

Longleaf and Gopher Tortoises: *An Odd Pair Supporting a Full House*

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When European explorers first reached the southeastern United States, they encountered a landscape far different from that which we are now familiar. Those early adventurers, in search of legendary riches, found little of the gold they sought. The treasure they found took a significantly different form. The world they discovered was one dominated by the longleaf pine (*Pinus palustris*). This species and its associated ecosystem would later be found valuable in their own right.

The longleaf pine ecosystem once spread over the Atlantic and Gulf Coastal Plains from southern Virginia through central Florida and all the way to eastern Texas. Estimates vary, but its extent was once somewhere between 60 and 137 million acres. Though species associations varied from location to location, the structure and appearance of these widespread stands was very similar. Open forest canopies were dominated by the towering longleaf, some more than three feet in diameter, 120 feet tall, and as much as 500 years old. A scattered but important midstory consisted, for the most part, of fire-tolerant scrub oaks. Relatively little woody understory was present, but the ground was carpeted with a host of grasses, forbes, legumes, and other herbaceous species whose growth and diversity were encouraged by the abundant sunlight reaching the forest floor. The ancient longleaf forest presented a vista of great beauty matched by few in the world.

The southeastern longleaf pine ecosystem was dependent on another constant, one which initially seems incongruous with the idyllic nature of this unique habitat. Fire, frequent fire, was a part of life in this region. Initially, fires were started by lightning strikes which most often occurred during the growing season. Later, Native Americans set fires to clear land for farming and to improve conditions for hunting. Relatively cool ground fires often burned unimpeded for days or weeks and across many miles of almost unbroken longleaf forest. Coastal Plain woodlands burned regularly, usually at intervals of two to six years. These fires kept ground-level fuel supplies low and inhibited the survival of most shade-tolerant canopy species. Were it not for fire, the shade-intolerant, but remarkably fire-adapted longleaf pines, would have been quickly choked out by these other species.

The aesthetically pleasing longleaf pine community also concealed treasures which were not readily apparent. It was and remains incredibly diverse with regard to the plant and animal species of which it is comprised. Single stands often contain more than 200 plant species, most of which occur in the herbaceous ground layer. Of the 290 reptile and amphibi-

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Gopher tortoises are one of only four tortoise species found in North America, and they are the only one found east of the Mississippi River. They are relatively large and spend their entire lives on land. Adults average 10-12 inches long but may reach more than 15 inches. Average weights for adults are typically 9-12 pounds. Females of the species reach sexual maturity when their shells are approximately 9 inches long, which may require 10 to 21 years depending on location. Males are on the average smaller than females. Gopher tortoise shells are relatively high-domed, and are not hinged. Upper portions of the shell (carapace) are usually dark brown to gray-black, while the lower shell (plastron) is lighter, often with a yellowish tint. Gular projections present on the front of the plastron tend to be longer among males. Female gopher tortoises have flattened plastrons while those of males are more strongly concave. The heads of both sexes are blocky in shape with adult males having enlarged mental glands under their chins. Gopher tortoise hind limbs are short, stubby, and elephantine in appearance, while the forelimbs are enlarged, flattened, and possessed of large nails used in digging. They are estimated to live 40 to 60 years in the wild and have been known to live more than 100 years in captivity.

Primarily grazers, gopher tortoises feed on low growing grasses, forbs, legumes, fruits, and other herbaceous plants. Young, faster growing tortoises eat insects and other invertebrates more commonly than adults, presumably because of their high protein content. Young and old gopher tortoises alike are occasionally known to feed on carrion and sometimes even excrement. Their diet includes a wide variety of plant species and while they are largely opportunistic feeders, it is believed that individuals select among available choices based on immediate and specific dietary requirements. They are believed to play an important role as seed dispersers for numerous species on which they feed. These tortoises rarely drink standing water, only having been known to do so during periods of extreme drought. The vast majority of their water requirement is obtained from the foods they eat.

The life of a gopher tortoise revolves around its burrow, dug in areas having well-drained usually sandy soil, frequently 15-30

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an species native to the Southeast, 170 (96 reptiles, 74 amphibians) are found within the range of the longleaf pine ecosystem. A host of bird and mammal species prospered among the pines as well. Moreover, many of the species associated with the longleaf pine ecosystem are endemic, found nowhere else in the world. On a large scale, the longleaf pine – through its fire tolerance and tendency to form sunny, open stands – makes this beautiful, diverse, and unique ecosystem possible. This irreplaceable role, and the fact that its removal from the system would ultimately result in the loss of numerous other species, defines it as a keystone species of the ecosystem which bears its name.

As important as longleaf pine and the fire to which it is adapted are in shaping the longleaf pine ecosystem, another species also plays a keystone role. The gopher tortoise (*Gopherus polyphemus*) is a once common and still important component of the longleaf pine ecosystem. Though their range is now fragmented, gopher tortoises were once widely distributed throughout the southeastern coastal plain, most common in areas having sandy well-drained soil. Their range closely paralleled the coastal plain distribution of the longleaf pine ecosystem, which provided the three factors necessary for the long-term survival of gopher tortoise populations: well-drained sandy soils to allow digging of burrows; plenty of low-growing plants for food; and sufficient open, sunny areas for nesting.

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Spring 2009

Active gopher tortoise burrows can be identified by their classic flat-bottomed, high-domed appearance and the characteristic apron (area of excavated dirt and sand) in front of the opening. These burrows are the key to survival not only for the gopher tortoise, but for many other species as well, making the gopher tortoise an important component of the longleaf pine ecosystem.



Photo by Wendy VanDyk Evans, Bugwood.org

feet long and up to 10 feet deep. However, burrows up to 50 feet long and up to 18 feet deep have been documented. Burrows constructed in soils having a higher clay content tend to be considerably shorter and shallower than average. The depth is limited by the depth of the water table. A gopher tortoise burrow is slightly wider than the tortoise which dug it, thus allowing the animal to turn around at any point. There is an enlarged chamber at the lowest point of the burrow.

Active burrows are readily identifiable by their classic flat-bottomed, high-domed appearance and the characteristic area of excavated dirt and sand (apron) in front of the opening. Gopher tortoises build multiple burrows scattered across their home range. This home range size in general is inversely related to the amount of herbaceous ground cover (food) present. The more food available, the smaller the home range. The home ranges of

males are larger than those of females and, hence, males tend to construct and use more burrows than females. Adults are not known to share burrows simultaneously, except for brief intervals where a threatened tortoise seeks the first available refuge and that refuge happens to be an already-occupied burrow. Yet they will sometimes use an unoccupied burrow constructed by another gopher tortoise.

Gopher tortoises are active during the day (diurnal) during which they forage for food, bask in the sun, and visit the burrows of other tortoises. Activity levels depend largely on daytime temperatures. During the winter months, they may not leave their burrows at all during extended periods of cold. They will however, bask near the mouth of their burrow on warm days even though little food may be available. As the weather warms in

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Photo by James H. Miller, USDA Forest Service, Bugwood.org



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spring, gopher tortoise activity increases, especially from April through September. During the heat of the summer, tortoises often become largely crepuscular (most active during the early morning and late afternoon), spending the middle, hottest portion of the day in their burrows.

Though some breeding activity is known to occur among gopher tortoises from April through November, most actual copulation takes place during August and September. Breeding rituals are known to include males making low croaking noises and thumping their plastron on the apron outside the burrow of a female. Both sexes engage in head bobbing during courtship and prior to copulation. Battles sometimes occur between males for the attention of a female. Female gopher tortoises engage in sperm storage. Regardless of when actual copulation takes place, most females ovulate (with subsequent fertilization of the eggs) during April and May. Females lay 1 to 25 eggs (averaging 5 to 8) shortly after mating, usually May to June. The eggs are laid either in the apron of the female's burrow or in a nearby sunny spot. Incubation of the eggs in the warm soil requires 70 to 110 days (80 to 90 average), depending on soil temperature. Incubation at temperatures greater than 85 degrees Fahrenheit results in mostly female hatchlings, while incubation temperatures below this produce mostly males. Most hatchlings emerge during August and September. While some temporarily share the burrow of their mother, other hatchlings may use a nearby unoccupied burrow in which to overwinter. Some young gopher tortoises dig shallow burrows for themselves almost immediately.

Gopher tortoise populations, by their very nature, tend to be slow growing and hence slow to recover and/or expand into unoccupied habitat. Reaching sexual maturity alone requires 10 to 21 years after which females lay only one clutch of eggs per year. Further, loss of eggs to nest predators, especially raccoons

and fire ants, is frequently 80 percent or more. Finally, young gopher tortoises are prey to a host of reptilian, avian, and mammalian predators until their shells are fully hardened at 6 to 7 years of age. Though they have few effective predators as adults, it is estimated that as few as three of every 100 hatchlings survive to reproduce.

As previously mentioned, gopher tortoises are considered a keystone species of the longleaf pine ecosystem. As in the case of the longleaf pine itself, many species in the ecosystem depend on the gopher tortoise for survival or derive significant benefit from its presence. The value of the gopher tortoise to the ecosystem as a whole goes far beyond its role as a seed disperser for its plant food species, or the fact that the young tortoise is food for many other species. It contributes something much more important to the system, and that something is its burrow. While the digging of the burrow provides recycling of leached nutrients, the actual finished structure is a key to survival not only for the gopher tortoise, but for many other species as well. Although tortoises avoid sharing burrows with others of their own kind, they do not seem to mind sharing space with much of anything else. More than 360 species of mammals, birds, reptiles, amphibians, and invertebrates are known to spend all or a portion of their lives in either active or abandoned gopher tortoise burrows. Some species such as the gopher frog, the pine snake, the indigo snake, the scrub jay, the Florida mouse, the burrowing owl, and the gopher cricket are completely or largely dependant on these burrows for survival.

The burrows benefit the tortoises and their commensals (species who receive benefit from living in close association with another species without causing the other species harm) in numerous ways. Clearly, tortoise burrows provide safety from predators – both to species who actually reside in the burrows,

and to those who use them opportunistically (“any port in a storm,” so to speak). In the same way, they provide refuge from the regular fires which function to maintain the structural and vegetative components of the longleaf pine ecosystem. Without access to gopher tortoise burrows, many species would be hard pressed to survive long-term in this frequently hostile environment. Finally, and of at least equal importance, the burrows provide shelter from the environmental extremes of cold, heat, and drought. Because of their length and depth, gopher tortoise burrows maintain a much more constant temperature and humidity regime than that of the world outside. In the winter, they provide a more moderate environment during periods of cold. Similarly, during the summer, the burrows provide shelter from the frequently extreme heat in what has been termed by some “the southeastern desert.” Possibly more important than protection from heat, the relatively constant humidity in the depths of a gopher tortoise’s burrow provides critical protection from dehydration during periods of drought, especially for amphibians and some reptiles. It has been well documented, that as populations of gopher tortoises decline, so do the populations of species dependent on their burrows.

Times change and the world changes with human priorities. The landscape of the southern coastal plain has been no exception. As might be expected, the fortunes of the gopher tortoise have followed a path similar to that of its primeval habitat. The extent of the longleaf pine ecosystem in the southeastern United States has been reduced to less than three million acres, a small fraction of its former range, no matter whose estimate you use. Of the remaining longleaf forest, only four sites, totaling a mere few thousand acres, remain in a virgin state. The remainder are second, third, or fourth generation stands. Land clearing for the purposes of agriculture, mining, road building, and urbanization have each taken their toll. Timber harvests, many of the “cut out and get out” variety during the late nineteenth and early twentieth centuries, stripped the landscape of a treasure not recognized as such by those doing the cutting. Economic influences have dictated that most past and present reforestation in the Southeast has been to faster growing species such as loblolly or slash pine. In the past, many of these forest stands were planted using close spacings. At these planting densities, canopies quickly closed with little sunlight reaching the ground. The widespread exclusion of fire has allowed development of dense mid-story and understory forest components, while precluding the development of a diverse groundcover. The rolling savannah-like world of the southeastern coastal plain is, for the most part, gone, and it is estimated that gopher tortoise populations have declined by at least 80 percent in the last hundred years.



Photo by Chris Evans, River to River CWMA, Bugwood.org

If current trends continue, more than a beautiful landscape may be lost. At least 27 plant species associated with the longleaf pine ecosystem are federally listed as endangered, with 99 more listed as threatened or as “species of special concern.” More than 30 vertebrate species (amphibians, reptiles, birds, and mammals) historically tied to the longleaf community have declined to the point of listing as well. Currently, gopher tortoises are federally listed as threatened west of the Tombigbee and Mobile Rivers, and eastern populations are being considered for listing as well. In Alabama, they are considered a species of high conservation concern and are fully protected by law, while they are listed as threatened or endangered at the state level in South Carolina, Georgia, Florida, Mississippi, and Louisiana. Some of the other more publicized species for which concern exists include the red cockaded woodpecker, indigo snakes, red hills salamanders, gopher frogs, Florida mice, and several species of pitcher plant. Many declining species are associated with bog, seep, and ephemeral pool microhabitats embedded within the remaining longleaf stands and are found nowhere else.

Though recent trends have dealt the longleaf pine ecosystem a heavy blow, all may not be lost however. The developing Longleaf Restoration Initiative provides hope that we may not only conserve what remains of the longleaf pine ecosystem, but also see it expand. The aforementioned initiative is a joint effort

by numerous government and non-government agencies with the shared goal of seeing longleaf pine and its associated ecosystem restored on suitable sites across its historical range. The Forest Service, US Department of Agriculture, has made restoration of the mature longleaf pine ecosystem a priority on its lands in the southeastern region. In time, through reforestation of suitable sites to longleaf pine and the reestablishment of a more natural burning

regime within existing stands, considerable acreage of mature or maturing longleaf pine habitat may be restored. Also encouraging is the fact that numerous landowner cost-share programs, both state and federal, are prioritizing planting of longleaf pine on sites best suited to them. The Alabama Forestry Commission, the Alabama Department of Conservation and Natural Resources, and the USDA Natural Resources Conservation Service are leaders in this regard. Many non-government agencies such as the Longleaf Alliance are working systematically through research, education, and commercial activities, to promote retention and restoration of longleaf pine on productive sites throughout the Southeast. Together, the renewed interest in the longleaf pine and its associated ecosystem, combined with the commitment of those working toward its reestablishment, may well have turned a bleak future for many unique species – including the gopher tortoise – several shades brighter. ♣