to hybridization with other species at some time in the past, sometimes it is simply an individual difference as in a color variant.

On November 14, 2023, a Rock Wren with a color variation was found in Hillsboro. The bird in question, shown here, had a band of reddish feather ends across its lower back. This may be a young bird in molt.



Broad-billed Hummingbird

Cynanthus latirostris

by Bob Barnes

On October 21, 2015, we added a female Broad-billed Hummingbird to our yard list in Hillsboro. That list currently includes 175 species; back then it was much shorter - 135 or so.

On and off over the years we have seen them fairly regularly, especially in October to January. Recently, they have become much more common and 2023 was a banner year for them in Hillsboro.

The two photographs of a male, to the right, were taken on October 23, 2023, (bottom) and November 18 (top). After seeing them for weeks I finally decided I should take a photo or two.

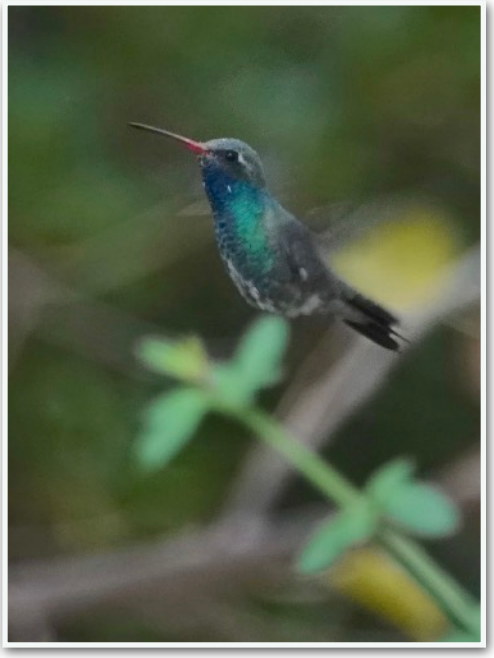
The somewhat better images, below, were taken in El Fuerte, Sinaloa, Mexico, where this species is found in swarms. They are provided here to aid in identification in the Black Range.

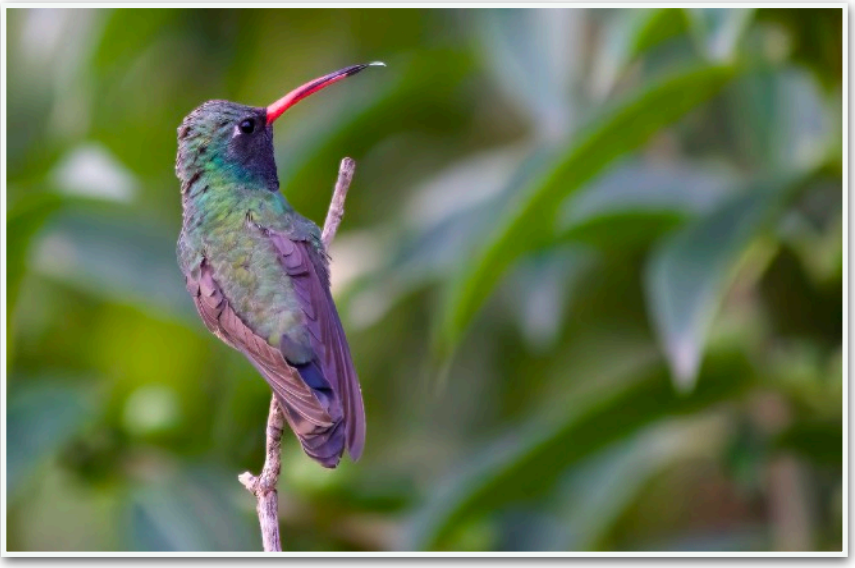
The range map below is used here under a CC 0, universal license provided by NatureServe. Note that the breeding range of this species extends northward from its year-round range, reaching the boothill of New Mexico. Traditionally, there have been periodic reports of the species wandering even farther north during the post-breeding period (which would match our observations). In general, the birds which are found in the breeding range depicted on the map are migratory, and some are found in Baja California Sur at times. On the following page we include an abundance map from The Cornell Lab (eBird) which includes data from 2007- 2021. It does not show a significant (or any) distribution of this species in the Black Range.

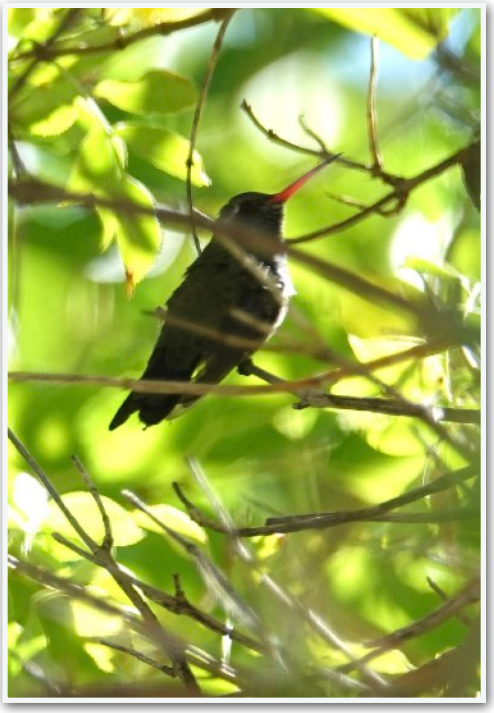
Please report sightings of this species to us so that we can draw a better picture of what is happening.

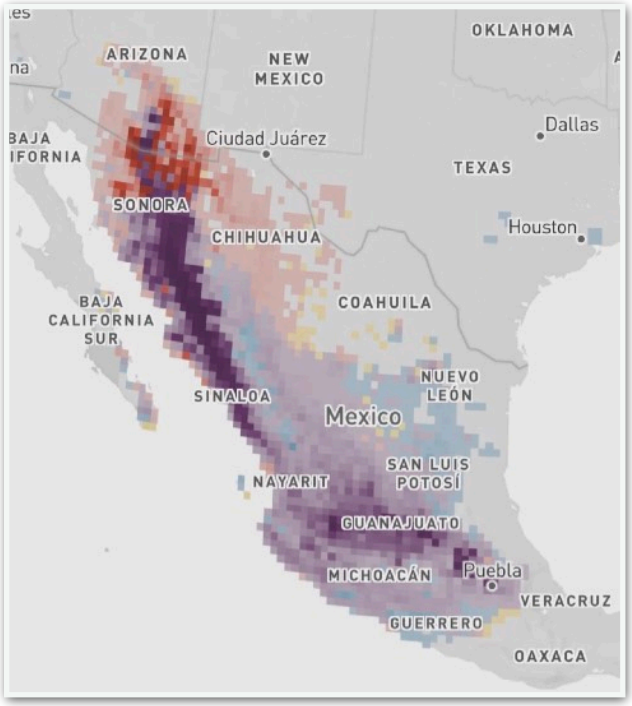
We have seen a fair amount of what appears to be range expansion from the south over the last few years. See articles in the first issue of this Journal (July 2018) about Northern Cardinals and in Volume 2, Number 2 (April 2019) about White-nosed Coati - and periodic updates on observations/ trends (see the Black Range Naturalist index), for examples of other probable range expansion.

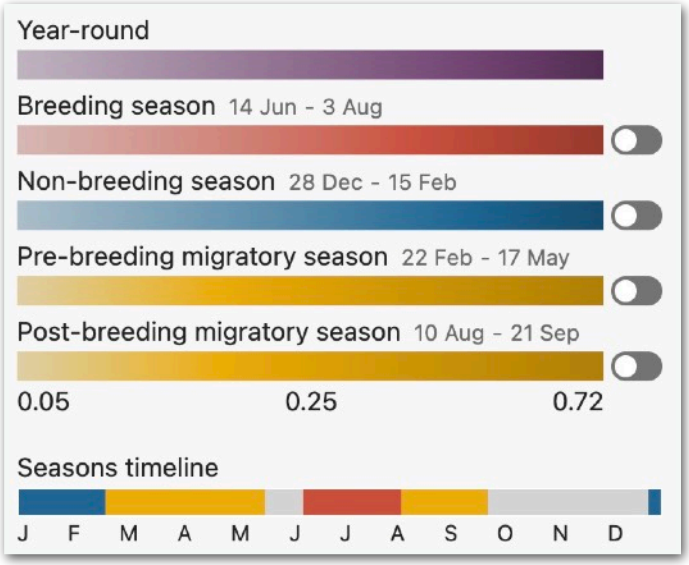
It is quite possible that we will be seeing Broad-billed Hummingbirds more frequently because we are experiencing a range expansion. But these things ebb and flow. . . .











Abundance map for Broad-billed Hummingbird, retrieved from Cornell Labs (eBird) on October 29, 2023.

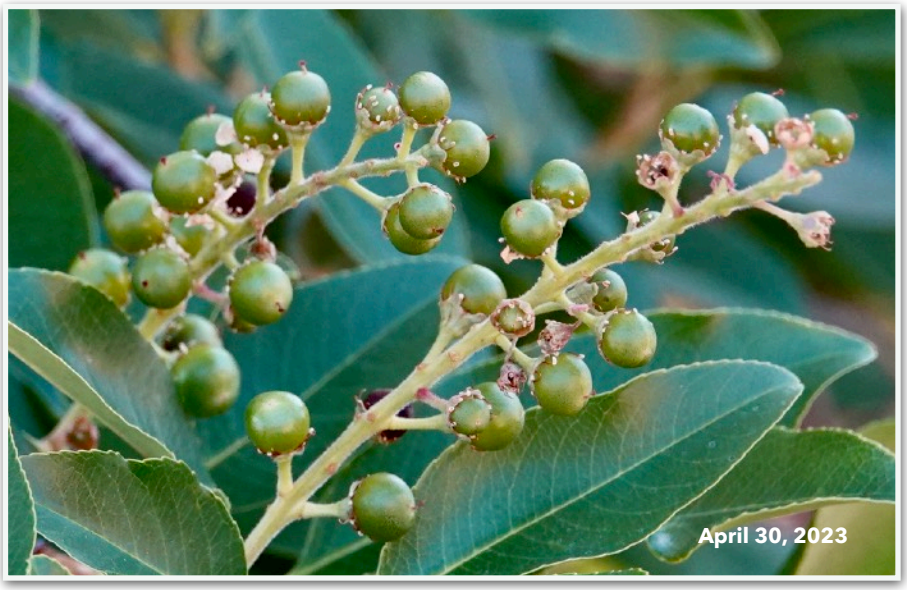
Black Cherry

Prunus serotina Gray var. *rufula* (Wooton & Standley) McVaugh

The photographs on this and the following page were taken along NM-152, west of Kingston, New Mexico, and document the flowering and fruiting season of this species. It is the most common species of cherry found in the Black Range, where it is found at mid elevations. These photographs were taken of trees at an elevation of about 7,500'. Range map to the right by Elbert Little, Jr., USFS.

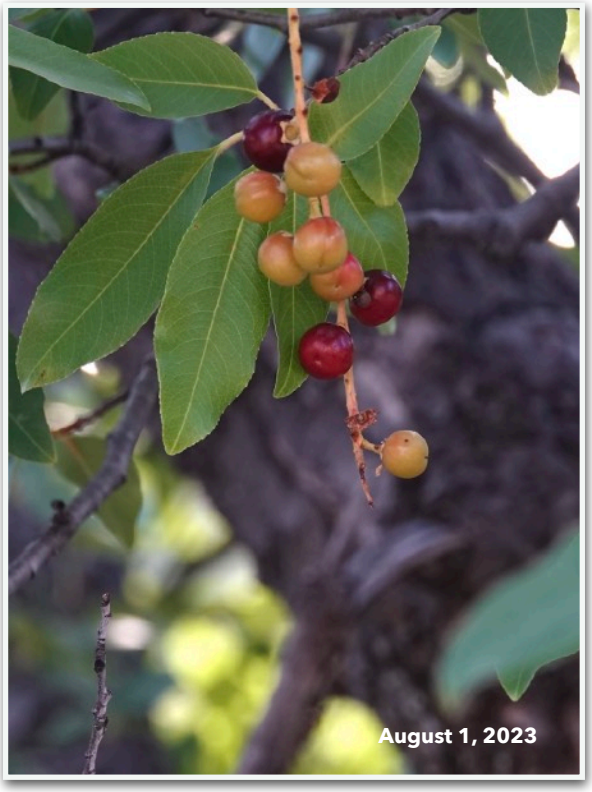
In Nahuatl this species is known as capolcuahuitl; a subspecies, *P s. capuli,* takes its subspecies designation (*capuli)* from the Nahuatl word. The fruit of the Black Cherry was an important food in pre-Columbian Mexico. The fruit may be eaten raw, or it may be made into jelly or a drink.

Black Cherry is a pioneer species, one of the first to appear after an area is cleared (naturally or by humans). Trees of the species are long-lived, some surviving to 250 years. Propagation is aided by birds and bears which eat the fruit and then pass them on in other locations.




May 7, 2023


May 7, 2023


August 1, 2023


August 1, 2023

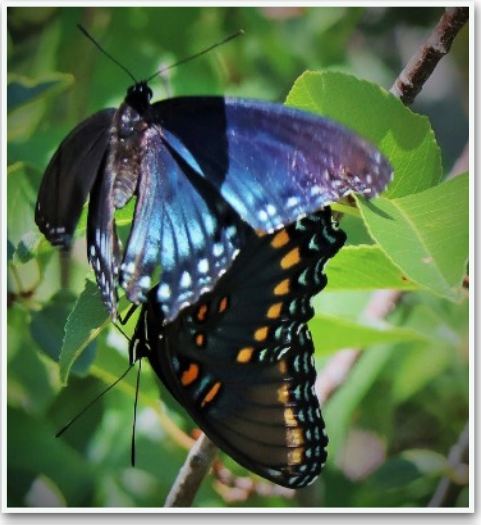
Black Cherry Addition - How the Exchange Works

This issue of the *Black Range Naturalist* was one of the first projects in the draft review project of the Black Range Exchange (see page 69). James Von Loh (Las Cruces) was able to provide the following after his review of the draft of this issue (he was not involved in the original article). Hopefully, this is indicative of how the process will work in the future.

Black Cherry *Prunus serotina* (Gray) var. *rufula* ([Wooton & Standley] McVaugh) - A Host Tree for Red-spotted Purple (Admiral) Butterflies, *Leminitis arthemis astyanax* (Drury, 1773) by James Von Loh

A few small Black Cherry trees have become established in Soledad Canyon within the Organ Mountains of Doña Ana County, New Mexico. Because they are hosts in the life cycle of large, bluish-black butterflies (Red-spotted Purples) I investigate them to photo-document mature butterflies and/or caterpillars. On September 10, 2021, a small Black Cherry tree, growing from an arroyo bank at the canyon mouth, supported a perching and territorial male Red-spotted Purple. The male aggressively defended this tree from other males, displayed to attract females by perching on an exposed twig, and made regular flights through adjacent vegetation to locate a potential mate.

After several minutes a female arrived, perching under leaf cover, while the male began courtship flights and fairly aggressive approach behavior to become her mate. It is nearly impossible to distinguish a male from a female Red-spotted Purple individually; however, the male is the noticeably smaller of a pair. Courtship was successful and the pair mated under dense leaves (through which I could not photograph). I began to visit the same Black Cherry tree during March 2022, and successfully photo-documented a later stage caterpillar on April 22nd. These caterpillars are notable because they mimic bird poop/droppings, which reliably protects them from potential predators.

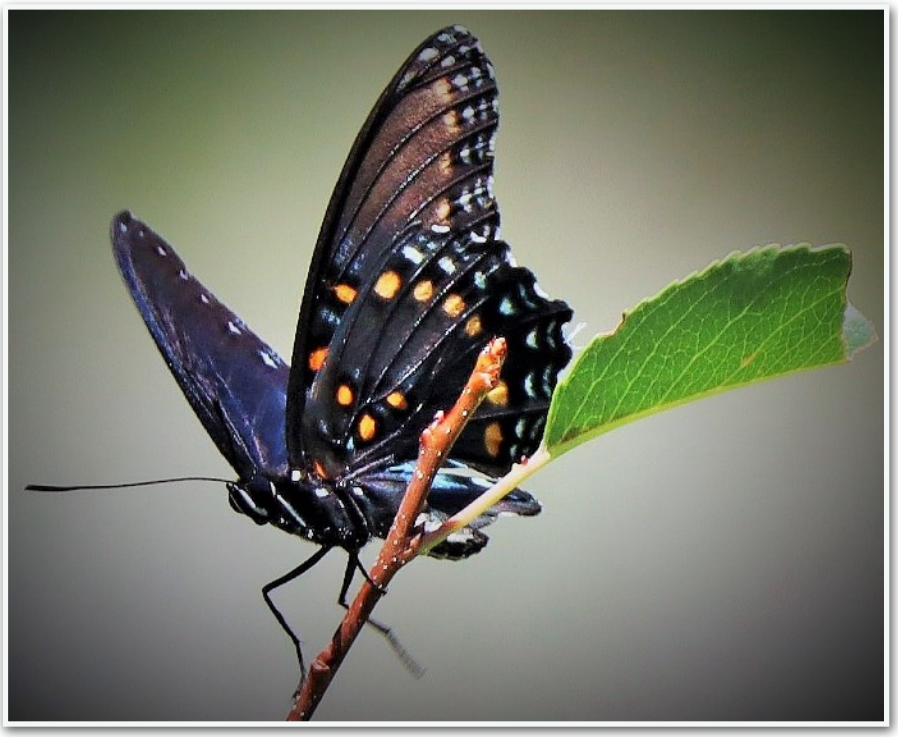


Bottom: Male Red-spotted Purple uses an exposed Black Cherry twig to perch, attempt to attract a mate, defend this small tree from other males, and to conduct searches in adjacent vegetation. September 10, 2021

Top Right: After several minutes a female arrives and perches under more-dense leaves near the tree trunk, stimulating the male to conduct courtship behavior like fluttering near her, exposing his bright ventral wing spots, as in this image.

Center Right: Soon the smaller male (above) perches near the larger female (below) and they interact to initiate mating, then move into denser leaf cover opposite my position.

Top Left, Next Page: Following the courtship, mating, and egg-laying behaviors, Red-spotted Purples visited nearby Red Morning Glory, *Ipomoea coccinea* (L.) flowers to take nectar from the multitude available during the 2021 monsoon season.



Left Center: Red Morning Glory vines and flowers draped over tall shrubs near the Black Cherry tree and were abundant during September 2021. Many butterfly species and individuals were photo-documented nectaring from these small red flowers, distributed throughout Soledad Canyon.

Top Right: Red-spotted Purple mating and egg-laying behaviors were successful and on April 22, 2022 I photo-documented caterpillars in a late instar stage (nearly large enough to transform into the pupa stage within a chrysalis). This caterpillar is documented crawling on the small tree to find more Black Cherry leaves to eat.

Bottom: Enlarged view of this "bird dropping mimic" caterpillar as it completes the feeding stage (about two weeks following hatching). The yellow thorax spots resemble eyes while the white areas resemble nitrogen products excreted by birds alongside the dark organic waste color.

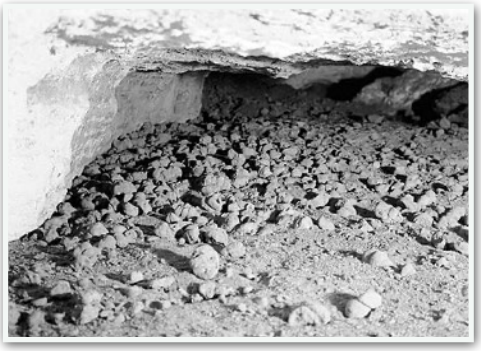
Nothrotheriops shastensis

Those Who Lived Here Before

Nothrotheriops shastensis **lived hereabouts during the Pleistocene. A nearly complete specimen was found in a lava tube at Aden Crater east of Deming (see two images at the right from August 2014 - more at this link - scroll down). The specimen still had hair and tendon. It is now on display at the Yale Peabody Museum of Natural History (see image below).**

Attribution for restoration shown above.

This species grew to about 9' tall (standing) and could weigh as much as 550 pounds. In our last issue, we referenced the human footprints found at White Sands National Park. There were footprints of other animals as well at the site, including a ground sloth. Not this species, but rather the Harlan's Ground Sloth, *Paramylodon harlani*, which stood 10' tall and weighed in at about 2,300 pounds. It became extinct about 10,000 years ago; humans played a major role in that extinction. Our subject species went extinct at about the same time, probably for the same reasons. The pile of dung (below - NPS) left by this species is from Rampart Cave, Arizona.



Cicadas

Much of the eastern United States will enjoy the sound of billions of cicadas this spring. We have fewer individuals here in the west.

On July 27, 2022, Véronique de Jaegher and Bob Barnes collaborated on an article for the Sierra County Citizen, which Véronique called "Cicadas among us". Véronique furnished the images, which are shown on this page and at the top left of the following page.

Barnes wrote: "Cicadas are so loud and they only hatch every human generation or so. That is what most people know about cicadas. That is only partially true: yes they are loud, but there are 170 or so species of Cicada found north of the Mexican border with the United States. With that many species you've got to know there are differences in their life styles.

"They are divided into two basic groups. The periodic cicadas are those which emerge every 13 or 17 years (that is a story in itself), and the annual cicadas which (like the one shown here, *Hadoa duryi*) have life cycles of two or three years. The name cicadas (pronounced suh-KAY-duh [sə-ˈkā-də], suh-KAH-duh [sə-ˈkä-də], or sī-ˈkā-də) is either from the Western Apache word for 'sing' or from the Latin cicada ('buzzer'). Although the first is more romantic and more likely to appear in a book about the old west, my money is on the Latin derivation.

"Yes, all make a racket. Well, the males make a racket as they try to attract mates. If you wish, you can follow this link to listen to what one sounds like: *Hadoa duryi song* – but crank up the audio to get a real sense of what it sounds like. That sound is a 'whole insect' work of art. If you were to look inside the first abdominal segment of a cicada you would find the tymbal muscle (found in few other animals).

"The tymbal muscle can contract from 120 to 480 times a second, depending on the species. Yes, a second. Each time the muscle contracts it bends the adjacent hard body part, and when it pops back a clicking sound is generated. Air sacs in the body of the cicada are 'tuned' to the frequency of the clicking sound and amplify the sound. Humans can't really distinguish individual sounds which last 1/480th of a second, so all of those clicking sounds seem like a continuous buzz to us.

"There are thousands and thousands of species in the world which do not have common names. Generally they are obscure and of little consequence to humans. Although *Hadoa duryi* is not exactly obscure and is a pretty big bug, it is (generally) simply known by its Latin binomial, its scientific name. As for what they eat, it is assumed (but not known definitely) that they eat pines, but they are also found in and around yuccas, cactus, and many other 'desert' plants. That lack of clarity about an insect which emerges in tens of thousands at once means that its eating habits are

of little (known) consequence to humans. If it were economically consequential we would know what it eats.

"Although this is an annual cicada, the numbers which emerge will peak every few years.

"Molts are the insect 'skin' that cicadas shed or leave behind when they become adults. (See image above.)

"The cycle is not well understood and as with many insects, the taxonomy is in dispute. Until 2015, for instance, this species was in the genus *Tibicinini* and was known as *Tibicinini duryi*, but had no common name.

Like humans, cicadas are diverse. Learning a bit about them makes them more interesting. "Periodical cicadas disrupt trophic dynamics through community-level shifts in avian foraging" sounds more studied than 'a whole lot of noisy bugs."

Since that article appeared in the Sierra County Citizen there have been (at least) two research efforts on cicadas which qualify as "follow-ups" for this journal.

"Periodical cicadas disrupt trophic dynamics through community-level shifts in avian foraging", *Science*, Vol. 382, Issue 6668, 20 October 2023, by Getman-Pickering et al., is the first we will discuss. In a discussion of the study's findings, Bianca Lopez (Editor's Summary) noted "They found that, compared with nonemergence years, cicada emergence led to lower caterpillar predation by birds, higher caterpillar densities, and higher herbivory rates on oak saplings. As birds opportunistically switched to cicada prey, their control over herbivory declined, showing the far-reaching short-term impacts of a resource pulse."

This study is noteworthy on several counts. One is the study's integration of data from citizen science sources from the beginning. That is, how that data was to be accessed was a significant factor in determining how to best test the hypotheses being advanced by the study group. But, nothing new here. This approach seems to be a standard in cicada research. In 1851, Gideon Smith used newspaper subscribers to delineate 18 brood "districts" of cicadas. Today a mobile app (Cicada Safari) is used by more than 200,000 observers to add to our knowledge of these species.

The study participants recorded 82 bird species feasting on cicadas during the 2021 food pulse (cicada hatching). Everything from swans to gnatcatchers. The cicada pulse had a marked effect across the biological community, with bird species changing their food preferences from vegetative eating to cicada eating, for instance, or from eating caterpillars which were eating oaks to eating cicadas. All of these shifts had significant knock-on effects.

The second study of note was conducted by the Agricultural Research Service (USDA-ARS) - West Virginia Appalachian Fruit Research Station. The question? Do cicadas eat anything after they molt into the adult stage? Apparently this question has been one of ongoing debate, with the consensus in most quarters being that they did not. Wrong!

"The historical belief that adult cicadas in general do not feed on plants can likely be attributed to their lack of recognizable mandibular mouthparts and the inconspicuous nature of cicada feeding damage," wrote the study authors.

The study was also conducted on the 2021 Brood X pulse. Their findings were published in the *Journal of Insect Science*, Vol. 23, Issue 5, September 2023, "Do adult Magicicada (Hemiptera: Cicadidae) feed? Historical perspectives and evidence from molecular gut content analysis", Hepler et al. The study found that "Both nymphs and adults were found to have ingested a range of woody and herbaceous plants across 17 genera and 14 families."

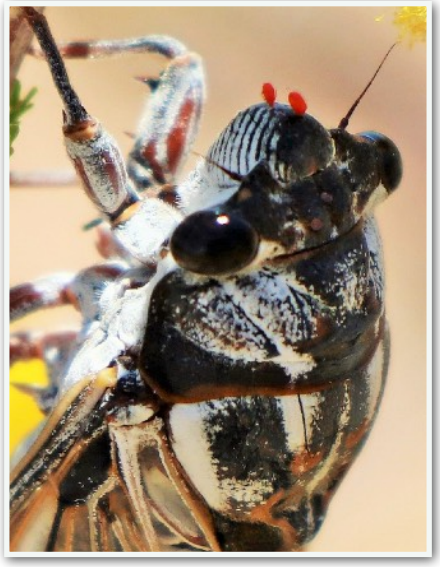
Following a review of an early draft of this issue, James Von Loh provided the following.

Hadoa townsendii (Uhler, 1905) - Cicada (no common name)
by James Von Loh

These photographs are from Tortugas Mountain, the only site/habitat I observed and photo-documented *Hadoa townsendii*, in May 15-21, 2020. They extensively occupied Viscid Acacia, *Vachellia vernicosa* ([Britton & Rose] Seigler & Ebinger) tall shrubs, a few used Ocotillo, *Fouquieria splendens* (Engelm.), and Spanish Dagger, *Yucca treculeana* (Carriere) to perch and sing. They also perched and sang from dead branches of various short shrubs, flying to the tall shrubs named above when approached.

iNaturalist offers the following: *"Hadoa townsendii (formerly Tibicen townsendii) is found in the south-western United States, where it is known from Arizona, New Mexico, and Texas. It occurs in desert grasslands, intermountain deserts, and the Chihuahuan Desert and is associated with Yucca. For instance, it has been reported from lower desert mountain vegetation in association with Soaptree Yucca, Yucca elata. Hadoa townsendii resembles H. bifida and H. simplex. The song is a whining buzz."* (Sanborn & Phillips 2013; Hill et al.)

Below: Larval skin (exuvia) attached to a shrub branch where the mature cicada emerged. 05/17/20



Top Center: Head and thorax enlargement. Note the relatively common parasites (spider mites?) attached to its face. 05/15/20

Top Middle Center: Perched and singing from an Ocotillo stem, this cicada moved up the stem and sang (see video). 05/21/20

Bottom Middle Center: High perch for cicada on flowering Viscid Acacia tall shrub. 05/15/20.

Bottom Center: Typical cicada perching behavior while singing to attract a mate; they move slowly around the Viscid Acacia stem to better hide when approached. 05/20/20

Cacama valvata (Uhler, 1888) - Cactus Dodger
by James Von Loh

Cactus Dodger, *Cacama valvata* (Uhler, 1888), are common to abundant cicadas along the Arroyo Trail at the base of the Organ Mountains. Much use is made of Western (Netleaf) Hackberry, *Celtis reticulata* Douglas, trees for perching, hiding, singing, and mating; however, they use a wide variety of shrub and tree species for mating behavior and the grasses and litter below for roosting at night. I have observed and collected digital images of them between May 27th and June 9th of 2022 and 2023.

Top of the Following Page: Perched on and singing from a short shrub branch, this Cactus Dodger has red parasites attached to its front foot and its wing base.

Left on the Following Page: Mature cicada perched on and singing from a pre-flowering Viscid Acacia stem. 05/17/20

Right on the Following Page: Cactus Dodger perched on a dead limb while singing to attract a mate. 05/28/22

Following Page

Top Left: Cactus Dodger perched on a twig while singing to attract a mate. 05/28/22

Center Left: Cactus Dodger perched in the shadow of a Catclaw Acacia branch while singing to attract a mate. 05/28/22

Bottom Left: Cactus Dodgers perched in the shadow of a Catclaw Acacia branch while possibly courting in a pre-mating behavior. 05/29/22

Top Right: Cactus Dodger perched on a slender Whitethorn Acacia, *Vachellia constricta* ([Benth.] Seigler & Ebinger), stem while singing to attract a mate. 05/29/22

Center Right: Cactus Dodger perched against a dead Cholla (*Cylindropuntia* sp.) stem while singing to attract a mate. 05/29/22

Bottom Right: Cactus Dodger perched on a stem while singing to attract a mate. 06/09/22

Top Left: Ventral abdomen enlargement of a Cactus Dodger perched in a Western (Netleaf) Hackberry tree to hide and sing to attract a mate. 05/29/22

Bottom Left: Cactus Dodger perched on a branch while singing to attract a mate. 06/09/22

Top Right: Cactus Dodger perched on a twig while singing to attract a mate. 5/27/23

Bottom Right: Cactus Dodger perched against a dead Cholla (*Cylindropuntia* sp.) stem while singing to attract a mate. 05/27/23

Hadoa duryi (Davis, 1917) "Orange and Black Cicada"

by James Von Loh

Davis' original description reads: "Type male, Jemez Springs, New Mexico, 7,000 ft., June 27, 1917 (John Woodgate). Davis collection.

Allotype female. Box Canyon, Grant County, June, 1912 (Charles Dury). Davis collection.

A black and reddish species much resembling an *Okanagana* in coloring, especially when the wings are closed. The head at the eyes not much broader than the front margin of the pronotum." (*Hadoa duryi,* Davis, 1917 - *Cicada Mania*)

On July 24, 2021, I observed an individual of this species perching, singing, crawling along the trunk of a Desert Willow, *Chilopsis linearis* ([Cav.] Sweet), tree - one of the native plantings at the Dripping Springs Visitor Center of the Organ Mountains.

Top Left, Center Left, and Bottom: Orange and Black Cicada crawling and occasionally singing from the bark of a Desert Willow tree trunk. 07/24/21

Top Right: Enlargement of the dorsal head and thorax of an Orange and Black Cicada. 07/24/21

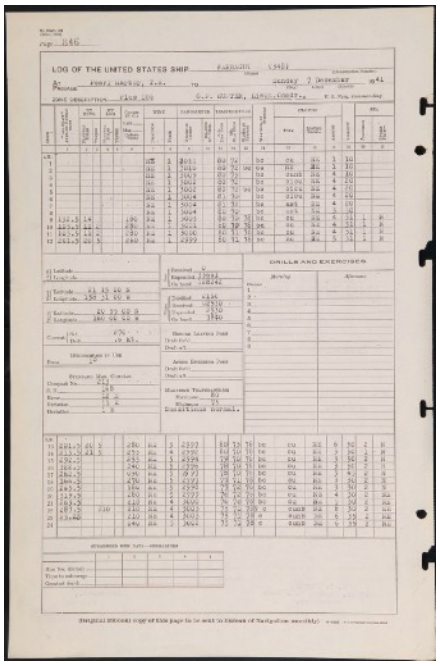
Follow-Ups and Tidbits From The Literature

You Can Acquire It But You Can't Necessarily Recall It

It is an age old problem. How can you store and retrieve knowledge? On a small scale we grapple with this all of the time at *The Black Range Naturalist*. Digital material is only as good as the storage where it resides, and storage degrades, server companies go out of business, server capacity becomes too expensive, etc. While the digital format enables the sharing of much more than can reasonably be done with print media, there is something transitory about electricity. Print copies are not only expensive, they lack a certain utility: you can punch that website link on a paper copy all day long and all you will do is make a hole.

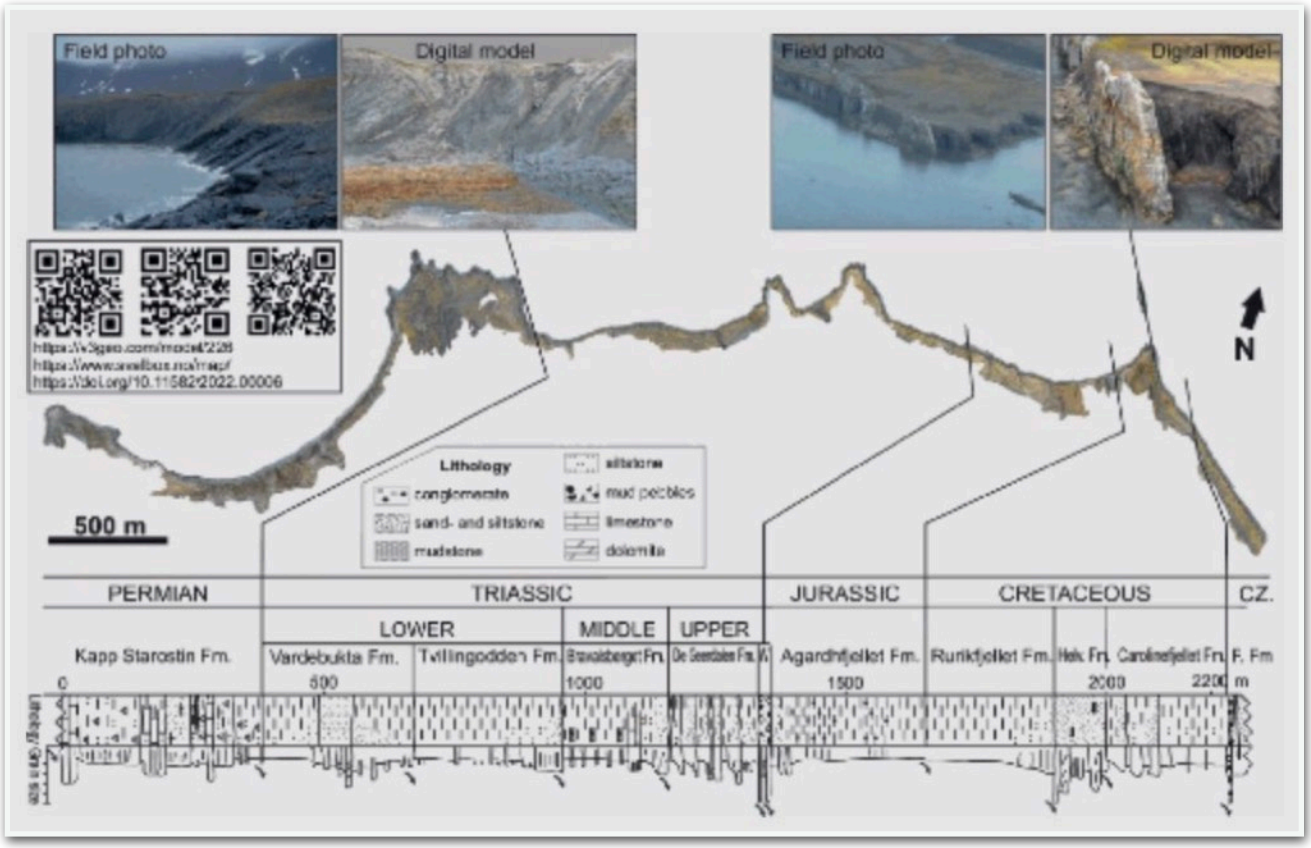
The Black Range is a very rugged place and - as with many other places in the world - there are attempts to capture it in all its glory. Unattainable. Except, maybe some headway. Senger et al. in "Digitising Svalbard's Geology: the Festningen Digital Outcrop Model", *EarthDoc - Online Geoscience Database,* Vol. 40, Issue 3, discuss their digital modeling techniques. See one of the graphics, below, from the article. It shows field photos, the digital models created from the photos, and a graphic overlay indicating the mineralogy and historical geology of the area. Incredible detail is created using drone images and sophisticated computer algorithms. But the cost of "server maintenance becomes prohibitive". The Svalbard project is trying to tackle this issue as well. We wish them luck. Our tool kit grows by the day. Some of the tools will play out, some will not.

Related to this issue is the recent release of weather data gathered during World War II by ships in the Pacific Ocean. The ship log shown at the right is from the U.S.S. Farragut on December 7, 1941. It contains the weather observations made on that day, and since ship log entries are made continually, such logs are available for every day the ship was active. All of these ship logs - read paper - have now been declassified, and a public effort is underway to capture the weather information which they contain. This information should further improve our weather modeling capabilities. (Teleti, Hawkins, and Wood, "Digitizing weather observations from World War II US naval ship logbooks", *Geoscience Data Journal*, Royal Meteorological Society, September 18, 2023.)



Black and Grizzly Bears and Some Alligator Juniper

In the January 2023 issue (Vol. 6, Number 1) we provided a survey of the bear species in the Black Range.



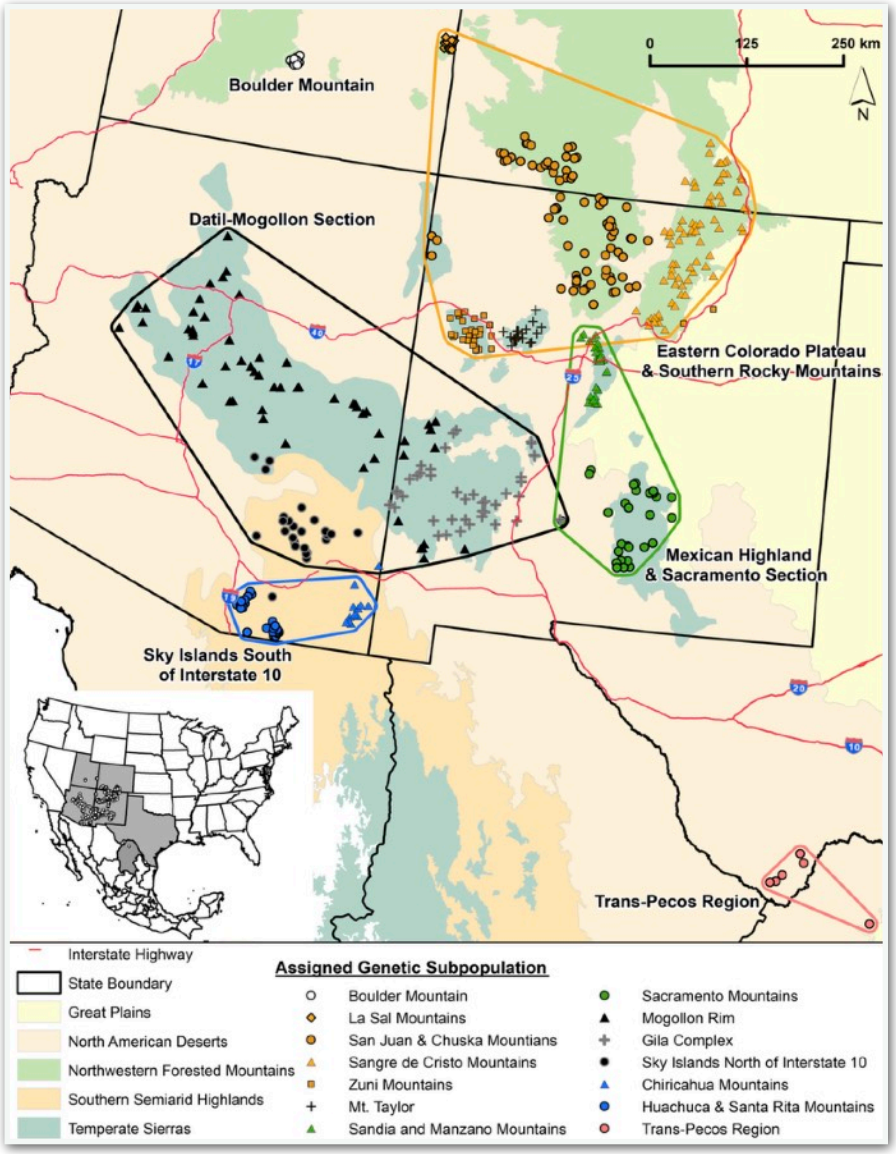
The study by Gould et al. ("Pleistocene-Holocene vicariance, not Anthropocene landscape change, explains the genetic structure of American black bear (Ursus americanus) populations in the American Southwest and northern Mexico", *Ecology and Evolution*, 10 October 2022) did not come to our attention until after the January 2023 issue of this journal hit the street.

The authors used "a suite of microsatellites and a sample of 550 bears" to identify "14 subpopulations organized hierarchically following the distribution of ecoregions and mountain ranges containing black bear habitat. The pattern of subdivision we observed is more likely a product of postglacial habitat fragmentation during the Pleistocene and Holocene, rather than a consequence of contemporary anthropogenic barriers to movement during the Anthropocene." The map to the right identifies the subpopulations that were recognized in the study. Bears in our area were assigned to the "Gila Complex".

"Black Bears were last isolated during the Last Glacial Maximum (LGM) ~26.5 kya and had contracted into three glacial refugia located in Beringia, the Pacific Northwest, and the American Southeast, and a fourth hypothesized refugium in the southwestern United States and northern Mexico . . . As glaciers receded (~20 kya), black bears expanded out of their respective refugia resulting in admixture among populations in west-central and east-central North America and the formation of region-specific subpopulations.

"As the Holocene aridified, habitats preferred by bears either shifted up in elevation, such as in the Madrean Sky Islands along the U.S.–Mexico border, or farther north in latitude and the bears likely followed suit. Thus, vicariant events, namely climatic change that drove the distribution of important food plants for this forest-adapted species, may have influenced the distribution of black bears."

As an isolating factor the study noted that "resistance'" to movement between regions "was lowest in areas with higher forest canopy, higher levels of precipitation, and less rugged landscapes. Precipitation contributed the most to the top-ranked resistance surface (58%) followed by canopy (40%)".



Movement between the subpopulation areas noted above may become more problematic as the effects of climatic changes become more pronounced. Although we have seen Black Bears in the Rio Grande valley and they are fairly common along the margins of the Black Range, they may be forced upward in elevation by vegetative change. These changes may further isolate the existing subpopulations.

The findings of this study are not significantly different from those noted for changes in *Juniperus deppeana* distribution (see: Black Range Naturalist, July 2023, Vol. 6, No. 3., "The Natural History and Range of Alligator Juniper"). In that issue we noted that "*Juniperus deppeana and its varieties form a discontinuous ring in the mountains above 2000 m (occasionally down to 1500 m) around the Chihuahuan desert in the southwestern US and Mexico, thence at 1600 - 2200 m in the mountains in the very southernmost part of Mexico and northern Guatemala. Wells (1966 - see below), using data from rat middens from the Big Bend Texas region, concluded that during the Wisconsin (70,000 - 13,000 ybp) life zones descended about 800 m, enabling the formation of pinyon-juniper in the present Chihuahuan desert between the Big Bend Region of Trans-Pecos, Texas, and the city of Del Rio. Even if the effects of glaciation were mediated southward into Mexico so that life zones descended only a few hundred meters in Hidalgo, it appears that all of the now disjunct populations (varieties) of J. deppeana were connected in a continuous ring of distribution around the Chihuahuan desert (perhaps with islands of J. deppeana within the ring). The recently described J. d. f. elongata (Adams & Nguyen, 2005) grows as scattered trees in the Davis Mountains of Trans-Pecos, Texas . . . Wells found 'Eight Pleistocene wood rat middens*

at elevations of 1200, 880, and 600 meters in the Chihuahuan Desert contain abundant macrofossils of pinyon pine, juniper, shrubby live oak, and Opuntia, together with smaller quantities of Agave lechuguilla and other xerophytes of existing desert vegetation, which indicate a xerophilous woodland vegetation in the lowlands, as much as 800 meters below existing woodland, during the Wisconsin pluvial." (Wells, Philip V., "Late Pleistocene Vegetation and Degree of Pluvial Climate Change in the Chihuahuan Desert", *Science*, Vol. 153, Issue 3739, August 26, 1966, pp. 970-97.)

Responding to the January 2023 issue of this journal, Jerry Davis noted that "*When I was Forest Wildlife Biologist on the Kaibab National Forest, I looked into the Grizzly Bear and Jaguar occurrence on the Forest. I believe the last Grizzly was killed in Bear Canyon south of Williams in the early 1900s and the last Jaguar was killed at the South Rim of the Grand Canyon about the same time. The expeditions of Lt. Sitgreaves notes evidence of Grizzly Bears at what is now Sitgreaves Mountain and other Grizzly Bear notes are in his records of his expeditions in the mid 1800s when they were exploring the territory for resources.*"

Cottonwoods

We have two species of cottonwood growing in the Black Range. There is also a hybrid between the two which is found here.

Populus x acuminata is a hybrid of *Populus deltoides* and *Populus angustifolia*. Its leaves have a shape which is in between the narrow shape of the *P. angustifolia* and the cordate shape (heart-shaped) of *P. deltoides*. It is commonly known as the Lance Leaf Cottonwood.

The specimen shown above center was found growing in one of the washes of Ready Pay Gulch east of Hillsboro. The rock appears to be limestone. This is a rather strange place for a cottonwood to be growing. These cottonwoods are "survivors", but most of the time this is a very dry place.

P. angustifolia is a western species, while *P. deltoides* is found in much of the United States. At one time Lance

Leaf Cottonwood was considered a full species and not a hybrid.

Why bring this up at this time? Because Sarah Love's PhD thesis is on *P. angustifolia*. Her presentation "Using Sky Islands to Study Climate Change Across the Globe" was posted (follow link) on the Sky Island Alliance website on November 16, 2023 (also on YouTube) - it may still be there. If so, it is worth watching.

Rock Daisies

In "Edaphic specialization onto bare, rocky outcrops as a factor in the evolution of desert angiosperms" Lichter-Marck and Baldwin (Proc Natl Acad Sci U S A. 2023 Feb 7;120(6):e2214729120. doi: 10.1073/pnas.2214729120. Epub 2023 Jan 30. PMID: 36716359; PMCID: PMC9963280) posit that "*Understanding the processes that enable organisms to shift into more arid environments as they emerge is critical for gauging resilience to climate change, yet these forces remain poorly known. In a comprehensive clade-based study, we investigate recent shifts into North American deserts in the rock daisies (tribe Perityleae), a diverse tribe of desert sunflowers (Compositae).*" They found that "*Estimates of life history and micro-habitat in the rock daisies reveal a correlation between a suffrutescent perennial life history and edaphic endemism onto rocky outcrops, an ecological specialization that evolved prior to establishment and diversification in deserts. That the insular radiation of desert rock daisies stemmed from ancestors preadapted for dry conditions as edaphic endemics in otherwise densely vegetated tropical deciduous forests in northwest Mexico underscores the crucial role of exaptation and dispersal for shifts into arid environments.*" (Underline added)

This is not necessarily the answer that some would wish for. Many hoped that these species had enough inherent genomic plasticity to adapt to the new drier environments. In fact, this has been the operating ontology in most of the field for quite some time. At least in the case of the species assessed in this study - that is not how it happened. A less hopeful outcome, perhaps, but it underlines the importance of micro-habitats and the diversity of ecological niches which currently exist.

The study considered the "unique life-history traits closely tied to micro-climate specificity to build an integrative understanding of ecological transitions and trait evolution through time for 73 out of 84 species of rock daises." The Vascular Plants of the Gila Wilderness website lists *Pertiyle coronopifolia* from the Mogollon Mountains. On September 23, 2010, R. Sivinski collected a specimen of this species about 11 air miles WNW of Cuchillo on the north face of a rhyolite cliff. As far as we can tell, this is not one of the species included in the study.

Bird Taxonomic Updates

2023 changes to the avian taxonomic listings (in our area), include:

- Northern Goshawk - now American Goshawk, *Accipiter atrocapillus;*
- Cattle Egret - now Western Cattle Egret, *Bubulcus ibis*.; and
- Cordilleran Flycatcher - once again Western Flycatcher, *Empidonax difficilis*.

Communication in Non-Human Species and Citizen Science

Humans do not understand what other species are communicating to each other. Some would want that statement to be nuanced, something like "very well". However, our capabilities are so poor as to be nonexistent.

The difference in capability is hard to fathom. Summit is a supercomputer located at the Oak Ridge National Laboratory. To quote the lab's website, "A 200-petaflop machine, Summit can perform 200 quadrillion (peta-) floating point operations per second (-flops). If every person on Earth completed one calculation per second, it would take the world population 305 days to do what Summit can do in 1 second." (underline added)

When such computing capability is linked to machine-learning algorithms we are able to assess huge amounts of data to sift it for patterns and to determine their meanings. (We use "machine-learning [ML] algorithms" as a term of art; others use AI, artificial intelligence, deep learning, and various other terms and acronyms.)

In "Using machine learning to decode animal communication" (Science, 14 July 2023) Rutz et al. discuss the issues and strategies being employed to advance our knowledge in this area. They note:

"Researchers must infer the meaning, or function, of animal signals through observation and experimentation. This is a challenging task, not least because animals use a wide range of communication modalities, including visual, acoustic, tactile, chemical, and electrical signals – often in conjunction, and beyond humans' perceptive capabilities. Observational work focuses on recording the signals of interest as well as detailed contextual information, including the identity, state, and behavior of both the senders and receivers of signals, their relationships and past interactions, and relevant environmental conditions. Some signal types may be produced only under certain circumstances, eliciting a specific behavioral response; a classic example is a vervet monkey (*Chlorocebus pygerythrus*) giving an alarm call when it spots a predator, which causes group members to seek shelter. Establishing such correlations enables the formulation of hypotheses about signal function that can then be tested experimentally (e.g., with controlled playbacks).

"Following this approach, decades of careful research have produced major advances in understanding animal communication. But there are considerable challenges, such as avoiding anthropocentric biases in data collection and interpretation, processing ever-increasing volumes of data, charting the full complexity of animals' signaling behavior, and achieving comprehensive functional decoding. ML offers some potential solutions. . . .

"Large volumes of audio and video data are held in community-sourced archives (such as the Macaulay Library or xeno-canto), are being accumulated by passive recording arrays, or can be scraped from the internet. Mining these data sources will provide fascinating glimpses of the richness of animal communication, but on its own, such work is unlikely to achieve breakthroughs in decoding signal function. This is chiefly because robust information on the identities and states of the senders and receivers, and the specific communication context, is usually lacking. . . .

"It is clear that community mobilization and appropriate resourcing are required to ensure that species experts are fully involved in the annotation and interpretation of existing recordings and can lead targeted efforts to collect new data at scale, in both the laboratory and field. For wild animals, a range of methods can be used to collect suitable datasets, including observation of focal subjects, autonomous cameras and audio recorders, drones and robots, and animal wearables (bio-loggers). Some bio-logging devices can collect audio and body-motion data simultaneously for the same individual."

The concept outlined above, the melding of large amounts of data - much accumulated through "citizen science" initiatives - with phenomenal computing and assessing tools may lead to a breakthrough in our understanding of the natural world.

Our individual efforts in developing the data set can have substantial effect. Contributions of your observations to iNaturalist, eBird, BAMONA, BugGuide, and many other programs may be much more important than we can now imagine.

Disadvantages and Advantages of Being Horny

In several of our past issues, including the January 2024 one, we have discussed the horned lizards found in the Black Range. The horns they (and a variety of other species) have on their heads have long been a matter of evolutionary angst. Why have horns?

A recent study provides some insight (Banfi, Meiri, Shine, Van Damme, and Baeckens, "Foraging mode constrains the evolution of cephalic horns in lizards and snakes", *Biology Letters* (The Royal Society), Volume 19, Issue 11, November 22, 2023. https://doi.org/10.1098/rsbl.2023.0395).

The authors posited that "*although horns may be beneficial for various functions (e.g. camouflage, defence) in animals that move infrequently, they make active foragers more conspicuous to prey and predators, and hence are maladaptive. We therefore expected horns to be more common in species that ambush prey (entailing low movement rates) rather than in actively searching (frequently moving) species. Consistent with that hypothesis, our phylogenetic comparative analysis of published data on 1939 species reveals that cephalic horns occur almost exclusively in sit-and-wait predators. This finding underlines how foraging mode constrains the morphology of squamates and provides a compelling starting point for similar studies in other animal groups.*"

The article, and the numerous citations in the article, explore our current knowledge of this issue.

Social Behavior in Garter Snakes and the Personalities of Rattlesnakes

The Black Range projects recently published *The Reptiles of the Black Range* which included the several garter snake species in the Black Range. The studies noted below may be useful in our exploration of the natural history of this area.

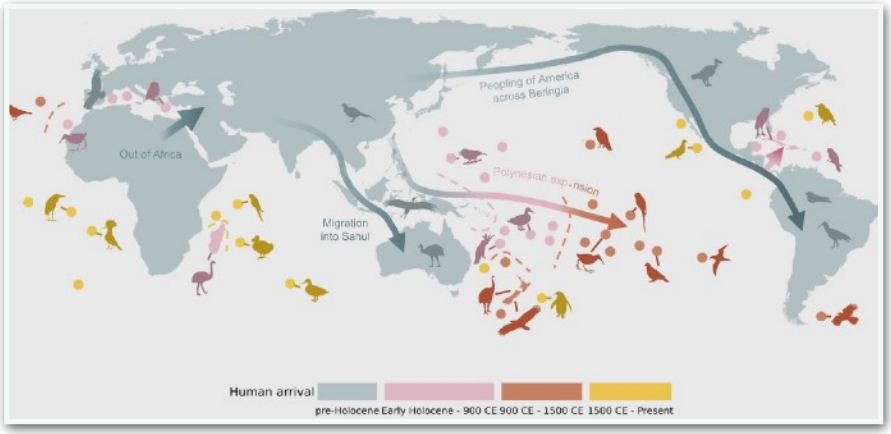
On 15 April 2020 Skinner and Miller published "Aggregation and social interaction in grater snakes (Thamnophis sirtalis sirtalis)" in *Behavioral Ecology and Sociobiology* (2020, 74:51). On September 2022, Brown and Kumpan joined them in the publication of "Snake personality: Differential effects of development and social experience" in the same journal (76:135).

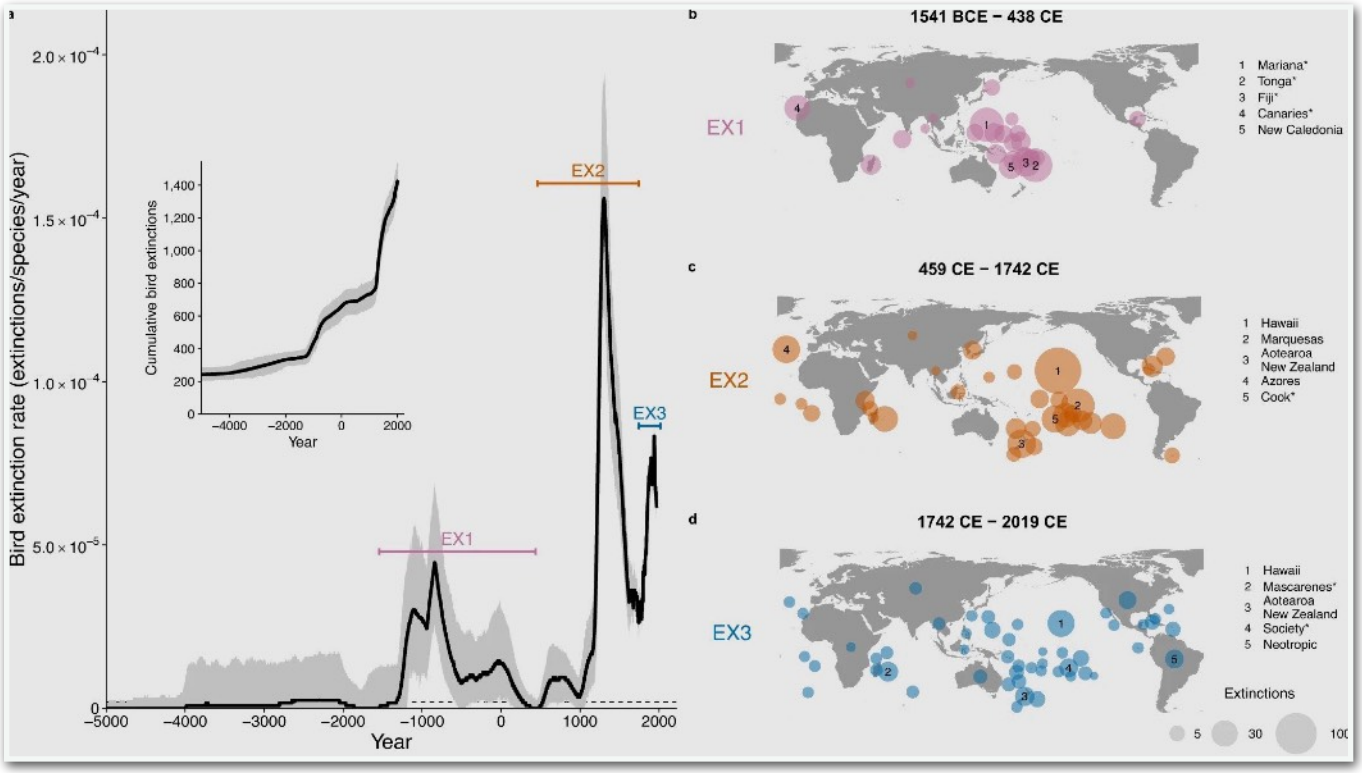
And on the same topic, there is "Personally rattled: a unique protocol to support the presence of personality and behavioral syndromes in rattlesnakes" by Da Cunha, O., Horne, L.M. & Johnson, J.D., in the same journal (77:115). In that study the authors reported that "*Crotalus atrox* exhibits individual behavioral differences consistent through time and behavioral syndromes comparable to other species."

Human Caused Bird Extinctions

Rob Cooke et. al. in "Undiscovered bird extinctions obscure the true magnitude of human-driven extinction waves" *Nature Communications* 14, 8116 (19 December 2023). https://doi.org/10.1038/s41467-023-43445-2 reported that "humans have already driven more than one in nine bird species to extinction, with likely severe, and potentially irreversible, ecological and evolutionary consequences." The graphics shown below are from this study.

Earlier we noted the extirpation of the Grizzly Bear from the Black Range by the northern Europeans and the extirpation of the California Condor by the people who lived in the area during the Holocene. Here we simply reinforce the idea that these were not local phenomena. Wherever humans go they destroy the natural world. Unfortunately the work of the human species has just begun, and our efforts have resulted in extinctions which are occurring at rates which are about 1,000 times faster than in normal evolutionary periods. Whereas the great extinction events of the past (end of the Ordovician which occurred at about 444 Mya when 86% of all species went extinct; the late Devonian at about 360 Mya when 75% of all species went extinct; the end of the Permian at about 250 Mya when 96% of all species went extinct; the end of Triassic at about 200 Mya when 80% of all species went





extinct; and the end of Cretaceous at about 65 Mya when 76% of all species went extinct) were all driven by natural phenomena, our species bears the sole responsibility for the current crisis. At this point it is not possible to determine if the great extinction we have created will be as significant as the last five. However, it is already clear that we have been responsible for the destruction of an exceptional amount of diverse life. In previous periods the evolutionary processes have enabled the life which survived these mass extinction periods to diversify and give life on earth another chance. Let's hope that the next alpha species is wiser and less driven by greed. But in a universe in which the basic model of life is built on competition, that seems unlikely.

(Unofficial) Results of the 2023 Hillsboro Christmas Bird Count

On December 21, 2023, thirteen people scoured the countryside within a 15 mile diameter circle centered near Tierra Blanca Road, south of Hillsboro. They followed established routes in the area. Also included in the count were "feeder watches" in Hillsboro and in the Berrenda area south of Hillsboro. In all, participants walked 45.33 miles and drove 95.6 miles as part of the effort. They were in the field 81.4 hours (43.7 hours walking, 16.7 hours driving, and 21 hours watching at feeding stations). This count is managed by Kathleen Blair and Jan Richmond. In all, 95 bird species were reported.

Species reported were: American Wigeon, Mallard, Scaled Quail, Gambel's Quail, Montezuma Quail, Wild Turkey (note that this is the first Wild Turkey ever reported on a Hillsboro Christmas Count), Golden Eagle, Northern Harrier, Sharp-shinned Hawk, Cooper's Hawk, Red-tailed Hawk, Killdeer, Eurasian Collared-Dove, White-winged Dove, Mourning Dove, Greater Roadrunner, Barn Owl, Great Horned Owl, Northern Pygmy Owl, Anna's Hummingbird, Acorn Woodpecker, Williamson's Sapsucker, Yellow-bellied Sapsucker, Red-naped Sapsucker, Ladder-backed Woodpecker, Downy Woodpecker, Hairy Woodpecker, Northern Flicker, American Kestrel, Merlin, Prairie Falcon, Vermillion Flycatcher, Black Phoebe, Say's Phoebe, Loggerhead Shrike, Pinyon Jay, Steller's Jay, Woodhouse's Scrub-Jay, Chihuahuan Raven, Common Raven, Mountain Chickadee, Bridled Titmouse, Juniper Titmouse, Verdin, Bushtit, White-breasted Nuthatch. Rock Wren, Canyon Wren, Cactus Wren, House Wren, Marsh Wren, Bewick's Wren, Black-tailed Gnatcatcher, Ruby-crowned Kinglet, Eastern Bluebird, Western Bluebird, Townsend's Solitaire, Hermit Thrush, American Robin, Curve-billed Thrasher, Crissal Thrasher, Gray Catbird, Northern Mockingbird, Phainopepla, Orange-crowned Warbler, Yellow-rumped Warbler, Cassin's Sparrow, Grasshopper Sparrow, Chipping Sparrow, Black-chinned Sparrow, Brewer's Sparrow, Black-throated Sparrow, Fox Sparrow, Dark-eyed Junco, White-crowned Sparrow, Sagebrush Sparrow, Vesper Sparrow, Song Sparrow, Lincoln's Sparrow, Canyon Towhee, Rufous-crowned Sparrow, Green-tailed Towhee, Spotted Towhee, Northern Cardinal, Pyrrhuloxia, Red-winged Blackbird, Western Meadowlark, Brewer's Blackbird, House Finch, Pine Siskin, Lesser Goldfinch, American Goldfinch, and House Sparrow. In all, 4,462 individual birds were recorded.

Christmas Bird Counts are conducted every year between December 14 and January 5. The date for the 2024 Christmas Bird Count will be set sometime around the first of December 2024. If you would like to participate in that count please contact Kathleen Blair or the editor, rabarnes@blackrange.org, who can pass on your inquiry.

These photographs were taken by Michael Henry during January 2024, in Kingston. Dr. Henry noted the unusual time of year (they are typically found farther south in the Sierra Madre Occidental in January.)

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