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Native Grassland Monitoring and Management

TEXAS A&M AGRILIFE EXTENSION

Contents

Cover photo courtesy Gary Price, 77 Ranch

Native grasslands provide many benefits, including wildlife habitat, livestock forage, and watershed protection. (Photo courtesy of Blake Alldredge, Texas A&M AgriLife Extension Service)

Native Grassland Monitoring and Management

Introduction

Widespread loss of native grasslands has led to major wildlife population declines, particularly for northern bobwhite and other grassland bird species. Much of the tallgrass prairies in the Trinity River basin have been converted to introduced grasses for livestock production, such as bermudagrass (*Cynodon dactylon*) and bahiagrass (*Paspalum notatum*), or removed for row crop production. Restoring these areas to native grasslands will provide critical habitat for northern bobwhite and other grassland bird species, as well as white-tailed deer. Increasing fuel and fertilizer prices may lead livestock producers to restore native grasses as an alternative forage choice for livestock because of their reduced input costs. In the publication *Native Grassland Restoration in the Middle Trinity River Basin* (SP-469), steps were outlined for restoring native grasslands from introduced grass-dominated systems. Once restored, native grasslands require continuous monitoring and management to prevent undesirable grass and woody species from establishing, and to promote greater diversity and health of the grassland.

Just as a well-developed, detailed plan is necessary for a successful grassland restoration, a post-restoration monitoring and management plan is required to ensure continued sustainability and success of the land operation.

This publication describes different monitoring techniques used to observe changes in the soil and plant communities and to assist landowners regarding when to conduct certain management techniques. These monitoring and management techniques, however, are applicable statewide, not just in the Trinity River basin. It is essential for landowners to understand which technique is best for their situation and when to properly conduct the technique to ensure continued productivity and meet their land operation goals. Hunting, fishing, and nature tourism adds almost $9 billion to the Texas economy every year (Phillips, 2012). Therefore, landowners should be vigilant to monitor their wildlife habitats in order to benefit economically from these activities on their land.

What is Monitoring?

Once restoration activities have been accomplished, it is important to frequently monitor the restored area, especially the first 2-3 years after reseeding. During this time, root systems of seeded native species are developing so aboveground growth may be minimal. Patience and a watchful eye are critical during this phase when native grasses and forbs are becoming established.

Monitoring the ecological site "condition," or health of the land, is necessary for landowners to evaluate how past land management decisions are affecting the plant, soil, and water resources of the landscape (McGinty and White, 1998). Monitoring specifically examines the plant species present and how much area they cover. Being able to see how range conditions change over time, also known as range trend, will allow land managers to make the best management decisions as conditions change (McGinty and White, 2000).

Why Monitor?

During a restoration project, desired plant communities should respond in a positive way by increasing in frequency and cover, although the time this process takes may depend on weather and soil types. Under normal management activities, monitoring allows a landowner to detect problems early and adjust management practices to improve range condition (McGinty and White, 2000).

Land managers should conduct activities that will improve land productivity by reducing erosion, promote greater rainfall infiltration, slow the rate of invasion by undesirable species, and sustain the land during times of drought (McGinty and White, 2000). One can evaluate the success of a project by monitoring wildlife populations, but without understanding the reasons why they are increasing or decreasing, a land manager cannot make informed decisions for future management. Therefore, based on the stated goals for the restoration project, monitoring the plant communities will help provide more definitive results. When developing a monitoring and management program, it is essential to base the techniques used on the initial restoration goals to also fit your specific land management goals (Masters, 1997).

Figure 1. Marking the base of a photo point with spray paint will help monitor erosion over time. (Photo courtesy Blake Alldredge, Texas A&M AgriLife Extension Service)

Monitoring Techniques for Restored Grasslands

Monitoring the vegetative communities on the land can be as simple as taking photos from established points, evaluating plant species composition and production in grazing exclosures or along transects, or conducting more detailed cover and/or nest clump surveys. Precipitation records should be collected year-round no matter what monitoring method is used to determine if changes in landscape cover are caused by weather patterns rather than management practices (Wright et al. 2005). Also, knowing whether you are short of rainfall will aid in making decisions that will benefit the land, such as reducing or removing livestock during a drought. Precipitation records can be easily obtained by installing a rain gauge in each pasture if possible (Appendix A). The following monitoring techniques should be conducted in late summer to allow sufficient growth of plant species for identification in order to evaluate habitat condition. Field guides are available at the AgriLife Bookstore and elsewhere that provide descriptions and photos to help identify plant species.

Photo Points

Purpose

Photo points provide an inexpensive and quick method for monitoring ecological site condition. Photo points are permanent locations where periodic photos can be taken to monitor changes over a large area (McGinty and White, 1998). Comparing photos, detailed observation notes, and precipitation records can help land managers determine what changes have occurred.

Figure 2. Grazing exclosures allow landowners to monitor grazing pressure by livestock. (Photo courtesy of Blake Alldredge, Texas A&M AgriLife Extension Service)

Materials

- Steel T-post and/or rebar
- T-post driver or hammer
- ½ to ¾ inch PVC pipe
- Compass
- Camera
- Spray paint
- GPS unit (optional)

Description

Photo points are easily established by driving a steel T-post or rebar into the ground. A GPS point may also be established to help locate photo points. Begin making detailed notes about the plant species present and visually estimate the abundance of certain plant species, if known, as well as any other considerations, such as slope. It may be prudent to mark the post with spray paint at the ground level to monitor if erosion occurs at the site (Figure 1).

Two types of photos should be taken at least annually: vertical and landscape. To take vertical photos, create a 3-foot by 3-foot square frame out of PVC pipe and place it on the ground near the photo point. Mark the corners by driving rebar in the opposite corners so that the exact location can be found next time. One or several of these frames can be established around each photo point. Take photos from above the plot frame looking straight down and compare plant cover and density, litter, and bare ground between photos taken annually (Appendix B).

Landscape photos are taken by facing each direction (N, S, E, W) at the photo point on the same day each year if possible or at the very least in the same month. Landscape photos will show broad vegetation changes, such as brush encroachment, or possibly grass species disappearance that may be occurring at the site. Establish multiple photo points in each habitat type or across the property.

Grazing Exclosures

Purpose

A land manager can evaluate ecological site health in an area by excluding livestock and/or wildlife from grazing a small, representative area, called a grazing exclosure (Figure 2). By comparing vegetation changes inside and outside of the cage, the land manager can determine if stocking rates are affecting species composition and overall plant growth and forage utilization.

Figure 3. Walking a transect line with outstretched arms will allow you to evaluate nest clumps in an area of 0.1 acre. (Photo courtesy of Blake Alldredge, Texas A&M AgriLife Extension Service)

Materials

- Steel T-posts
- T-post driver
- 4-foot tall 4-inch by 4-inch welded wire panels
- Bailing wire
- Fencing tool or pliers

Description

Exclosures can be built using four steel T-posts and 4-foot tall, 4-inch by 4-inch welded wire panels. Install the steel posts so that they make a square, and then attach the panels to the posts with bailing wire or another high strength wire. Exclosures should contain a minimum of 10 square feet, but can be bigger depending on cost and preference.

At least once a year, take detailed notes to compare the plant species that are present, the amount of area they cover, the amount of bare ground and litter of the areas inside and outside of the exclosure to examine if ecological site health is improving, stable, or declining (McGinty and White, 2000; Hanselka et al. 2009). Grazing exclosures can also serve as photo points by taking photos of the exclosure at ground level with some surrounding areas in view to see differences. In addition, exclosures can serve as the permanent location for taking landscape photos to help assess and document ecological site trend throughout years. It is a good idea to use a marker board or paper to write the date and which monitoring station the photo was taken to include in the picture for future reference.

Nest Clump Surveys

Purpose

Northern bobwhite and other grassland birds use bunchgrasses and prickly pear cactus for nesting as these plants provide concealment and protection from predators. Therefore, if the land is primarily managed for northern bobwhite, conducting nest clump surveys would be an ideal monitoring technique for a land manager to use. Understand that good bobwhite habitat is beneficial to many other grassland bird species. These surveys provide an efficient method for assessing habitat quality across a ranch as northern bobwhite require a minimum of 300 nest clumps per acre for adequate nesting habitat (Lyons and Wright, 2003; Wright et al. 2005).

Materials

- Three steel T-posts
- T-post driver
- Compass
- Measuring tape or rope of known length

Description

The basic concept of this method is to walk in a straight line of defined length determined by the surveyor's height and corresponding arm length (Table 1). By walking the transect line with arms outstretched, the surveyor can evaluate an area 0.1 acre in size by counting all basketball-sized nest clumps that fall within their arm span (Figure 3). Multiply the number of nest clumps by 10 to get the estimated number of nests per acre (Appendix C).

Select representative areas within the ranch that receive average grazing use by avoiding bedding grounds, water points, mineral/feeding locations or areas that are seldomly grazed, such as rocky areas. Once representative areas are selected, establish permanent transects (rectangular areas of defined length and width) by using three, 6-foot T-posts to permanently mark established transects. Drive a T-post into the ground at the beginning of the transect, then using a compass to maintain a straight line, step off half the distance of the total transect length. Drive another T-post into the ground at this point, then walk the remainder of the transect and drive the last T-post to

Table 1. Height is closely correlated with arm span. Based on arm-span width and transect lengths, ~0.1 acres can be surveyed for the presence of nest clumps. (Adapted from Wright et al. 2005)

Observer's Height	Transect Length
5' 4"	272 yards
5' 5"	268 yards
5' 6"	264 yards
5' 7"	260 yards
5' 8"	256 yards
5' 9"	253 yards
5' 10"	249 yards
5' 11"	245 yards
6' 0"	242 yards
6' 1"	239 yards
6' 2"	235 yards
6' 3"	232 yards
6' 4"	229 yards
6' 5"	226 yards
6' 6"	223 yards
6' 7"	221 yards

end the transect. The middle T-post will help you stay on course while surveying.

Cover Surveys

Purpose

A cover survey can help determine the amount of woody, forb, and grass cover, and bare ground that will aid in decision making for habitat management. For instance, northern bobwhite generally require between 5 percent and 30 percent brush cover for protection, between 25 percent and 75 percent bare ground for foraging, and grass cover below 50 percent (Wright et al. 2005). A land manager that seeks to manage for northern bobwhite will have to take these requirements into consideration when evaluating monitoring results. On the other hand, a land manager primarily raising livestock may want more grass; therefore, the goals of the operation will influence how the monitoring results are used to make management decisions.

Materials

- Steel T-posts
- T-post driver
- Compass
- Measuring tape or rope of known length

Figure 4. Record whether forbs, grass, brush canopy, or bare ground is present at the tip of your shoe every other step during a cover survey. (Photo courtesy of Blake Alldredge, Texas A&M AgriLife Extension Service)

Description

To save time and effort, use the same permanent transects established for the nest clump surveys. The cover survey method is very similar to that used for nest clump surveys, but instead of counting the number of nest clumps under your arm span, record whether brush canopy, forbs, grass, or bare ground is present at the tip of your shoe every other time your right foot hits the ground as you walk along the transect (Figure 4; Appendix D). After recording 100 points along the transect, add together the totals for each respective column (woody, grass, forb, bare ground) to estimate the percentage of cover for each. For example, if you recorded 45 total "hits" for grass, then grass cover would equal 45 percent.

For a more in-depth evaluation of the land, record the species of each plant encountered at the tip of your shoe instead of merely recording if it is a grass, forb, or woody plant. This will allow you to evaluate how abundant each species is. Ideally, 100 plants should be recorded and frequency of each species is determined by dividing the number of individual plants for each species by the grand total of plants recorded. For example, during your survey you count 50 indiangrass (*Sorghastrum nutans*) plants out of 100 total plants. This would equal a frequency of 50 percent, but be sure to conduct multiple surveys within the same habitat type and then average the results for a more comprehensive evaluation of the area.

Figure 5. Measuring grass stubble height can serve as an "early warning system" to move cattle or determine if grass height is sufficient for nesting cover. (Photo courtesy of Blake Alldredge, Texas A&M AgriLife Extension Service)

Grass Stubble Height Survey

Purpose

Measuring the grass stubble height can provide the land manager with important information, such as knowing when to move livestock to another pasture or if grass height is sufficient for nesting cover (Wright et al. 2005). Managing for sufficient grass stubble height can also provide long term range sustainability and watershed protection benefits, such as maintaining a healthy root system, greater rainfall infiltration, reduced runoff and erosion, lower soil temperature that reduces soil moisture evaporation, which in turn promotes future plant growth, and reduces invasion by less desirable species (Lyons and Machen, 2001; Redmon, 2002). As a general rule of thumb, many livestock managers "take half, leave half" when it comes to forage, but they should realize that almost 25 percent of the grass will be susceptible to trampling and insect consumption, thereby only leaving 25 percent of the forage for livestock, not 50 percent (White et al. 2000; Lyons and Machen, 2001). This means that for tallgrasses, such as little bluestem, big bluestem, indiangrass, and switchgrass, maintaining a 12-14 inch minimum height, and for mid-grasses, such as sideoats grama, maintaining a 6-8 inch height is appropriate (Lyons and Machen, 2001). For introduced grass species such as bermudagrass and bahiagrass, a 3-4 inch height is appropriate, and for kleingrass and old world bluestems 4-6 inch is recommended.

Materials

- Yard stick
- Flat metal washer
- Same materials used for cover survey

Description

Evaluating grass stubble height can be done at the same time as a cover survey simply by using a yard stick to measure the height of the grass plant as it naturally lies nearest your shoe every other time your right foot hits the ground (Figure 5; Wright et al. 2005). If there is no grass plant present at your recording point, use the "nearest neighbor" method by placing the flat metal washer at the heel of your shoe and then move perpendicularly from the transect to locate and measure stubble height for the nearest grass plant. After recording grass heights for up to 100 points on the data sheet, the land manager can then divide the total by the number of grass points to reach an average height, although this average height will be dependent upon the grass species evaluated (Appendix E). This method allows the land manager to evaluate habitat needs for ground-nesting birds. Livestock producers interested in forage production can also measure grazable leaf length of the grasses most likely to be grazed by gently stretching the plant to measure the entire length along the yardstick.

Forage Clipping Survey

Purpose

One final monitoring technique that can be done is a forage clipping survey. These surveys will help managers optimize plant consumption by livestock and at the same time leave enough plant material to protect the soil and promote future growth. Surveys should be conducted at the end of normal forage production cycles. This means late June-early July and late October-early November for the Trinity River basin and most parts of the state (Hanselka and McGinty, 2006). Another survey should be conducted in March to evaluate the amount of forage lost over winter.

Materials

- Handheld GPS (optional)
- ½ to ¾ inch PVC pipe
- Yard stick
- Hand shears
- Paper bags
- Weight scale

Figure 6. Use shears to clip plants to the ground within a plot frame to measure forage production. (Photo courtesy of Blake Alldredge, Texas A&M AgriLife Extension Service)

Description

The first step in a forage clipping survey is to determine the grazable acreage for each range site or pasture. Unproductive areas, such as brush thickets, rocky areas, lakes, and high slope areas are not grazable or used by livestock and should not be included in the determination (Hohlt et al. 2009). Mapping tools such as Google Earth or the Trinity River Information Management System (TRIMS; access at http://trims.tamu.edu) provide access to recent aerial imagery and have tools for measuring acreage and road or fence lengths that can be used to make this determination. It may be necessary to inspect all the areas to make a visual assessment of grazability as brush encroachment may have increased or decreased since the imagery was obtained. Using a handheld GPS, you can create points or lines to mark areas that are grazable or not and use the coordinates to pinpoint precise locations in Google Earth or TRIMS. At the same time, you can mark watering areas, mineral/feeding locations and other high or low traffic areas. From this analysis you can determine representative areas which are sites that receive average grazing use.

Next, construct a 3 foot by 3 foot (9 ft^2) plot frame using ½ to ¾ inch PVC pipe. Then begin taking photos showing height, density and cover of vegetation within the plot frame. It may be prudent to use a yard stick or ruler to determine height. This method will help you develop a photo guide for visual assessments in the future to rapidly estimate forage quantities. (See a sample photo guide in Extension publication L-5476 *Photo Guide to Forage Supplies on Texas Rangelands*.)

Place the plot frame in a representative area and clip all the live plants within the plot frame to the ground using shears and place vegetation in a paper bag for drying and weighing (Figure 6). Label the bag with sample number, date, pasture and/or location. Take several samples in each representative area to increase the accuracy of the survey. Before drying, weigh the bag to the nearest gram or tenth of an ounce, then heat the bag in a microwave for 30 seconds. Reweigh and reheat until the sample stops losing weight. Subtract the weight of a paper bag to determine the amount of dried forage in ounces per bag. Average all forage weights for the same representative areas.

To calculate forage production in pounds per acre, use the following equation:

302*weight in ounces = lbs/acre

From this you can determine the 25 percent designated for livestock forage. Healthy, well-managed tallgrass prairies in the Trinity River basin should have a minimum of 1,200-1,500 lbs/acre for soil protection and plant vigor (Hanselka and McGinty, 2006). For a more thorough explanation of this survey method, read Extension publication (B-1646) *How Much Forage Do You Have?*, available at the AgriLife Bookstore.

Management Techniques for Restored Grasslands

Native grasslands evolved under a disturbance regime that maintained the grasslands by enhancing native grasses and forbs and suppressing woody growth. The main disturbances that shaped native grasslands prior to European settlement were fire and bison grazing. Without disturbance, forbs and grasses are replaced by woody species in a process called succession, resulting in loss of habitat to many grassland wildlife species and a reduction in forage available to livestock.

Nowadays, it is impossible to manage land in this way due to widespread settlement and misconceptions regarding the use of fire as a management tool. Yet, there are various management techniques landowners can employ on their land to improve wildlife habitat and forage quality, such as chemical and mechanical treatment, prescribed burning, shredding, disking, and grazing management. Depending on the condition of the land, some techniques should be used together. The following general descriptions of commonly used management techniques may not be suitable for all properties. Landowners should be aware of local laws and ordinances and work with County Extension Agents, Texas Parks and Wildlife, Natural Resources Conservation Service, or Texas A&M Forest Service personnel to determine the best techniques to use for their specific property. For a quick reference on the time of year to conduct restoration, monitoring, and management techniques, see Appendix F.

Chemical and Mechanical Treatment

Introduced grass monocultures are often undesirable when managing for wildlife because they reduce the diversity of plants in the area. Unfortunately, many introduced grasses spread when disturbed by common management techniques. Chemical treatments with herbicides, such as glyphosate or metsulfuron methyl, are the most effective way to reduce introduced grasses. However, introduced grasses may continue to aggressively return, depending on the mortality success of the first herbicide application. If so, another application or spot applications of individual grass plants may be necessary to completely remove these species or limit them so that native species have an opportunity to establish and outcompete. When applying herbicide to introduced grass species, allow growth up to 10-12 inches and spray in late summer for highest mortality rate (Thigpen et al. 2012). Follow label directions, recommended herbicide application rates, and properly calibrate your sprayer to avoid excessive application and wasted money.

Figure 7. Mechanical brush treatments have the immediate effect of reduced canopy cover, but can cause significant soil disturbance and some species will vigorously resprout. A rotary mulcher is pictured here. (Photo courtesy Tim Siegmund, Texas Parks and Wildlife)

Although disturbance may spread invasive species, the lack of disturbance can promote brush encroachment. Many formerly open grasslands have transitioned into dense thickets of yaupon, mesquite, and other brush species. Therefore, brush management is important for maintaining wildlife habitat on Trinity River rangelands and should be part of the overall management plan. Often times, both mechanical and chemi-

Figure 8. Chemical brush treatments are more selective than mechanical methods for reducing brush cover without disturbing the soil. (Photo courtesy of Blake Alldredge, Texas A&M AgriLife Extension Service)

cal treatment methods can be used for effective brush management.

Mechanical methods, such as roller chopping, hydro ax mulcher, and using chainsaws will have the immediate effect of removing brush top canopy, but may result in low mortality and vigorous resprouting from the roots by certain brush species (Welch, 2000; Figure 7). Chaining, root plowing, and grubbing are other mechanical methods that prevent resprouting by removing the root systems in addition to the aboveground canopy. Chemical treatments such as broadcast applications or individual plant treatments are very effective at killing woody plants and do not cause significant soil disturbance as compared to mechanical methods (Figure 8). Broadcast application is best for large stands of dense brush cover, whereas individual plant treatments are best for smaller stands or when thinning a stand to leave certain desirable brush species. Individual treatment methods include cut-stump, basal bark, soil, and high-volume foliar applications (Welch, 2000). Once brush cover has been reduced, continual maintenance with herbicides and practices such as prescribed burning will be necessary to limit brush encroachment.

The ecoregion and species of interest will determine the most effective brush control methods (Mitchell et al. 2005). Also, the time of year for application will differ depending on the selected herbicide, the targeted brush species, climate and growth conditions. Be sure to always follow recommended herbicide application rates given on the label and to calibrate sprayers properly. Detailed descriptions of mechanical and chemical brush control methods can be found in Extension publication (E-44) *Brush Management Methods*, and specific recommendations for chemical application rates by species are listed in Extension publication (B-1466) *Chemical Weed and Brush Control: Suggestions for Rangeland*. Also, visit the PESTMAN website for specific recommendations on chemical and mechanical brush control in Texas at http://pestman.tamu.edu.

Prescribed Burning

Historically, fire was a natural occurrence throughout much of Texas and in the Trinity River basin, fires occurred every 3-6 years and maintained the tallgrass prairies by suppressing woody vegetation growth (Sparks et al. 2012). Early in the 20th century, the U.S. Forest Service began preventing fires and conducted media campaigns such as "Smokey the Bear" that por-

Figure 9. Prescribed burning provides numerous benefits to the land and is very cost effective. (Photo courtesy Brian Hays, Institute of Renewable Natural Resources)

trayed fire as destructive and unnecessary. This was due to a lack of knowledge and understanding of the benefits of fire to plant communities. Wildfires can grow out of control and create dangerous situations and undesirable effects, whereas prescribed burns follow guidelines that establish the conditions and manner under which fire will be applied on a specific area to accomplish specific management and ecological objectives (Figure 9).

Livestock producers and wildlife managers can experience substantial benefits from utilizing prescribed burning as a tool in their land management program. Benefits from prescribed burning include:

- Reduction in volatile fuel loads, thus reducing the chance for catastrophic wildfire
- Suppression of woody species
- Removal of excessive litter and debris to provide more bare ground for wildlife
- Increased vegetative diversity
- Stimulated germination of forbs and grasses in the seedbank
- Improved nutrient cycling
- Increased forage production, palatability, and nutritive quality
- Increased animal productivity
- Control of certain parasites and pests

Three things are needed for a prescribed burn: adequate fuel load, safe weather conditions, and ignition. Additionally, you should always have a burn plan (NRCS, TPWD or a local prescribed burn association can help develop these) and stick with the predetermined weather parameters. Having an adequate and continuous fuel load is needed to maintain the fire across the area to be burned. Therefore, remove livestock from the area to be burned in the latter part of the growing season to allow enough growth to reach a minimum of 1,500 to 2,000 pounds of grass per acre (White and Hanselka, 2000). Also, fuel moisture is important because it is easier to burn dry grass than green grass. Fuel moisture is dependent on temperature, humidity, precipitation, wind, season, and topographic location.

Weather conditions are critical to the success of the burn as they largely determine if a burn will be conducted or not on the day it is scheduled. Those wishing to burn need to closely monitor weather conditions in the days leading up to the burn, as well as the day of and during the burn. Burn crews need to be watchful to contain the fire should conditions change rapidly. In general, desired weather conditions include wind speeds of 6 to 23 miles per hour with a steady direction, air temperature 40°F to 80°F, and relative humidity 25 to 60%. Prescribed fires should not be

conducted within 48 hours of the expected passage of a weather front.

Though adapted to fire, plant response to fire will depend on a number of factors, including timing, fire type and post burn grazing management. In the middle Trinity River basin and most of Texas, prescribed burns usually take place from January to March. Burning in early to mid-winter will benefit late winter annual forbs and allow recovery of perennial grasses, whereas late winter burns after annual forbs have germinated will reduce their population, but still improves perennial grass nutritive value and suppress woody growth.

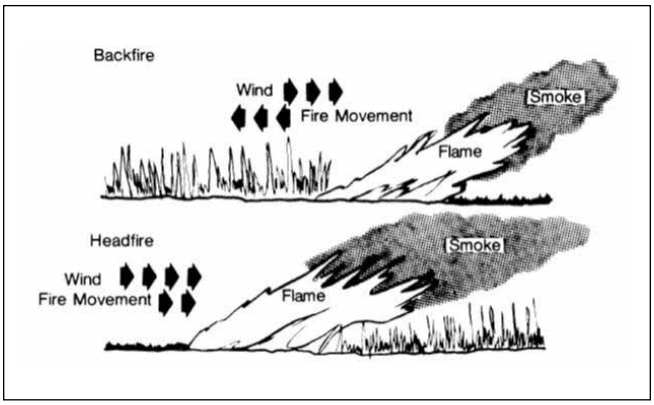

Figure 10. Headfires and backfires are two common firing techniques and each has their advantages. (Adapted from White and Hanselka, 2000).

Fire type is another consideration that must be taken into account depending on burn objectives (Figure 10). Headfires move in the same direction as the wind, resulting in a faster rate of spread, greater flame heights, and more effectiveness at top-killing shrubs and trees. Backfires move against the wind, so that they consume more fuel and create greater basal damage to woody species than headfires. In many situations, firelines will need to be constructed to ensure safety and containment of the burn. Firelines can be constructed using mechanical methods such as disking or using a blade to knock down vegetation to mineral soil (Figure 11). Also, using fire retardants or water to soak the vegetation can be used for fireline construction immediately prior to initiating the fire. Costs for prescribed burning will range from 50 cents to $10 per acre or more depending on fireline construction and if the landowner contracts the job with professionals. Also, costs should decrease with subsequent burns.

Figure 11. Disking along fencelines acts as a firebreak and can be a natural food plot once forbs germinate in the disked area. (Photo courtesy of Blake Alldredge, Texas A&M AgriLife Extension Service)

Figure 12. Exclude livestock from grazing burned areas for 60 to 90 days to prevent damaging plants. (Photo courtesy Dr. Wayne Hanselka)

Plant response after burning is highly dependent on rainfall, but in general, livestock should not be allowed to graze for 60 to 90 days after burning with average rainfall to prevent damaging the plants (Figure 12; Hanselka, 2009).

Figure 13. Shredding is not a preferred method of brush control, but may allow enough time for grass to grow and provide fuel for prescribed burning. (Photo courtesy Dr. Jim Cathey, Texas A&M AgriLife Extension Service)

The landowner conducting the prescribed burn is legally responsible for unintended damage. However, according to the Texas Prescribed Burning Act passed in 1999, if a certified prescribed burn manager conducts the burn and has at least $1 million in liability insurance coverage, the burn manager is held liable for damages, not the landowner. The best thing to do is work with your neighbors to keep them informed of your activities. Texas Commission on Environmental Quality (TCEQ) regulations state that burning must be downwind of or at least 300 feet from any structures unless written approval is obtained from the owner. It is also prudent to increase the liability coverage of your insurance. To protect yourself as much as possible, develop a detailed prescribed burn plan with a local burn manager who has experience in burning. Also, consider joining a local prescribed burn association. These "neighbor-helping-neighbor" organizations provide much needed expertise, equipment, and "boots on the ground" to help conduct a safe and effective fire. Communicate with the local authorities to keep them informed of your activities.

For more detailed information on prescribed burning and developing a burn plan, read Extension publications (E-37) *Prescribed Range Burning in Texas* and (E-460) *Planning a Prescribed Burn* available at the AgriLife Bookstore (agrilifebookstore.org). Contact your local County Extension Agent, Texas Parks and Wildlife, Natural Resource Conservation Service, or Texas A&M Forest Service representatives to help you develop a burn plan and conduct it.

Another resource for prescribed burning is the newly formed Prescribed Burn Alliance of Texas (http://pbatexas.org/). There is a variety of information available on their website and they can help form a prescribed burn association in your area if there is interest with the local landowners.

Shredding

Prescribed burning and grazing management are preferred methods for maintaining native grasslands, although there are situations where burning and grazing may not be feasible and shredding may be a suitable alternative to enhance species diversity (Figure 13; Knapp et al. 1999). Shredding is not a desirable method for brush control. However, it may be necessary the first 2-3 years after seeding to reduce competition from annual forbs and undesirable grasses (Dillard, 2000). Deck heights should be set at a minimum height of 4 inches, but higher settings are preferred to maintain adequate cover and reduce moisture loss from the soil that is needed for grass seedlings to grow. Shredding is not a preferred method for managing wildlife habitat as it can create a deep thatch layer at the ground level that is more difficult for bobwhite chicks to travel through and can prevent seedlings from receiving sunlight. If shredding must be done, do so in February to provide cover during fall and early winter and to avoid disrupting critical nesting and reproductive periods in spring and early summer (Harper, 2007). Shredding

Figure 14. Disking implements can be used to break up the top 2-4 inches of soil. (Photo courtesy of Blake Alldredge, Texas A&M AgriLife Extension Service)

an entire field is unnecessary. Shredding strips in July and August will encourage native grass growth on fields primarily composed of forbs without largely disrupting nesting and reproductive activity.

Disking

Disking is another tool land managers can employ to increase plant species diversity (Figure 14). In the absence of disturbance, such as fire, grasses tend to dominate fields over time and reduce annual forb diversity ground-nesting birds require for food and cover. Disking acts as a disturbance by breaking up the top 2-4 inches of soil, opening the structure at ground level and exposing annual forb seeds to sunlight and rainfall, which will promote germination. This creates a natural food plot and saves the landowner money by using seed already present in the soil and adapted to the climate of the area (Figure 15).

Frequency of disking can vary, but will generally range from 1-2 years to refresh annual forb communities. The best time of year to disk is December – February. There is no need to disk an entire field, as strips 20 feet wide and 100 yards long will greatly benefit deer, quail, and wild turkey. It is best to disk strips close to cover, such as brush mottes, forested areas, or an area with numerous bunchgrass clumps. This will allow quail and other species to forage the disked area for food and quickly return to the cover areas to escape predators.

Figure 16. Grasses tend to dominate over time, as pictured above, and cattle can be used to control grass growth and allow forbs to grow. (Photo courtesy of Blake Alldredge, Texas A&M AgriLife Extension Service)

Figure 15. Disked areas can save landowners money by acting as natural food plots. (Photo courtesy of Blake Alldredge, Texas A&M AgriLife Extension Service)

Landowners can also disk strips throughout the field to reduce grass dominance and promote movement within the field. Disked strips provide an additional benefit as they can act as firelines for landowners using prescribed burning to enhance wildlife habitat (Figure 11).

Grazing

The Father of Wildlife Management, Aldo Leopold, once noted there were five tools necessary for conservation; that is, the ax, plow, cow, fire, and gun. While some of these tools and their influence are intuitive, the use of the cow is oftentimes questioned. It should be understood maximizing production of livestock and wildlife at the same time is not possible, but using livestock as a tool to manage wildlife habitat can increase plant diversity and provide additional income for the ranch.

When managing wildlife habitat, whether the tallgrass prairie or other ecosystems, grass management can be a crucial strategy. Uncontrolled grass growth can limit forb production due to severe competition (Figure 16). Forbs, whether used for forage or seed production, many times are more valuable to wildlife species than grass, and are relished by deer and by many species of upland birds. Therefore, the stocking rate of cattle is the most important decision when it comes to grazing management of wildlife habitat.

Generally, light grazing (35 percent use of primary forage species) to moderate grazing (35 to 45 percent) encourages forb production due to control of grass species and disturbance caused by livestock movement (Lyons and Wright, 2003).

Using cattle, which are predominantly grass-roughage eaters, to reduce grass height favors increased forb production. Mature cows, which must be managed on a year-round basis, however, may not be the best animal choice. Instead, the use of yearling cattle (stocker cattle) may offer the benefits of grass removal, while minimizing some of the negatives associated with year-round ownership. In years with good to above-average precipitation and high rates of grass growth, yearlings may be purchased as necessary to control grass abundance. Once the grass has been utilized to the desired level, the yearlings may be sold. During dry years, when less grass is produced, fewer yearlings or none may be utilized. This increased level of flexibility allows the manager to tailor the number of head to the amount of grass to be controlled without concerns for year-round ownership and winter feeding. Additionally, if the manager prefers not to purchase yearlings, they may instead opt to lease the property for yearlings based on a weight gain or on a per head per month basis. Note that the use of other kinds of grazing livestock, such as sheep or goats, is not as desirable as the use of cattle since there is increased potential for diet overlap with deer and other wildlife species.

No grazing should occur on restored sites until after the 2 year period required for native grasses to establish. After this period, land managers should regularly monitor grazed fields to ensure grasses are not over-utilized. As discussed previously, maintaining a 12-14 inch minimum height for tallgrasses and 6-8 inch minimum height for midgrasses will reduce runoff and soil erosion and benefit future plant production by leaving more residue, which will allow greater rainfall infiltration (Hanselka et al. 2002; Lyons and Machen, 2001). For quail, a 12-14 inch minimum will provide sufficient nesting cover, while wild turkey and deer may require a minimum height of 18-24 inches for cover (Lyons and Wright, 2003). In addition, wild turkey and deer require about 40 to 60 percent brush cover (Lyons and Ginnett, 2001). To ensure minimum heights are maintained, developing a rotational stocking plan allowing rest from grazing may be the best way to ensure recovery.

Wildlife Management and Property Tax Valuation

Wildlife management now qualifies for open-space (1-d-1) appraisal and landowners pay the same amount of taxes as agricultural land (Redmon and Cathey, 2010). Wildlife management is agriculture. Law requires three out of seven qualifying management practices be conducted as part of a wildlife management plan to maintain open-space valuation. Some of the previously discussed management techniques that qualify for land appraisal purposes include: grazing management, prescribed burning, brush management, and range enhancement. Much of the data obtained from the monitoring techniques described in this publication can also be used in annual reports required by many chief appraisers. For a complete discussion on how to obtain open-space appraisal based on wildlife management, read Extension publication (ESP-377) *Wildlife Management and Property Valuation in Texas* or contact your county appraiser.

Conclusion

Native grasslands provide many benefits to landowners, including wildlife habitat and watershed protection. Increasing opportunities to receive income from hunting, fishing, and ecotourism activities encourages landowners to enhance the habitat on their land. To ensure continued productivity of native grasslands, landowners need to periodically monitor the condition of plant communities and soil resources. Various management techniques should also be conducted to protect the land from brush or invasive plant encroachment and provide sufficient wildlife habitat. The monitoring and management techniques discussed in this publication will aid landowners in developing their monitoring and management plan and evaluate the success of a native grassland restoration project and/or continued productivity. Landowners should also contact their local County Extension Agent, Texas Parks and Wildlife biologists, or Natural Resources Conservation Service biologists or grazingland specialists for help in developing these plans.

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Appendices

Appendices A-E are adapted from Wright et al. (2005). *Copy and print these sheets for recording monitoring data in the field.*

Appendix A. Precipitation records sheet

Pasture Name _____ Habitat Type _____

Rain Gauge Number _____

Record Number	Observer	Date	Amount (inches)	Cumulative Total
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
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20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Appendix B. Photo point data sheet

Ranch Name _____ Pasture _____

Class and Number of Livestock _____ Date In _____ Date Out _____

	Key Habitat Name and Location	Date	Time	Photographer	Landscape (Y/N)	Ground Level (Y/N)	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

Appendix C. Nest clump survey data sheet

Observer	Date	Pasture Name	Habitat Type	Transect Number	Nest Clumps Counted	Multiplication Factor	Nest Clumps Per Acre
						10	
						10	
						10	
						10	
						10	
						10	
						10	
						10	
						10	
						10	
						10	
						10	
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						10	
						10	
						10	
						10	
						10	
						10	
						10	

Appendix D. Cover survey data sheet

Observer _____ Date _____

Pasture Name _____ Habitat Type _____

Transect Number _____

Bare Ground																					
Forbs																					
Grass																					
Brush																					
Step #	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	Tot
Bare Ground																					
Forbs																					
Grass																					
Brush																					
Step #	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	Tot
Bare Ground																					
Forbs																					
Grass																					
Brush																					
Step #	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	Tot
Bare Ground																					
Forbs																					
Grass																					
Brush																					
Step #	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	Tot
Bare Ground																					
Forbs																					
Grass																					
Brush																					
Step #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Tot

Grand Total– Bare Ground	Grand Total– Forbs	Grand Total– Grass	Grand Total– Brush

Appendix E. Grass stubble height data sheet

Observer _____ Date _____

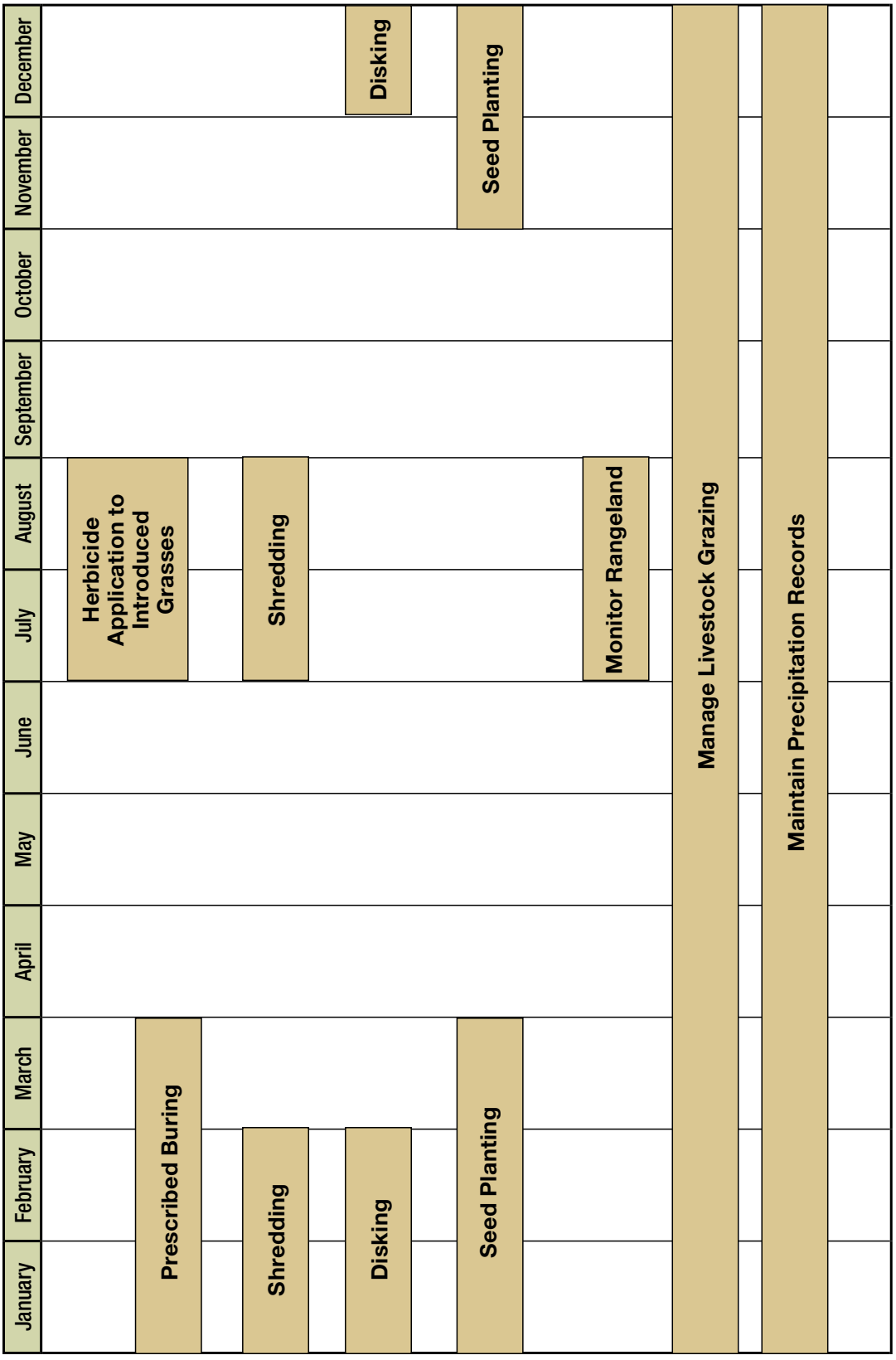
Pasture Name _____ Habitat Type _____

Transect Number _____

Step #	Grass Height	Step #	Grass Height	Step #	Grass Height	Step #	Grass Height	Step #	Grass Height
1		21		41		61		81	
2		22		42		62		82	
3		23		43		63		83	
4		24		44		64		84	
5		25		45		65		85	
6		26		46		66		86	
7		27		47		67		87	
8		28		48		68		88	
9		29		49		69		89	
10		30		50		70		90	
11		31		51		71		91	
12		32		52		72		92	
13		33		53		73		93	
14		34		54		74		94	
15		35		55		75		95	
16		36		56		76		96	
17		37		57		77		97	
18		38		58		78		98	
19		39		59		79		99	
20		40		60		80		100	
Tot		Tot		Tot		Tot		Tot	

Grand total from all columns		**Divided by 100 =**		**Average stubble height**

Appendix F. Calendar of Management Activities for Grasslands in the Trinity River Basin



Appendix F. Calendar of management activities for grasslands in the Trinity River basin. Mechanical brush control can be done at anytime, chemical brush treatment varies depending on herbicide used, but generally during the growing season.

Photo courtesy of Blake Alldredge, Texas A&M AgriLife Extension Service

Authors

Blake Alldredge
Extension Associate
Texas A&M AgriLife Extension Service

Dr. Larry Redmon
State Forage Specialist
Texas A&M AgriLife Extension Service

Dr. Megan Clayton
Extension Range Specialist
Texas A&M AgriLife Extension Service

Dr. James C. Cathey
Extension Wildlife Specialist
Texas A&M AgriLife Extension Service

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