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Managing Heat for Wildlife on Texas Rangelands

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All animals must keep their body temperature in a thermoneutral zone in order to survive—in warm climates, animals must shed excess heat. To accomplish this, wildlife employ a variety of strategies to mitigate the direct and indirect effects of excess heat. These strategies may be behavioral, such as seeking shade or drinking water, or physiological, such as sweating, panting, or gular flutter in birds. This heat dissipation determines the heat an animal actually experiences (operative heat). Because digestion produces heat, most wildlife limit food intake and movement when heat stressed. For a malnourished animal, this circumstance increases the likelihood of disease-related mortality.

Rising global and regional temperatures, whether from long-term climate change or short-term weather patterns, such as drought, require wildlife managers to understand how heat affects wildlife, and how to mitigate these effects on Texas rangelands. When considering habitat, one must think about the usability of an area in terms space and time—is a habitat usable by the species of interest during crucial times? When considering temperature, insufficient conditions for diminishing heat may reduce how long and how much space is livable for wildlife.

Managing rangelands for diverse plant communities helps protect wildlife from the detrimental effects of heat stress. *Photo by Dr. John M. Tomeček*

Many parts of the Texas landscape are not limited in terms of food or water. However the carrying capacity for target wildlife is limited by the availability of thermal cover. Summer temperatures on bare ground throughout the state may exceed 160 °F. Without adequate thermal cover, no animal can survive such extreme temperatures.

The following explores the effects of heat on a variety of rangeland wildlife species and offers solutions to address those problems. Because many species use vegetation as refuge from heat, we provide range management strategies and techniques that help create and maintain adequate vegetative thermal cover.

Harmful effects of heat on wildlife

The direct and indirect effects of heat on wildlife vary greatly among species and environments. Excessive heat generally requires animals to stop daily foraging and to seek cover. This means lost nutrients, and a potential decrease in overall health. Some animals may adjust for this by foraging at night—hunters often lament when deer make this adjustment. Some species, however, are incapable of nocturnal activity. Further, many young animals cannot easily regulate their temperatures or travel to avoid heat during the first weeks of life. As a result, exposure to excessive heat may severely impair health, or cause animals to die.

Some wild animals, though adapted to environments where harmful temperatures occur, have difficulty living in the Texas heat. Each animal, however, has mechanisms to avoid heat loads harmful to its physiology, and in a natural ecosystem, these mechanisms would prevent excessive loss of wildlife. Those who depend on wildlife as a resource must, therefore, consider the thermal suitability of an area.

The following sections review heat problems as they apply to a variety of wildlife species of interest to owners and managers of Texas rangeland. Included are considerations to minimize the harmful effects of heat exposure. Though this list includes animals of economic and aesthetic interest, many other species can benefit from the management practices listed below. Including these practices in your range management plan will help you improve your property's environment in ways that will make effective animal thermoregulation more possible.

Traditional land management in Texas provided for diverse, sustainable rangelands. The interface of wildlife management and livestock production in Texas is the stewardship of rangelands. *Photo by Dr. John M. Tomeček*

Mammals

White-tailed deer and mule deer

In Texas, white-tailed deer (*Odocoileus virginianus*) or mule deer (*Odocoileus hermionus*), can be found in almost every part of Texas. These two species differ in many ways, but their need to avoid harmful heat is similar. For adults, screening cover (at least 24 inches tall) from predators is also essential for them to avoid harmful heat exposure. No matter the plant species or habitat type, this cover should comprise at least 15 percent of the landscape. Additionally, deer will likely use riparian woodlands where available—it is important to protect these areas from habitat degradation. When considering supplemental nutrition, whether feed-based, naturally-growing, or food plots, remember that deer will eat and move less when heat is a problem. Although some deer will switch to nighttime feeding, research suggests that the hottest places during the day are still avoided by deer at night [1]. Closed canopy tree cover with a dense grass understory provides optimal bedding cover for deer [2].

One of the most important management considerations for deer is fawning cover. Every spring, fawns are born across Texas. To survive to adulthood, they need to avoid predation and exposure to heat stress. Appropriate fawning cover can hide young deer from predators until they are old enough to escape attack. Less is known about the ability of fawning cover to prevent harmful heat exposure. Because young animals are incapable of efficient thermoregulation, they require relatively tall, dense vegetation to delay indirect heating, and shady cover to protect them from direct solar heat. An effective management solution would leave dense stands of grass, forbs, or even brush at least 24 inches tall adjacent to closed canopy cover, such as trees or tall brush [3]. While exotic grass monocultures may meet cover needs, the decrease in plant diversity and forb availability could be detrimental to fawn foraging given their limited mobility. Because deer prefer edge habitat, fawning cover is easy to establish along woody or brushy borders.

Bighorn sheep

The bighorn sheep (*Ovis canadensis*) is making a comeback from the brink of extinction in the rugged, mountainous regions of west Texas. For this species, however, caves and trees are essential cover from heat for adults and juveniles [4]. While landowners cannot typically create new caves, it is essential to retain the large tree canopies that Bighorn require. These trees should be relatively free of brushy undergrowth to maximize shade space, and allow sheep to see predators.

Pronghorn

The pronghorn antelope (*Antilocapra americana*)—the second-fastest animal on the planet—is adapted to large, open spaces. In Texas, pronghorn once roamed the western two-thirds of the state. Today, they are restricted to regions of the Panhandle and the Trans-Pecos that maintain open, grassland habitats. For animals in these regions, the risk of death from heat stress is considerable. Like deer, their young bed down in prairie grasses to avoid predators and overheating. Although adult pronghorn do not prefer tall grasslands for movement, leaving some dense stands of grass and brush across the landscape provides essential cover for fawns. At least 12 to 18 inches of grass is required to adequately screen fawns from predators as well as heat stress. Bedding sites with grass that is 24 inches tall have been shown to increase fawn survival [6]. For adult pronghorn, similar vegetation may allow survival during periods of summer heat. In this animal's arid range, it is especially important to manage in a way that will provide these structures during drought periods.

Small mammals (Rabbits, Squirrels, Mice, Rats)

To many, small mammals may seem unimportant—in some areas, rabbits are intensively controlled for damage they can do to crops and gardens. However, people negatively affected by coyote and fox predation may manage for rabbits, as they provide an important food source to these predators. In their absence, these predators often turn to sheep and goats, or wildlife, such as adult and juvenile deer.

Like for any species that have fairly short lifespans and have many offspring in a single year (r-selected), a year or two of insufficient range management can spell the end for rabbits on a property. For example, North American rabbits build nests in depressions, lined by and covered over by dense vegetation. Young cottontail rabbits (*Sylvilagus* spp.) are especially at risk of death from heat exposure, as they highly immobile and cannot regulate their own heat. Leaving stands of dense grass, forbs, and low shrubs interspersed throughout rangeland provides adequate rabbit nesting habitat. These are often located along fencerows and woodland edges.

Rabbits do best in grasslands systems that provide screening cover from predators and shade from heat. Cottontails build nests in thick grasses that help protect their young from harmful heat. *Photo by Dr. John M. Tomeček*

Birds

Quail

Research has clearly defined the effects of heat on quail. Temperatures in excess of 95 °F are somewhat harmful for quails. At roughly 105 °F, quails will die within a few hours. At about 120 °F, quail eggs become inviable within an hour [7]. These temperatures often occur on open ground in the middle of a Texas summer. Temperatures at ground height are often 30 to 40 °F warmer than those reported by the National Weather Service. Exposure to these temperatures may cause death, but certainly will reduced health and quails ability to respond to antigens. Given concern over the contribution of disease to quail decline, providing thermal refuge may reduce disease prevalence.

Northern bobwhites rely heavily on bunch grasses to protect eggs from harmful heat stress that can kill eggs or reduce the fitness of birds that do hatch. *Photo by Dr. John M. Tomeček*

When adult quail encounter intolerable temperatures, they will seek shade if available. Vegetative structures that provide loafing cover are an essential habitat consideration for any range manager who wants to support healthy quail populations. Such brush structure should be roughly 5 to 10 yards in diameter, provide dense canopy coverage, but have a relatively open understory to allow easy movement at quail level. Plant species ideal for providing shade will vary by range type and site. A list of examples can be found in Table 1.

Quail nest in vegetative structures for protection from predators and also to shield eggs from heat. While quail nest in a variety of ground structures; native, warm-season bunch grasses provide ideal protection from thermal stress. Fortunately, these grasses are at the peak of their annual growth during the nesting season. Recent research suggests that clumps of little bluestem at least 9 inches in diameter and 12 to 18 inches tall reduce heat on eggs below lethal levels. These results can be extended to similar grasses. The same research found the surrounding ground cover affects the extent to which this heat can be reduced. How long nesting structures maintain below-harmful heat levels appears to be directly related to how much of the ground is covered. This cover does not necessarily need to be grass. In fact, grass that is too dense can limit quail movement and reduce the presence of forbs which are an important food source. Many forbs produce ideal ground cover while keeping temperatures lower. Additionally, forb-rich areas also support rich insect diversity that are critical to laying hen and chick diets for the first few weeks of life. Grasses and forbs are critical habitat components.

This northern bobwhite female seeks shade under woody cover during the heat of the day. Maintaining adequate, well-interspersed clumps of woody plants helps adults stay safe during Texas Summer heat. *Photo by Dr. John M. Tomeček*

Turkeys

Wild turkeys (*Meleagris gallopavo*) are much like quail in that they nest and spend much of their lives on the ground—they have similar habitat requirements. Turkeys nests to protect their eggs in grasses, leaf litter, brush, or understory vegetation. This vegetation also provides important thermal refuge for eggs. Ideally this vegetation is at least 18 inches tall [8]. Furthermore, it is important that nest sites be distributed across the landscape and near a permanent water source [9].

This Rio Grande Wild Turkey is highlighted against two important habitat needs: mature trees for roosting, and bunch grasses for nesting and brood rearing. The forb-rich cover this turkey is standing on provides essential forage for adult and juvenile birds. *Photo by Dr. John M. Tomeček*

Screening and overhead cover is critical to protect poults from predation. Young turkeys cannot adequately thermoregulate, so areas with shrubs that are 2 to 6.5 feet tall are ideal for protection against heat as well as predation [10]. As adults, turkeys depend on permanent roosting sites—maintaining tall trees will provide safety and appropriate nighttime microclimates.

Doves

Unlike other upland game birds for which heat is a concern, doves (*Zenaida* spp.) are capable of traveling great distances to find cover from heat. However, when managing rangelands to provide dove habitat, it is important to remember that doves will not eat as much when heat-stressed. Thus, it is essential to provide woodlands and supplemental water adjacent to feeding sites. Although doves prefer watering areas with excellent visibility, they will drink from ponds, puddles, or streams when necessary. Mourning doves only need water once a day during even the hottest times of year [11]. The Eurasian Collared Dove is spreading quickly, so managers should monitor dove watering behavior to ensure that these invasive doves are not excluding native doves from water sources.

Doves and other tree-dwelling birds, often favor nesting sites in east-facing trees or structures that protect them from afternoon heating [12]. Managers should promote nesting habitat adjacent to water and food, while providing visibility to protect against avian predators. A semi-circle of trees or tall brush to the west of a water source, with agricultural plantings or forb-rich rangeland just beyond, would provide an ideal nursery for young doves.

Doves can travel great distances to find usable habitat—if you want to keep doves on your property, you need to provide for all dove habitat needs, including heat management.

Prairie Grouse

Few prairie chickens (*Tympanuchus* spp.) remain in the State of Texas. In the past, they occupied grasslands from the Red River to the Gulf of Mexico. While the decline of prairie chickens is related mostly to the fragmentation of the large, contiguous prairies, these birds are also sensitive to heat. Research shows that, across their range, chick production is strongly related to precipitation and to the number of heat stress days [13]. These factors are beyond our control; however, we can mitigate heat and drought by reducing livestock grazing or setting aside un-grazed areas to provide needed habitat. No one can guarantee enough precipitation to grow sufficient grass cover, but moderating grazing can buffer against periods of lower rainfall. The recent listing of the Lesser Prairie Chicken in the Texas Panhandle as a federally-threatened species has made maximum prairie chicken production and survival even more important.

Songbirds

One of the most important considerations for maintaining songbirds in Texas rangelands is the availability East-facing nesting places to protect them against harmful heat [12]. Many bird species primarily select nesting locations primarily by vegetation species or structure. A secondary consideration is the site's ability to shield eggs from the sun. Cavity-nesting birds, such as woodpeckers, often create their own thermal refuge. However, they require snags in which to construct these cavities. After a tree dies, consider leaving it to become this type of habitat. Snags can also be of useful habitat for small mammals.

Reptiles and amphibians

While many reptiles require open space for moderate warming by the sun, when heat exceeds safe levels, they need places they can go to avoid sunlight. Optimum habitat would comprise open spaces in the form of bare ground, particularly sites with little to no rock in the soil, while still including some low brush or cactus cover in which

Texas Horned Lizards require bare ground interspersed with vegetation to help maintain their temperature needs. This species has declined in many regions due to habitat loss, including thermally-suitable habitat. *Photo by Dr. John M. Tomeček* to escape from the sun. This is generally achieved by brush management that restricts dense tree canopy to riparian areas, without eradicating the brush entirely. Such landscapes also provide bobwhite and cotton-tailed rabbit cover. These range considerations are important for reptile species of concern, such as the horned lizard (*Phrynosoma cornutum*), the massasauga rattlesnake (*Sistrurus catenatus*), and the state-threatened Concho rattlesnake(*Nerodia paucimaculata*)[14]. As a practical matter, forcing reptiles into sub-optimal thermal environments may increase their exposure to predation [15].

Native rangeland near Sonora, Texas that has traditionally been managed with prescribed burning and goat grazing to manage for redberry and blueberry juniper encroachment.
Photo by Dr. Morgan Russell

Management strategies

A variety of range management strategies can be used to create and maintain habitat in which animals can thermoregulate effectively. An approach that incorporates several management practices often produces the best results. Creating habitat for a single species must be framed within a broader management plan that provides healthy ecosystems that can meet the needs of all species of wildlife and livestock.

Overusing rangeland resources limits plant diversity and reduces an area's wildlife, aesthetics, and water quality. Native plant and animal species are critical to the function and integrity of Texas rangelands. Identifying plant species correctly is central to any management strategy. An effective manager must be able to identify plants, understand their uses and functions in the ecosystem, then determine if management is necessary. If you need help developing a land management plan, contact your local Natural Resource Conservation Service office, Texas Parks and Wildlife Department biologist, Texas A&M AgriLife Extension Agent or Specialist, or other qualified professionals.

Grazing

Managed grazing can create thermally-suitable habitat that benefits many wildlife species. For example, white-tailed deer and quail suffer if rangelands become brush or grass monocultures [16]. Cattle grazing can provide openings for forbs, which contribute thermal cover for fawns, turkeys, and other wildlife. Such plants are also a large part of white-tailed deer and wild turkey diets. They also provide seeds and habitat for insects that are eaten by quail and turkey.

In semi-arid and arid environments, careful grazing management ensures there will be residual forage necessary for quail nesting sites in bunchgrasses, such as little bluestem [16]. Specialized grazing systems can improve habitat by alternating grazing and rest which promotes needed changes in the composition and structure of vegetation.

The livestock species you choose is as important as the stocking rate. Some livestock, more than others, compete with native wildlife for habitat resources. Generally, livestock grazing should not exceed 25 percent of the current year's herbaceous growth—grass stubble height should not be grazed below 8 inches [17]. This helps insulate the ground against heat, and improves the soil moisture retention. The traditional "take half and leave half" approach should be the most grazing allowed—taking less than half is better. High stocking rates and continuous grazing will degrade the quantity and quality of grasses. This creates landscapes that are less profitable for livestock, and thermally unfit for many wildlife species.

Choosing when, where, how much, and how often to graze livestock can optimize other ranching enterprises. Numerous wildlife species depend on diverse browse, forbs, grass, and grass-like plants. Maintaining a healthy overall range condition is an excellent way to increase species diversity. As conditions improve on a specific range, the number of plant species will usually increase.

Species diversity improves the stability of the plant community. Diversity also increases the quantity and quality of the diet available to wildlife. To monitor grazing intensity, you can use grazing exclusions to compare grazed/ungrazed sites. For range condition to improve, it must have periods of rest. To achieve optimum wildlife habitat, grazing should be staggered so that all forage species have periods to regrow. The ideal condition for each range is determined by balancing site ecology with your enterprise's economic needs.

Mechanical

Woody plants are an essential part of thermal cover, but you must manage them to prevent excessive woody cover. Too little woody cover may expose wildlife to harmful heat, but too much brush can hinder movement and decrease the availability of forbs and herbaceous plants. Finding the right balance of cover and openings is essential—wildlife need both. To achieve this balance, use selective thinning methods instead of woody plant eradication.

Brush sculpting is one type of selective thinning. Sculpting can involve leaving islands of brush with connecting corridors. This approach provides safe habitat and protected pathways for wildlife to move between sites. Cleared areas can provide plants for grazing. Brush reduction treatments work well for establishing openings in mature stands of closed-canopy brush, such as cedar (*Juniperus* spp.). Initial treatments provide a starting point for future management strategies, such as prescribed burning or grazing. Typically, a skid steer with and shears is used for cedar trees that are more than 3 feet tall. Sculpting brush creates a much more diverse and favorable environment for wildlife. It also can enhance multiple-use values of rangeland.

Mechanical brush maintenance is an annual task and should be performed when most bird species are not nesting (September-February). Machines used for mechanical brush treatment can also damage native sod-forming grasses and bunchgrass. Take care to protect critical bunchgrass nesting areas. Remember also that mechanical brush control, greatly reduces the fine fuel loads needed for a successful fire for 1 to 2 years.

Chemical

Herbicides continue to be a valuable management tool on rangelands, and managing resprouting species, such as pricklypear, mesquite, and redberry juniper is a life-long commitment. However, these sometimes-problematic species can be valuable to wildlife. Perhaps the greatest advantage to using herbicides is that it can be used to sculpt brush without disrupting the soil. The Brush Busters program [18], promotes individual plant treatments (selective brush control) as a means of enhancing wildlife habitat. Vast, dense stands of brush are not conducive to most wildlife species [19].

Dr. Allan McGinty applies a chemical to an individual plant stem to manage immature mesquite south of San Angelo, Texas. *Photo by Dr. Morgan Russell*

Individual plant treatment, however, is not always economically viable. To achieve desirable wildlife habitat you must balance ecology and economics. For example, if the number of undesirable plants exceed 400 per acre, individual treatment is no longer economically viable. Furthermore, brush in excess of 400 plants per acre limits the herbaceous cover needed as thermal refuge for many species. Treating mesquite aerially can increase herbaceous vegetation by reducing the competition for available resources. Aerial treatment can be used to achieve an appropriate woody canopy cover and ample interspersion of brush structure for screening and thermal cover.

Fire

To promote thermally suitable vegetation on rangelands, fire is likely the least expensive and most closely mimics naturally occurring processes. Historically, fire maintained open grasslands and mixed brush ecosystems that provided the natural thermal refuge to which many wildlife species are adapted. However, the introduction of fire suppression in the late 1800s, has caused many landscapes to become dominated by various brush species.

New vegetative growth on previously burned redberry juniper trees are scattered across a hillside North of Menard, Texas. Redberry juniper is one of the most dominant re-sprouting species on West-Central Texas rangelands, and although prescribed burning can be used to manage redberry juniper, its vegetative buds below the soil surface maintain its fire resistance. *Photo by Dr. Morgan Russell*

Prescribed burning can kill non-sprouting brush species, increase forb abundance, increase forage nutritional value, and increase overall soil nutrient values. These control characteristics cannot be replicated with any other management strategy. Wildlife may prefer recently burned sites, due to the new, highly palatable growth that burning promotes. Prescribed fire is typically performed from September through February to avoid destroying thermally suitable nest sites, such as little bluestem, used by quail, turkeys, and other ground-nesting birds. Prescribed fire plans are made before the burning season—pastures are left un-grazed in order to build fine fuel loads. Appropriate cool-season weather for burning includes 25 to 35 percent relative humidity and wind speeds less than 10 mph.

A backing fire moves against the wind through native perennial grass and live oak near Junction, Texas on a prescribed burn implemented by the Edwards Plateau Prescribed Burn Association. *Photo by Dr. Morgan Russell*

Patch burning has been used to promote forb production for white-tailed deer and to provide variation in habitat structure. The idea behind this method is to burn scattered patches of grassland within a pasture at intervals to create a mosaic of plant diversity. Patch burning can also be used as a follow up treatment of small brush not killed during a prescribed burn. A brush-cutter can be used to selectively open up areas and effectively extend the treatment life of a prescribed burn.

Conclusions and resources

Managing Texas rangelands for heat can be a challenge. It is neither feasible nor practical to monitor every square yard of property to determine if temperatures are suitable for wildlife. However, landowners and managers can use range conservation, brush control, and grazing management to achieve landscape habitats that provide, among other things, refuge from heat. These management guidelines will help wildlife and livestock enterprises better withstand drought and enjoy increased production due to healthier adults and higher survival rates of young.

Identifying and implementing practices that are appropriate for your property can be difficult, but state, federal, and private organizations have staff in your area to provide technical assistance. These include:

- **AgriLife Extension**
  agrilife.org
  naturalresourcewebinars.tamu.edu
  texnat.tamu.edu
- **Texas Parks and Wildlife Department**
  tpwd.texas.gov
- **Natural Resource Conservation Service**
  nrcs.usda.gov
- **Grazing Lands Conservation Initiative**
  grazinglands.org
- **Texas Wildlife Association**
  texas-wildlife.org
- **Texas and Southwest Cattle Raisers Association**
  tscra.org
- **Texas Sheep and Goat Raisers Association**
  tsgra.com

Glossary

brush sculpting. Concept of sculpting brush-infested rangeland for multiple use, including wildlife habitat, watershed management, recreational enterprises, endangered species, landscape enhancement, and livestock production.

carrying capacity. The number animals a given area can support.

cover. Any structure that provides screening, protection, or insulation against weather events, sunlight, predators, etc.

edge habitat. Areas in the transition between two habitat types (i.e. woodland and grassland).

gular flutter. Rapid passing of air through moist air sacs to cool a bird's body through evaporation.

interspersion. Mixing of elements, in this case, habitat components.

loafing coverts. Cover that provides protection from sun and predation risk in sufficient structure that animals can move freely, or loaf, underneath it.

monoculture. A stand of vegetation consisting of only one species.

operative heat. As opposed to ambient heat, the heat actually experienced by an animal, as established by their ability to regulate body temperature.

poult. A term referring to juvenile wild turkey, pheasant, or chicken.

r-selected. Animals with short lifespans but that produce large numbers of offspring in a single reproductive cycle.

range condition. Current ecological condition (as determined by species composition) of rangeland as compared to its ecological potential.

screening. A obstruction that limits visibility of animals.

substrates. Any surface type.

thermal cover. Structures that protect animals against thermal extremes.

thermal suitability. The degree to which an area meets thermal requirements by a species to live there.

thermoregulation. The ability to regulate body temperature.

understory. Vegetation growing underneath a canopy, such as brush under trees, or forbs and grasses under brush.

warrens. Tunnel systems dug by European rabbits to provide shelter from weather, and protection against predation.

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