Chapter 3. Maintaining and Restoring Grasslands

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Northeastern grasslands have provided habitat for grassland birds and other wildlife for many hundreds of years. Historically, most of northern New England was forested with grasslands generally restricted to scattered small openings along river floodplains, wetlands, and beaver meadows. Southern New England, on the other hand, was described by many early settlers as having some extensive openings and many smaller grasslands, usually in the form of coastal sandplain grasslands and heathlands, and openings maintained through Native Americans' use of fire. Further south, in areas such as Long Island and Virginia, large grasslands and savannahs were quite common. These openings were among the first areas settled and farmed by Europeans.

By the 1800s, grasslands were widespread throughout the region and grassland birds including grasshopper sparrows, savannah sparrows, vesper sparrows, upland sandpipers, eastern meadowlarks, and bobolinks benefited. During the late 1800s and the early 1900s, grassland quality and quantity declined due to changes in agricultural technology, a reduction in the use of fire, the loss of farm acreage in New England, and an increase in the human population. Wildlife species adapted to grassland landscapes are now diminishing as farmlands are left idle and revert to forests or are replaced by housing and commercial development.

Remnant stands of native warm-season grasses still remain throughout the Northeast along railroad grades, rivers, roadsides, cemeteries, pastures, old fields, and reverting farmlands. Although cooler temperatures in parts of the Northeast do not allow warm-season grasses to produce as much biomass as they do in the warmer climates, a variety of species have proven useful for reclamation projects, wildlife habitat improvements, and forage production throughout the region.

Comparative values of cool-season vs. warm-season grasses

Grasses are generally categorized into two groups: cool-season grasses and warm-season grasses. Most of the grasses found in the Northeast are non-native, cool-season grasses. They grow best during the spring and fall when soil and air temperatures are cool. This group of plants begins active growth when minimum air temperatures reach 40 to 42o F. Grasses in this group include smooth brome grass, timothy, Kentucky bluegrass, tall fescue, and orchardgrass. Alfalfa and clover, though legumes, are often incorrectly referred to as cool-season grasses.

As agricultural activity spread through the region after European colonization, various cool-season grasses were introduced because they are easily established, they green up earlier than native grasses and thus provide excellent early season forage, they can be closely grazed, and they can be easily managed as monocultures. However, there are some disadvantages to using cool-season grasses. These include high cost to maintain stand vigor (fertilizer, lime, herbicides, and re-seeding), and low quality forage during the summer. Some species such as tall fescue grow so dense that it hinders travel of songbirds, rabbits, and quail in their search for food or bare ground for dusting sites. Tall fescue also produces a toxin that inhibits other plant species including many native species that are becoming increasingly rare. A reduction in plant diversity has a direct impact on the array of butterflies, moths, bees, small mammals, and birds within a particular patch of grassland habitat. Cool-season grasses also mat down easily from winter storms resulting in poor cover for wintering wildlife and for nesting the next spring.

Native warm-season grasses, those species present in the region prior to European settlement, are typically referred to as "prairie or bunch grasses." These grasses grow best in the summer heat, from June through mid-September, and do not begin green-up until the minimum air temperature reaches 60 to 65o F and soil temperatures reach 50° F. Native grasses including switchgrass, indiangrass, big bluestem, and little bluestem once dominated the Great Plains and accented the forested regions of the east as savannahs. Broomsedge is perhaps the most common native species found in many old fields. Today native grasses are typically mixed with wildflowers along roadsides and railroad rights-of-ways, in remnant fields, and in fields planted by conservation agencies and organizations.

Figure 1. (From left) Switchgrass, little bluestem and big bluestem are a few of the native warm-season grass species that are increasingly being planted in the Northeast because of their value to wildlife. Photos by Paul Rothbart.

Warm-season grasses provide a multitude of ecological benefits and management opportunities:

- They are well adapted to a variety of site conditions.
- Maintenance costs are low once stands are established. Native grasses do not typically require ongoing insecticide and herbicide applications. Fertilizer is not needed unless a stand is intensively managed for forage.
- Root systems are extensive, growing 5 to 15 feet deep. Root systems completely regenerate every three to four years resulting in increased soil fertility, organic matter, and carbon sequestration. Deep root systems provide excellent drought resistance and soil holding capabilities. Native warm-season grasses provide excellent wildlife habitat. Most native warm-season grasses are "bunch grasses" that grow in clumps. The clumping nature of these plants typically results in more bare ground under and between individual plants, which provides dusting areas and travel corridors for birds and their feeding broods. The bunchy structure also allows a diversity of forbs, legumes, wildflowers, and insects to colonize the area, creating better foraging conditions. Warm-season grasses do not mat down easily under winter snows. Therefore, they provide excellent winter escape cover and nesting cover the following spring.
- Warm-season grasses are harvested or grazed at a greater height (eight to ten inches) than cool-season grasses, thus offering reliable nesting cover while also providing forage.
- Warm-season grasses provide dependable forage production. They are less influenced by severe weather fluctuations, more disease and insect resistant, they provide quality summer forage when cool-season species have slowed growth, and are long lasting.
- Native grasses are tolerant of and even stimulated by fire. They are readily managed with prescribed burning and can yield excellent nesting and brood-rearing habitat.

Habitat values of small and large grasslands

Grasslands provide habitat for a variety of wildlife, including meadow voles, meadow jumping mice, white-tailed deer, red fox, cottontail rabbits, several species of sparrow, meadowlarks, turkeys, bobwhite quail, bats, butterflies (e.g., swallowtails, monarchs, fritillaries, among others), and a wide array of amphibians and reptiles including green snakes and box turtles.

Although grasslands provide habitat for a wide array of wildlife species, recent concerns over grassland habitat have focused on declines in grassland bird populations. Breeding Bird Surveys throughout the United States have shown alarming declines in the number of grassland birds nationwide. These declines are reflected throughout our region (Table 1).

Table 1. Status of grassland birds in the Northeast [taken from Mitchell et al. 2000)].

Species	CT	DE	MA	MD	ME	NH	NJ	NY	PA	RI	VA	VT	WV
Upland sandpiper	E		E	E	T	E	E	T	T	E	T	T	T
Horned lark	T												
Vesper sparrow	E		T				E						
Savannah sparrow							T						
Grasshopper sparrow	E		T		E		T			E			
Henslow's sparrow			E	T			E	T			T	E	T
Bobolink							T						

E = state endangered; T = state threatened.

Maintaining grasslands provides critical habitat for this group of birds. Following the guidelines prepared by Jones and Vickery (1997) for the Massachusetts Audubon Society, grasslands in the remainder of this chapter will be categorized as small, large, and agricultural. Small grasslands are 10 to 75 acres in size and are not in agricultural use. These types of grasslands include conservation areas, recreation fields, small landfills, corporate parks, and airports. Large grasslands are more than 75 contiguous acres and include conservation lands, airports, and landfills. Agricultural lands are grasslands on active farms including hayfields, crop fields, and pastures.

Small, isolated grasslands

Small, isolated grasslands are not suitable for grassland birds such as upland sandpipers and grasshopper sparrows that require large contiguous tracts for breeding (Table 2). However, these sites do provide summer breeding habitat for bobolinks, eastern meadowlarks, northern bobwhite, and savannah sparrows. In the fall, these fields provide food for migrating sparrows, larks, and warblers.

Figure 2. Bobolinks (a) and savannah sparrows (b) utilize small grasslands. Photos by Paul Fusco.

Large grasslands

Upland sandpipers, grasshopper sparrows, and northern harriers (all listed as threatened or endangered in most northeastern states) nest in large contiguous fields that contain a mosaic of mowed areas, tall grass meadows, and wildflowers. In the fall, large grasslands provide feeding and loafing areas for migrating sparrows and warblers, while waterfowl and shorebirds sometimes feed in flooded portions of these fields. These fields are also important to birds of prey such as American kestrels and short-eared owls that forage for small mammals throughout the year. Large fields are also beneficial to rare snowy owls in the winter. They regularly visit large airports and wet meadows in the region from more northerly climes.

Figure 3. Upland sandpipers (a) and Northern harriers (b) require extensive grasslands of 75 acres or more. Photos by Paul Fusco.

Agricultural fields

Agricultural hayfields, meadows, and pastures have provided homes to grassland birds for hundreds of years in the Northeast. Grassland specialists utilize these sites for nesting, brood rearing, and foraging. Songbirds including bobolinks and eastern meadowlarks build ground nests, raise young, and forage in hayfields, meadows, and pastures during the summer. In the fall, agricultural fields provide feeding sites for migrating larks, sparrows, and warblers. Many hawks and owls including American kestrels, northern harriers, and short-eared owls forage in these fields for small mammals. Waterfowl and shorebirds frequently feed in flooded portions of crop fields during migration.

Managing and maintaining grassland fields

Prescriptions for grasslands

Cool-season grasses and agricultural lands certainly can be beneficial to wildlife. The vast majority of grasslands throughout the Northeast are dominated by introduced cool-season species, which provide valuable habitat to grassland specialists such as savannah sparrows, bobolinks, and eastern meadowlarks. It is essential that we conserve, maintain, enhance, restore, and establish both cool- and warm-season grasslands throughout the region. Due to a heightened interest in establishing native warm-season grasses, increased availability of seed sources, wildlife and ecological values inherent with these native species, and the availability of funding to conduct private land habitat enhancement practices, the management guidelines presented in this chapter will concentrate on these native grasses. Many of the management recommendations such as mowing dates, use of prescribed burning, grazing, and the use of herbicides would also apply to cool-season grass management.

Before rushing into any management project, a thorough evaluation of the project site should be conducted, so no harm is done to any thriving or potentially valuable warm-season grasses. An evaluation may reveal conditions where warm-season species remain but in a suppressed condition. In such situations, a combination of management prescriptions (i.e. prescribed burning, brush and tree removal, mowing, and/or herbicide applications) may restore warm-season grasses without the need to re-plant.

Although established stands of native warm-season grasses require minimum maintenance, periodic management is important. Stand deterioration is usually caused by a combination of competition from woody plants and cool-season grasses, overgrazing, or an accumulation of plant litter. In the Northeast, management may be necessary every three to four years. Activities should be scheduled outside of the primary bird-nesting season (April 15 to August 15) and some untreated sections should remain to ensure that food and cover is always available. Species-specific management must consider individual habitat needs (Table 2).

Table 2. Habitat characteristics for grassland birds in the Northeast [taken from Mitchell et al. (2000)].

Species	Minimum habitat patch size (acres)	Vegetation type[a]	Vegetation height (inches)
Upland sandpiper	64-113 (NY)	Sandplain grasslands (ME), Old hayfields with short patchy grass (NY), Peatlands with ericaceous shrubs (Quebec)	4-6 (WI)
Horned lark	< 2.5 (NY) 2.5-25 (MO)	Sparsely vegetated agricultural fields (NY), Stony acid soils with sparse grasses (WV)	Very short to bare soils (NY)
Vesper sparrow	12-25 (ME)	Sandplain grasslands with patchy vegetation (ME), Acid soils with coarse grasses and 44% open ground (WV)	
Savannah sparrow	12-25 (ME)	CSG pasture (MD, NY), Marshes (Quebec), Sandplain grasslands (ME), Sparse grasslands (WV)	12 (MD) 33 (PA) 8-24 (Quebec) 17 (WV)
Grasshopper sparrow	64-113 (NY)	Sandplain grasslands (ME), Old hayfields with short, patchy grass (NY), Lightly grazed CSG pastures with 9% forbs (NY), Bunchgrasses with 30% bare ground (WV)	22 (NY) 8-14 (WV)
Henslow's sparrow	74-89 (NY)	Old fields with scattered shrubs and dense litter (MD), Ungrazed CSG pastures with 13% forbs (NY), Grass-dominated old hayfields with thick litter (NY) Tall, dense hayfields (PA)	40-46 (PA)
Eastern meadowlark	60 (NY)	Diverse old fields (MA), Sandplain grasslands with high % forb and grass cover (ME), CSG pasture and forb dominated fields (NY)	16 (WI)
Bobolink	4 (MA) 40 (NY)	Grass-dominated old fields (MA), Sandplain grasslands with high % forbs (ME), CSG pasture and forb dominated fields (NY)	13-16 (Ontario)

[a] CSG = cool-season grasses

Prescribed burning

- Prescribed burning is the most effective management tool to maintain and rejuvenate native grasslands. Burns should be conducted between March 1 and April 15. Burns can be conducted later in the summer (after August 15) and early fall to reduce woody plants that invade grassland fields. Check with the state fire authorities to determine if there are any restrictions on proposed burning. Burning increases

forb diversity, promotes vigorous warm-season grass growth, releases nutrients back to the soil, and suppresses invasive competition. Burning, unlike other routine management practices, removes accumulation of vegetative litter from the ground's surface. Removal of this thatch can be critical to ground-nesting birds that travel through the fields to forage for food and escape from predators.

- Although a limited number of nests may be destroyed in a prescribed burn, grasslands burned every three to four years have higher avian nesting densities than unburned sites.
- Burning produces more succulent vegetation, which is more palatable to rabbits and deer and supports a larger number of insects that are readily available to young birds.

Refer to the prescribed burning section of chapter 10 for information on planning and conducting prescribed burns.

Mowing

Mowing has long been used to manage grasslands as a means to suppressing invading hardwoods.

- Timing is critical. Mowing should generally be scheduled outside of the primary bird-nesting season (April 15 to August 15).
- Mow every two to three years in fields not used for high quality hay production.
- In intensively managed agricultural fields where mowing occurs during the bird-nesting season, strips and edges should be left unmowed to provide areas of food and cover.
- In agricultural fields over ten acres, delay the cutting of the outer 75 feet of the field and mow the interior portion early. This practice will provide some nesting cover while minimizing the impact on high quality hay.
- Utilize standard wildlife conservation mowing practices such as raising the mower blades to at least ten inches or more, which permits the grass to recover quickly.

Herbicides

Herbicides can be utilized to control weeds in grasslands. Each herbicide controls or suppresses a range of weeds and differs in its effects on warm-season grasses. Selective spraying of isolated patches of woody plants or exotic invasive plants such as autumn olive and multiflora rose can be accomplished with Roundup® or a combination of Garlon® 3A and Escort®. Applying a selective herbicide such as Plateau® throughout an entire field will enhance existing native grasslands where tall fescue may be a problem, but may stunt switchgrass. Refer to the herbiciding section of chapter 10 for a more detailed discussion on applying herbicides.

Figure 4. Prescribed burning (a) is the preferred method of maintaining grassland habitats. However, in situations where burning is not feasible, periodic mowing (b) is a suitable alternative. Photos by Paul Rothbart.

Grazing

- Moderate grazing can benefit grassland wildlife. Grazing produces a diversity of grass heights and reduces ground litter, which at certain densities can be detrimental to foraging birds and wildlife escaping from predators. Grazing on fields with high densities of ground nesters during the critical nesting period (April 15 to August 15) should be closely monitored.
- Develop a rotational system that creates a mosaic of plant species and structure, while providing a longer period of time for animals to graze. On fields utilized by grassland nesters, 40% of the vegetation should be maintained at a minimum height of 8 to 12 inches.
- Do not overgraze. This will reduce plant vigor and lead to erosion, reduced invertebrate diversity, increased weed invasions, and decreased wildlife usage.
  Refer to the grazing section of chapter 10 for other wildlife considerations associated with grazing.

Native warm-season grass planting considerations

A native warm-season grass establishment plan should be considered when high quality grasslands do not exist and management treatments to enhance existing grasslands have failed. Several factors should be considered during the planning process to improve chances of success.

Objectives

Objectives for native grassland restoration may include the following:

- Beauty
- Historical value
- Erosion control due to their extensive root systems
- Enhancing grazing systems by providing quality summer forage to augment cool-season species
- Landscaping that conserves water and reduces chemical applications
- Providing habitat for a diversity of wildlife species.

Specific objectives will play a significant role in determining the desired seed mix and seeding rates.

Site selection

Site selection criteria should include climate, location, existing vegetation, soils, cropping history, potential future site use, and potential use of fire as a management tool. Warm-season grasses can be successfully established on an array of sites ranging from forestland to agricultural fields. All sites must be reclaimed to a plantable condition, which may require herbicides, land clearing, or agricultural equipment. Geographic factors play a significant role in grassland establishment. Regional characteristics will have a major influence on seeding regimes, variety selection, seeding rates, planting dates, and soil nutrient requirements. Few site conditions exist in the Northeast that challenge cool-season grass establishment. In contrast, there are several factors that may create problems for warm-season grass establishment.

- The length of the growing season and the heat received during that time period are key factors that affect seed germination, seedling growth, and ultimately the number of years to achieve good stand density.
- The Northeast region has shorter, cooler growing seasons than the Prairie and Plains states because of the high incidence of cloudy days and the cooling effects of forest cover. Successful plantings require a growing season of 100 to 140 days.
- Frost heaving during the fall, winter, and spring after planting can ruin a promising grass stand. On poorly drained sites where air and soil temperatures are cooler, moisture alternately freezes and thaws causing plants to be uprooted. Such areas should be avoided or planted during late spring or early summer to ensure that the seedlings are well developed prior to the first freeze. Do not burn a stand of young, frost-heaved grass. The fire will kill the roots.

- Soil characteristics must be thoroughly evaluated to determine the type of vegetation needed to meet specific habitat objectives. Native warm-season grasses tolerate a broad range of soil types and conditions. However, there are a few site conditions that are simply not suitable for warm-season grasses. These sites contain soils that remain wet due to poor internal drainage, continuous flooding, and heavily compacted soils comprised of more than 30% clay.
- Elevation and aspect play roles in microclimatic variations that must be considered during seed selection. On warm and better-drained sites big bluestem, little bluestem, indiangrass and switchgrass would be good choices for planting. On cool, poorly drained sites eastern gamagrass, switchgrass and wild rye would be better suited.
- Cropping history provides valuable insight regarding herbicide carryover and potential weed problems that may impact seedling survival and vigor. Pastures and hay fields may have infestations of persistent weeds such as thistle, quackgrass, reed canarygrass and smooth bromegrass, which can reappear immediately or soon after seeding. Warm-season plantings do well following an annual crop rotation in which the preceding crop was corn treated with Atrazine®. Planting a crop such as Roundup®-ready soybeans can also alleviate some weed problems.

Seed Selection

Seed Selection is a key component to a successful planting. Always purchase native grass seed in terms of pounds of pure live seed (PLS) - a combination of germination and purity. This is the best way to ensure that you do not pay for the unavoidable inclusion of leaves and stems in the fluffy seeds of bluestem and indiangrass. PLS % = (% purity x % viable seed) divided by 100. Tags placed on bags of seed by manufacturers list the percentage of pure live seed, germination rates, percentage of inert materials and percentage of dormant seed and weed seeds in each bag. The tags should also indicate a lack of noxious weeds. Do not to use seed originating more than 100 miles north or 200 miles south of the project site to minimize problems with hardiness and disease. Within the Northeast, east-west variation is not critical because precipitation is not a limiting factor. Elevation, however, can be significant. An elevation change of 1,000 feet is equivalent to a move of 175 miles to the north. The number of native grass "cultivars" (species or varieties that have undergone replicated testing for two or more generations to document the heritability of traits, performance, and adaptability) that are commercially available for the Northeast are much more limited than for the Plains states. Still, a number of cultivars are available that are suitable for the growing conditions found in the Northeast (Table 3).

After determining specific objectives and evaluating site characteristics, other factors must be considered.

- Purchase seed from a reliable source, allowing several months lead time to ensure availability.
- Purchase seed of individual species and prepare your own mix. Do not mix small, hard seeds with light, fluffy seeds.
- Purchase warm-season grass seed as pure live seed (PLS). This process ensures that you are paying only for viable seed of the species or cultivar desired, not for dead seed, sticks, stems, and weed seeds.
- Seeding rates of warm-season grasses range from 5 to 12 lbs of PLS/acre, which equates to approximately 30 to 60 seeds/ft^2. This rate is much lower than that needed for cool-season plantings because warm-season grasses are bunch-type plants which occupy more space per plant.
- Eastern gamagrass used for grazing should be planted as a single species because it can be difficult to manage in a mixed stand. Another excellent option for grazing and haying is a mixture of big bluestem, indiangrass, and switchgrass planted at seven to nine lbs PLS/acre.
- Plant diversity is the key for wildlife. A good mix of warm-season grasses is a combination of big bluestem, little bluestem, indiangrass, and switchgrass seeded at a rate of 5 to 12 lbs PLS/acre. Southern and midwestern states plant at a rate of five to seven lbs PLS/acre while in the Northeast a higher

rate of 10 to 12 lbs PLS/acre is used because of greater site and climatic variation. On high quality agricultural soils a lower seeding rate (particularly switchgrass) should be utilized to avoid developing stands that are too dense for optimum wildlife benefits. The switchgrass component on high quality sites should not exceed one lb PLS/acre. Legumes and wildflowers can be added to a seed mix at approximately one lb PLS/acre. Plant variety adds structural diversity and therefore a greater diversity of nesting and perching sites for wildlife. Plant diversity also ensures more stable seed production and increases insect populations.

Table 3. Suggested cultivars for the Northeast.

Species	Cultivar	Geographic Use Area
Big bluestem	Kaw	Southern VT/NH & south
	Niagra	All
Little bluestem	Aldous	NY & south
	Camper	NY & south
Salt meadow cordgrass	Avalon	VA to NH, coastal wetlands
Smooth cordgrass	Bayshore	VA to NH
Deertongue	Tioga	All
Eastern gamagrass	Pete	All
Sideoats gramma	El Reno	NY & south
	Trailway	Southern New England & north
Indiangrass	Cheyenne	VA & south
	Lometa	VA & south
	NE-54	NY & north
	Osage	Central PA & south
	Rumsey	VA & north
Sand lovegrass	Bend	Central VT, NH & south
	NE-27	NY & south
Coastal panicgrass	Atlantic	All
Switchgrass	Blackwell	NY & south
	Cave-In-Rock	NY & south
	Kanlow	Long Island & south
	NJ-50	PA & south
	Shelter	WV to southern NH
	Trailblazer	Central VT & north

Pre-planting preparation

Pre-planting preparation actually begins the year prior to seeding. Once a site has been selected and the proper seed mix has been determined, an evaluation of existing vegetation, mulch, nutrient deficiencies, and weed problems must be conducted. A heavy mulch layer hinders proper seed placement, maintains cooler soil temperatures that slow down germination, and serves as a source of high slug populations (within the northern portions of the region) that can destroy warm-season grass seedlings as they emerge the following spring. Tilling the soil or burning the site the year prior to planting can address these concerns.

On sites being converted from agricultural use, re-growth of grasses such as tall fescue, foxtails, crabgrass, and reed canary grass can crowd out emerging seedlings. Fields dominated by these grasses should be herbicided with Roundup® or another suitable product the fall prior to planting. If the vegetation is over two feet tall the field should be mowed prior to herbicide application.

Figure 5. On sites being converted from agricultural use, perennial grasses, which can crowd out emerging seedlings, can be treated with herbicide prior to planting. Photo by Paul Rothbart.

Planting preparation

Planting preparation considerations prior to seeding include planting date, seedbed conditions, weed control, seeding rate, and equipment. Dormant seedings are not recommended for warm-season grasses in the Northeast because of the probability of frost heaving, seed loss to feeding wildlife, and early spring competition from weeds.

- Optimum seeding dates throughout the Northeast are between mid-spring and early summer, typically May and June. Warm-season grasses require minimum air temperatures of 60 to 65 ° F and soil temperatures of 50 ° F. Later plantings may reduce weed and cool-season grass competition, while earlier plantings allow more time for stand establishment.
- Warm-season grass stands do not usually require fertilizer applications during establishment and if managed for wildlife may never require fertilization. If fertility levels are low due to cropping history or poor soil quality, potassium and phosphorus may be applied at the rate recommended according to soil test results. Nitrogen should not be applied during the establishment year because it will stimulate weed competition.
- Weed control prior to planting is essential for successful establishment of warm-season grasses. If weeds persist after pre-planting year treatments, a selective herbicide such as Plateau® can be applied during the spring. Other herbicide options include Banvel® or 2-4D, but these cannot be used if forbs or legumes are part of the seed mix. Note that Plateau® will suppress or retard switchgrass.
- Tilling is a non-chemical option for controlling weeds. Deep plowing and/or multiple diskings can be used to remove each new crop of emerging weeds up to the time of planting. Tilling should be

followed by soil compaction prior to seeding. A drawback of tilling is that the soil disturbance results in the germination of weed seeds that had laid dormant in the soil.

- A combination of herbicides and tilling is probably the most effective means of controlling weeds. This involves tilling the soil, allowing weed seeds to germinate over a period of 7 to 14 days, applying Roundup® to the newly germinated weeds, and planting a few days later.
- Seedbeds must be firm for successful seeding. This helps to conserve moisture and ensures good seed-to-soil contact, which is critical for adequate germination. Recently tilled soil should be compacted with a roller packer or soil finisher prior to planting. A seedbed is properly prepared when a human footprint penetrates no more than 1/4 inch deep. If the soil is not properly compacted, seeds will be planted too deeply and adequate germination will not occur. Soil packing is not necessary in stubble fields because compaction is already adequate.

Planting equipment and practices

The equipment used to plant warm-season grasses should provide a uniform distribution of seeds planted at the proper depth and provide for good seed-to-soil contact. Seeds should be planted at a depth of 1/4 to 1/2 inch. Up to 25% of the seed should be visible in the drill rows on the soil surface to ensure that the seed is not planted too deeply. Seed of switchgrass, coastal panicgrass, and deertongue are small and hard and can be planted with a regular grain drill that has a legume box attached or a traditional broadcast seeder. Eastern gamagrass seed resembles corn seed and is best planted with a corn planter at a depth of one inch. Most of the seed mixes used for wildlife contain big bluestem, little bluestem and indiangrass, which are all light and fluffy. Poor seed distribution will occur if using traditional seeding equipment to plant seeds of these species because seeder tubes become plugged quickly. This can be overcome by adding a light rate of oats or an inert carrier such as cracked corn or pelletized lime to the warm-season seed mix. These carriers will help the fluffy seeds flow through seeder tubes properly.

A no-till drill, such as a Truax® or Great Plains® seeder, is the most effective means to plant fluffy warm-season grass seed. These drills are designed with multiple seed boxes to plant warm- and cool-season grasses, legumes, wildflowers and small grains. The warm-season box is divided into compartments each with an auger/agitator, picker wheels for feeding the seed into the seed cup and oversized drop holes to ensure proper seed disbursement. Optimum seed placement is achieved with double disc furrow openers, depth bands and independent press wheels. This equipment works well on prepared seedbeds, agricultural fields with residual cover and herbicide-treated sod. Heavy-duty versions of no-till seeders are needed for the latter two scenarios. Specialized broadcast seeders are also available for planting fluffy native seeds on prepared seedbeds and have the advantage of eliminating the artificial row effect that results from using no-till seeders. If broadcasting seed, be sure to roll or pack the soil after seeding to ensure good seed-to-soil contact.

Regardless of seeding equipment used, it must be calibrated prior to seeding. When seeding with a no-till drill, it is critical to routinely observe and clean the seeding tubes and furrow discs to assure proper seed distribution.

Figure 6. A no-till drill, such as a Truax® (pictured) or Great Plains® seeder, is the most effective means to plant fluffy warm-season grass seed. Photo by Paul Rothbart.

Post planting evaluation and management

Patience, patience, patience

A variety of methods can be used to successfully establish warm-season grasses. Success is never guaranteed. However, if the guidelines presented in this chapter are followed, failures should be rare. Evaluating stand development is very important and patience can be the key factor to a successful planting. Native grass seedlings spend most of their first year developing extensive root systems for the long haul. It is often difficult to find the thread-like leaves during the first growing season. Give the stand two full growing seasons before making a final determination as to its success or failure. If a field has one strong plant per square foot by the second growing season the stand is successful. A successful stand may take 2 to 3 years to become fully functional.

During the first two years and in particular the first growing season, weeds are the biggest concern because they may out-compete the warm-season grasses. A variety of techniques may be applied during this critical establishment period and thereafter, for long-term grassland maintenance.

- Mowing should be used to control weeds during the first summer. Every time weeds reach 18 inches in height they should be mowed back to six to eight inches. This mowing regime will reduce competition for sunlight and moisture and prevent unwanted species from producing seed. Mowing before the weeds are too tall will prevent thick mulch layers from developing that might smother the warm-season seedlings. Discontinue mowing or cut higher after mid-August to avoid cutting the warm-season grasses that are developing their root systems. If prescribed burning is not an option, then mowing or haying should be continued every three to five years for maintenance. Generally, clippings should be removed whenever possible since dense thatch can be detrimental to nesting grassland birds. However, some species including upland sandpiper, vesper sparrow, and Henslow's sparrow prefer thicker levels of thatch.
- Prescribed burning can help control many woody plants and cool-season grasses. Burning should not be conducted the first year after planting because damage to young plants may occur. Commence burning during years three or four and every two to five years thereafter. Burns should be conducted during late February through early April when native species are dormant, or new growth is less than two inches tall.
- Herbicides can be utilized to control weeds during and after the establishment period. Each herbicide controls or suppresses a range of weeds and differs in its effects on warm-season grasses. Selective spraying of weedy patches is one approach. Another is to use a selective herbicide such as Plateau® throughout an entire field. Plateau® will provide control of an array of annual and perennial grasses and broadleaf plants. Plateau® can be helpful in establishing big bluestem, little bluestem, and indiangrass but may inhibit or injure eastern gamagrass and switchgrass.
- Warm-season grasses are quite palatable and nutritious for livestock, but are subject to damage by excessive grazing pressure. Grazing for short time periods and/or on a rotational basis can be beneficial to the long-term productivity of a native grass stand. When grass has been taken down to a height of 10 to 12 inches, livestock should be removed to allow the grass to regrow. When the grasses have reached 24 inches grazing can be resumed. The final seasonal rotation should leave a minimum height of 12 inches so the plants have an adequate energy reserve to initiate strong re-growth the following spring.
- Warm-season grasses established for wildlife can be long lived with little or no soil enhancements required. Periodic soil samples will indicate soil amendment needs. Warm-season grasses and forbs that are cut for hay will need occasional phosphorus and potash fertilizer.
- Monitoring should be a component of all habitat projects. Unfortunately, these activities are traditionally under-funded and therefore rarely completed. Typical monitoring efforts should include annual bird and vegetation surveys that are reproducible at designated plots. At a minimum, data collected in vegetation surveys should include species present, percent cover, structural diversity, woody plant and cool-season grass encroachment and ground litter density. Photographs taken from the same location

and looking in the same direction, before and periodically after seeding is a quick and easy means of monitoring progress. Corrective measures should be taken as monitoring results dictate.

Figure 7. Patience is required when trying to establish a stand of warm-season grasses. Stands may require two years to become established. Photo by Paul Rothbart.

Warm-season grasses have unique characteristics that make them especially beneficial to grassland birds and a wide variety of other wildlife. These habitat benefits along with the ecological, aesthetic, and historical values have led to a renewed interest in the restoration of native grasslands. Fortunately, there are funding opportunities available through many government programs (i.e. Wildlife Habitat Incentives Program, Landowner Incentives Program, Conservation Reserve Program, Wetlands Reserve Program, Environmental Quality Incentives Program, and the U.S. Fish & Wildlife Partners Program) that will allow natural resource agencies, organizations, and private landowners to establish and/or enhance these critical but vanishing habitats. Technical assistance may be available through state wildlife agencies, Natural Resources Conservation Service, and U.S. Fish & Wildlife Service staff to work with landowners in evaluating, planning and conducting these valuable grassland projects (refer to chapter 12 for more information on potential funding opportunities and obtaining technical assistance).

When establishing a stand, remember to plant shallow, mow weed competition, and have patience. Stands may require two years to become established.

A multi-faceted approach is essential in dealing with grassland habitat loss (cool- and warm-season) and the associated breeding bird declines on a regional basis. This includes maintenance of existing grassland habitat, restoration of degraded grasslands, creation of new grasslands where feasible, outreach regarding grassland values and development of mutually beneficial agricultural-grassland wildlife operations, and development and continuation of monitoring and evaluating programs.

Suggested reading

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Biographies

Paul Rothbart is the District Operations/Habitat Program Supervisor for the Connecticut Department of Environmental Protection's Wildlife Division. Paul received his B.S. in Natural Resources Conservation from the University of Connecticut and his M.S. in Wildlife Science from Louisiana State University. Paul has been involved with habitat management activities including sage grouse habitat restoration, early-successional field enhancements, and wetlands management throughout his 25-year career. Paul enjoys developing cooperative partnerships essential to delivering habitat management practices both on state and private lands. Paul currently serves as the Northeast Upland Habitat Committee Chair.

Steve Capel grew up in Indiana and Illinois, and headed west for his undergraduate education at Utah State University. He then spent a couple of years working on waterfowl in North Dakota, while pursuing a Master's degree from the University of Missouri. After seven years as a Big Game Biologist in Kansas, he began 17 years as a Regional Wildlife Manager with Kansas Wildlife and Parks, dealing extensively with quail, pheasant and rabbit management, and managing early-successional habitats. He has spent the last 15 years in Virginia, supervising early-successional wildlife efforts, including a major bobwhite restoration initiative.