



Eggs upon laying, with my finger for reference. Photo by the author.

Incubation

One of the night snakes I had in the past came to me after somewhat recently mating in the wild. This female laid two eggs on October 3rd, 2022. After incubating at 80 degrees Fahrenheit for 63, days both eggs hatched out on December 5th. Should I get eggs again down the line, I will make sure to take proper weight and length records—something I am regretting skipping over now.



Hatchlings in comparison to my finger. Photo by the author.

The First-Ever Commercially Available Native Plant Seed Mix for a Reptile

by

Dustin Rhoads

It's a comfortably cool morning in October 2022, and here I am along with ecological restorationists Emily Neiman, Leslie Boorhem-Stephenson, and Orion Weldon, planting 100 pounds of a brand-new native plant seed mix for Texas Horned Lizards (*Phrynosoma cornutum*) at country music singer Willie Nelson's ranch in Spicewood, Texas. I could say this journey started early 2010 when I read a book by entomologist Douglas Tallamy about how you can invite and sustain native wildlife and their food webs in your yard with native plants; but in reality, this journey started long before that—at least as far back as my birth. Then again, I could even make the case that this story can trace its roots to the spring of 1837.

Six months after Charles Darwin completed his *HMS Beagle* expedition, John James Audubon started his own from New Orleans, traveling aboard a US revenue schooner along the Gulf Coast. From at least late April thru mid-May, Audubon visited Galveston in the then-newly founded Republic of Texas to complete his legendary *Birds of America* illustrated work. Audubon encountered many birds in Galveston, and among them was the species that became the symbol for the society that would later bear his name—the Great Egret (*Ardea alba*). On plate 386 of his book is an ecological diorama that is vaguely (but not totally) familiar to my many wanderings around my youthful stomping grounds: an egret is there among “crawdads” (Cambaridae) chimneys—both familiar sights along the irrigation ditches around my neighborhood. Somewhat less familiar, however, is the tall bunchgrass—perhaps Eastern Gamagrass (*Tripsacum dactyloides*)—in the background. Even less familiar is another animal that Audubon had instructed engraver Robert Havell, Jr. to etch onto the copper plate—a Horned Lizard (*Phrynosoma* sp.).



Audubon's “White Heron” (aka Great Egret) from *Birds of America* (1838). JJ Audubon painted the egret from scenes on location in Galveston and Charleston. Image in public domain, courtesy of the National Audubon Society.

Fast-forward to 1980. I was born in the place where Audubon stepped off the USCGC *Campbell*, was greeted by the secretary of the Texas Navy, Samuel Rhoads Fisher, and encountered the ecological setting in which he painted the Great Egret and saw other natural wonders like Ivory-billed Woodpeckers (*Campephilus principalis*). By this time the area was a quite-changed, blue-collar Texas oil refinery town a few minutes' walk from Galveston Bay, in a typical working-class neighborhood meticulously turfed and routinely manicured with a monoculture of exotic St. Augustine carpet grass (*Stenotaphrum secundatum*) lawns and lined with mature and equally exotic Chinese Tallow trees (*Triadica sebifera*). But only two-and-a-half decades before my birth, my childhood neighborhood was a nearly treeless coastal prairie filled with a diversity of native bunchgrasses like cordgrass (*Spartina* spp.), bluestems (*Andropogon* spp.), paspalums (*Paspalum* spp.), Switchgrass (*Panicum virgatum*), muhlies (*Muhlenbergia capillaris*), and gamagrass (*Tripsacum* spp.)—species that had been there for tens of thousands of years, up until only a quarter century before I graced the scene. This was the setting that welcomed Audubon to my place of birth nearly 200 years ago but had ironically eluded me by just one score and five.

By the time I was born, the rich historical community of Texas native wild grasses had been replaced with a depauperate roster of foreign plants. The limited animal species I could find in my yard as a child matched the limited parameters of such trimmed, controlled landscaping. But even though they were few in diversity (consisting of only three natives encountered with any consistency), herps were my window into the exquisite beauty of wildness because, for a toddler, they were the most accessible—I could *touch* them. We had lime-colored Green Anole lizards (*Anolis carolinensis*) that could climb way up the trees, and down below the canopy shaded in the leaf litter, Gulf Coast Toads (*Incilius valliceps*) and Rough Earth Snakes (*Haldea striatula*) kept their small bodies cool and damp, buffered from the Texas heat. These were the few reptile and amphibian species that could be found on a regular basis because they didn't need to cross busy roads as often to find mates, shelter, or food. They could also subsist because they were the few herp species that could live on the paltry few invertebrates that could eke out a living in a conventional suburban yard landscaped with exotic plants and doused regularly with pesticides, herbicides, and fertilizers. We also had one single non-native herp species—Mediterranean Geckos (*Hemidactylus turcicus*)—which hunted moths on the outside walls at night. Encounters with these few taxa cemented my interest in nature and herpetology from a young age. I was grateful for their presence. But by the time I was four years old, I had become well-aware that this assemblage of reptiles and amphibians was not only different compared to what it was just a quarter century prior, it was also missing many key players.



Top photo: When I was a teenager in 1993, my family moved into a subdivision called “Swallows Meadow” on the north side of Texas City, a couple minutes' walk from Galveston Bay. A 40-acre remnant of coastal prairie crisscrossed with dirt bike trails was nestled between our neighborhood and an adjacent subdivision, North Village, connected by a single unpaved road. My younger brother, Austin, found Texas Horned Lizards (*Phrynosoma cornutum*) in that field in the late 1990s (and didn't tell me about it) while I was too busy being a teenager riding my bicycle to my girlfriend's house in North Village.

Bottom photo: Today, that 40-acre prairie remnant is now houses—a subdivision called Bayside Landing. There are no more Horned Lizards in Texas City, and they are all but gone in the entire Coastal Prairie ecoregion. I never saw a wild Texas Horned Lizard until I was 27. (*Google Earth* images, 1995 and 2023, respectively.)

The adults in my life—my parents, aunts, uncles, grandmothers, older neighbors, and friends' parents who grew up or lived in the same area and noticed my peculiar affinity for reptiles—told me of the animals they had encountered there in the 1950s and 1960s. Frequent visitors to their yards were such delightful guests as Box Turtles (*Terrapene carolina triunguis*), Rough Green Snakes (*Opheodrys aestivus*), Leopard Frogs (*Lithobates sphenoccephalus*), Speckled Kingsnakes (*Lampropeltis holbrooki*), Glass Lizards (*Ophisaurus attenuatus*), Garter Snakes (*Thamnophis* spp.), and the coveted Texas Horned Lizards. The ecstasy conjured up in my mind of what it could've been like finding such “exotic” fare in such a pedestrian place as my backyard induced in me such a pleasing reverie that I would nearly salivate at the thought of it, and yet simultaneously seethe in envy at the squandered luck that my elders possessed but did not seem to appreciate as much as I did.

What was the cause of it? Where did these animals go? Could we ever get them back? Would Galveston County kids ever have them in their yards again? As I grew and eventually pursued degrees in ecology with a personal emphasis on studying Texas herps, these questions yet remained with me. It was shortly after finishing my undergraduate studies when I came across the aforementioned book, *Bringing Nature Home: How You Can Sustain Wildlife with Native Plants*, by Douglas Tallamy, that seemed to answer those questions. Tallamy's main argument was one of community: that in terrestrial environments all energy from the sun is converted to food energy by plants; that those plants don't want to get eaten and defend themselves with chemical and structural adaptive defenses; that the main reason that energy locked up in plants eventually travels throughout the food web anyway is via specially adapted insects that have evolved past the plants' defenses; that more than 90 percent of those herbivorous insects specialize in one or a few types of native plants that they have co-evolved with (and thus diversity of plants supports diversity of wildlife higher up the food chain); and that most wildlife species—including nearly all songbirds, practically all reptiles, absolutely all amphibians, and many fishes and mammals—depend on eating those native insects that dined on those native plants. If you could trace any animal species' food web back to the native plants that sustain its food web, you could figure out which species of native plants to sow to create that animal's habitat. Simple.

As I followed this train of thought, I found other books, web sites, and even commercially-available native plant seed mixes that were made to support birds, butterflies, and bees—in other words, species that could reasonably traverse a road or highway to get to the native plant in your yard. But there were none of these resources for reptiles, and it bothered me because even though non-volant terrestrial vertebrates face more challenges spreading across our highway-ridden landscapes, Tallamy's principle still applies the same for those organisms.

After graduating with a Masters of Science degree in Biology, studying camouflage in Texas Horned Lizards, from Texas Christian University in Fort Worth in December 2019, I wanted to work for a company or organization that would allow me to work on that problem. To learn my native plants, I volunteered at the Fort Worth Nature Center greenhouse and participated in Native Prairies Association of Texas workshops. Finally, in spring of 2022, I was hired as an ecological restorationist for Native American Seed (NAS)—a company whose mission is “helping people restore the earth” via native Texas wildflowers and prairie grasses. With guidance and help from NAS veteran employees, meetings with San Antonio Zoo staff, Texas Parks and Wildlife botanists, and others, I was able start working on putting together a native plant seed mix for a reptile that all Texans love—the Texas Horned Lizard. It's fitting, isn't it? Few reptiles epitomize better the symbology of the American West.

When we are trying to restore Horned Lizards, what we are actually trying to restore is the community that supported them. Horned Lizards are part of a grassland community. And in some ways, they are latecomers to the grassland community and specialize in filling a niche role. The wildlife communities that welcomed Texas Horned Lizards to the central grassland of North America are paradoxically analogous to the communities embodied by the Euroamerican settler land ethic regime that replaced them. As Ernest Callenbach said in his book *Bring Back the Buffalo! A Sustainable Future for America's Great Plains*:

The first few trappers, explorers, and fur traders seemed to pose little threat. But after them came buffalo hunters, preying on the bison. Then came traders, making their living off the hunters and trappers and Indians. Then settlers took possession of the land to extract the accumulated richness of its soil, and gold miners invaded the Black Hills. Bandits, gunfighters, lawyers, and storekeepers arrived to live off the townsfolk and settlers. Finally, the military and its civilian helpers killed or rounded up the remaining Indians. ...The water and land were first exploited by open-range cattle barons and their hired guns, but then came 'the plow that broke the Plains.' Wave after wave of farmers built sod houses, plowed, planted, watched their crops shrivel or blow away, and went bust. So in time a new variety of predator appeared on the Plains: not carnivore, not even human, but nonetheless voracious. Banks gobbled up the farms. Giant grain-trading corporations learned to manipulate commodity prices, producing waves of bankruptcies. Seed companies, fertilizer companies, and equipment companies racked up sales to failing farmers. These new predators were mostly legal fictions called corporations: self-replicating organisms driven by an ineluctable need to maximize profits, protected by law from personal liability claims. They steadily sucked money from the farmers, driving them to try ever harder to squeeze money from the land. For a time, the farmers fought back through populist political organizations. They even formed a new party and sent a few representatives to statehouses and to Washington, but their uprisings were soon beaten down.

A news clipping from 1928. Even if you discount the horned lizard curio and short-term pet resale industry that permeated throughout the first sixty-plus years of the twentieth century, the fact that the tallgrass prairie is perhaps the most endangered ecosystem on the planet with less than 1% of it currently remaining is enough to understand 'what happened to the horny toad' in the historic tallgrass prairie range, i.e. all grasslands along and east of today's I-35 corridor. (From the *El Paso Evening Post*, May 26th 1928.)

HORNED TOAD INDUSTRY IS NEW PROJECT

El Paso Firm Plans Wide Business in Sale of Animals

El Paso has a new industry. It is the "Horned Toad Novelty Co., with headquarters in the Mills building.

J. R. Eichelberger has just started the business and is preparing to ship thousands of horned toads to merchants all over the country. He has mailed out hundreds of pieces of descriptive literature offering horned toads at \$1 each.

Accompanying each toad is a window display poster containing reproductions of newspaper stories about horned toads. Stories about the Eastland toad, that is reported to have lived in the corner stone of the Eastland county court house for 31 years, and about "Snoozer," El Paso's entrant in the Ft. Worth toad marathon are featured.

Eichelberger proposes to collect his toads by paying five cents each for them to anyone who will catch them.

Some of Eichelberger's literature headed by pictures of horned toads, reads:

"These toads, caught on the desert wastelands, are absolutely harmless. You can handle them without fear, and it is a sight to see them devour ants, gnats, flies and cockroaches, should you care to feed them.

"Crowds have come for miles to see one of these curious varmints. Zoos in the large cities have been swamped with people wishing to get a sight of the strange creature to such an extent that the keepers in Philadelphia, Cincinnati and Seattle were forced to order them.

"You can have one or as many as you like for your show window. Be the first to get your newspaper to write you up as well as attract the crowd and you will be happy."

The historian in me perceives that the disappearance of Texas Horned Lizards from the entire eastern half of their historic range—and many minor pinpoint extinction events throughout the whole range—is, when boiled down, merely a later-stage continuation of the dismantling and commodifying of the Great Plains that began 200 years ago. Horned Lizards are simply one of the last pieces of the prairie that held on. The land itself and its wild resources were seen as an endless commodity in “the era of the myth of inexhaustibility, the belief that the West is so vast, that the resources are so vast, that they can never be exhausted,” as historical novelist Michael Punke has stated. Texas Horned Lizards were not immune. As the prairie of the “American Serengeti” was first de-buffaloes, de-prairie dogged, de-wolfed, and eventually de-grassed of its natives, only the smaller species that could hang on to the scantiest patches of degraded prairie remained: “Horny Toads” and the Prairie Seed Harvester Ants (*Pogonomyrmex* spp.) they ate were among these. However, they too eventually succumbed; first in the tallgrass prairie of the Southern Great Plains, but eventually too in the midgrass prairie as their populations have continuously receded westward. *You tell me*, dear reader—after the annihilation of the American Serengeti’s big animals, what other Southern Great Plains megafauna could persist free-range at least a few more years on one-acre vacant sandlots, alleyways, and turnrows in smalltown America up-and-down the country’s central breadbasket?

Horned Lizards are, in a way, johnnies-come-lately to the prairie. About 57 million years ago, before the Great Plains was a grassland, it was a humid forest dominated by palm trees and soon inhabited by primitive horses, rhinos, and camels with puny teeth adequate for eating soft leaves. Then about 25 million years ago the tooth anatomy of their descendants changed—they all developed taller, higher-crowned teeth more suited for eating a tough, wiry newcomer called *grass*. A few more million years pass and social insects that specialize on grasses (like Seed Harvester Ants and Grass Harvester Termites, *Tenuirostritermes cinereus*) arrived on the scene, and a few million years after that, a toad-bodied lizard that specialized on eating these insects arrived too.

Horned Lizards, as you know, are insectivores and there are, of course, other insects that “fill in the corners” of the Horned Lizard diet. In creating a native plant seed mix for Horned Lizards, the priority was to include as many native plant species as possible to attract and support as many insects as possible, not only staples of Horned Lizard diet like Harvester Ants/Harvester Termites but also insects that seem important outside the usual diet like other species of native ants (Formicidae) and sweat bees (Halictidae), for instance. In particular, there was a focus on including native plants with extrafloral nectaries, elaiosomes, and species that support aphids (Aphididae)—since all those are directly important in the food web of native ants.

We also included a wide variety of bunchgrasses (more than 30 species) of varying heights to dually provide not only food for

Horned Lizard food but also to provide shade structures and cover under the grasses’ skirts, while allowing bare ground micro-trails to exist between the root crowns of plants for Horned Lizards to bask, forage, and camouflage against the soil.



The Horned Lizard Habitat Mix™ from Native American Seed (Junction, Texas). Photo by Lindsey Ebert (Rehoming Texas).

When Audubon incorporated the Horned Lizard in his Great Heron watercolor painting, he borrowed a specimen from Richard Harlan (who had only a decade before described in a paper Texas Horned Lizards brought to Thomas Jefferson from the Lewis and Clark expedition). This was not a Texas Horned Lizard but a lizard that Audubon called a “*Phrynosoma orbiculare*” (*sic*; Holbrook in his 1838 book corrected Audubon’s taxonomy—it was a Blainville’s or Coast Horned Lizard, *i.e.*, *Phrynosoma coronatum*) from the west coast of the continent, collected in 1834 by Harvard lecturer Thomas Nuttall. I have not come across any notes that explicitly stated Audubon saw Horned Lizards when he visited Galveston in the spring of 1837, but I like to think he did. They would have been common. As a teenager in the 1990s living where Audubon visited, I became aware of a couple tiny remnant populations of Texas Horned Lizards in Galveston County coastal prairie still hanging on—one in a field between my neighborhood and an adjacent neighborhood (and that field is now houses), and the other in a field in Dickinson, Texas. Those

populations have likely winked out, as have most of them east of the Interstate Highway 35 corridor. What can we do to restore them?

There are, of course, other inputs besides native plants that generate and maintain habitat suitable for Texas Horned Lizards. Keystone members of their community as well as natural wild processes build and maintain infrastructures so integral that if you remove them, it tripwires the entire community. History of the last 200 years in America has taught us that. Some of these members are species like Bison (*Bison bison*), Prairie Dogs (*Cynomys* spp.), Pronghorn (*Antilocapra americana*), Elk (*Cervus canadensis*), Wolves (*Canis lupus*), Dung Beetles (Scarabaeidae), and all other native insects in general. Some of these natural wild processes are things like lightning-ignited prairie fires, drought, and wind, but also raw materials like deep perennial roots and fertile soil. However, you first need the native plants if you hope to channel all of the sun's energy into that specific prairie community that supports Horned Lizards.

What we have created at NAS is a seed mix that will hopefully be a step in that direction of restoring this community, the current iteration comprising more than 83 species and varieties of native bunchgrasses and wildflowers of the Southern Great Plains. It's not a *perfect* solution in every situation or county, but it's a *good* solution, all Texas-native, and a damn sight better than Bermudagrass (*Cynodon dactylon*), Bahiagrass (*Paspalum notatum*), Buffelgrass (*Cenchrus ciliaris*), St. Augustine, or any of the other invasive, introduced, exotic carpet grasses choking the ecological landscape to death in a sea of monocultures. It's not only the first commercially available native plant "ecosystem in a bag" seed mix for Texas Horned Lizards, but also, to my knowledge, the first-ever commercially available native plant seed mix for a reptile (but I'd be happy to be wrong). My hope is that this will trend, so that we continue to learn the "native plant food web formula" for every species on earth. Onwards. And who knows? Maybe Willie Nelson will pen a song for the "Horny Toads" to one day return to his ranch.

Author's Note: An earlier version of this story appeared in the May 2023 issue of Phrynosomatics, the newsletter of the Horned Lizard Conservation Society.

SWCHR Laurence M. Klauber Memorial Summer Research Grant Update: Impact of Wildfire on Pathogen Prevalence in Sacramento Mountains Salamanders (*Aneides hardii*)

by

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Figure 1. Sacramento Mountains Salamander (*Aneides hardii*) from Otero County, New Mexico, USA, 2023. Photo by Drew R. Davis.

Study Background

The Sacramento Mountains Salamander (*Aneides hardii*; Figure 1, 2) is a unique lungless plethodontid salamander endemic to the Sacramento Mountain range within south-central New Mexico (Degenhardt *et al.* 1996). Across this range, it can be found under logs and bark in spruce-fir forests at elevations >2400 m (Figure 3; Scott and Ramotnik 1992; Scarpetta 2019). Though it is currently not afforded any Federal designation or protection, it is listed as state-threatened in New Mexico, and it remains of significant conservation interest due to its restricted range and population isolation (Osborne *et al.* 2019). Globally, amphibians face many threats, with major attention given to the role of pathogens in population and species declines (Collins and Storfer 2003; Wake and Vredenburg 2008). Major pathogens of concern include *Batrachochytrium dendrobatidis* (*Bd*), *B. salamandrivorans* (*Bsal*), and various strains of ranaviruses, which have all been contributed to observed declines in amphibians (Gray *et al.* 2009, 2023; Olson *et al.* 2021), though the occurrence of these pathogens is poorly understood (*Bd*, ranavirus) or presumed absent (*Bsal*) in New Mexico (Duffus *et al.* 2015; Johnson and Fritzler 2019; Grear *et al.* 2021). Given their potential threat, it is important to understand the prevalence and distribution of these pathogens in order to