NBCI
National Bobwhite Conservation Initiative™

The Comprehensive Guide to Creating, Improving & Maintaining Bobwhite Habitat

GRASSLANDS

CROPLANDS

RANGELANDS

OAKS & MIXED HARDWOODS

MINELANDS

SOUTHERN PINE FORESTS

PASTURELANDS

As prepared by the National Bobwhite Technical Committee

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Abbreviations used in this document for photo sources

GADNR - Georgia Department of Natural Resources
IDNR - Iowa Department of Natural Resources
ILDNR - Illinois Department of Natural Resources
KDFWR - Kentucky Department of Fish and Wildlife Resources
MDC - Missouri Department of Conservation
NBCI - National Bobwhite Conservation Initiative
NGPC - Nebraska Game and Parks Commission
SCDNR - South Carolina Department of Natural Resources
TPWD - Texas Parks & Wildlife Department
VDGIF - Virginia Department of Game and Inland Fisheries
WHF – Wildlife Habitat Federation
WVDNR - West Virginia Department of Natural Resources

NBCI would like to thank all of the participating agencies and staff that graciously provided photos.

Habitat Management Practices that Benefit Bobwhites

Quail Management Practices for Cropland

Agricultural Lands *- Increase the amount and enhance the quality of nesting, brood-rearing, escape and roosting cover for bobwhites and other grassland wildlife on agricultural lands, through the establishment and/or management of native warm-season grasses, forbs and shrubs.*

Modern clean farming eliminates nesting and brood habitat–photo by Chuck Kowaleski TPWD

Problem:

Farming practices and agricultural land use have undergone significant changes over the past 40 years. Some changes are noticeable like larger crop fields; clean farming using herbicide tolerant crops; removal of hedgerows; conversion of woody draws to grassed waterways; and continuous corn and soybean rotations. Other changes have been subtle. Shrubby draws have grown up into forests, fescue, brome and Bermuda grass have invaded hedgerows and ditch banks, and idle fields are now farmed intensively or have grown up in trees. During certain times of the year, row crop fields may provide adequate food for quail; however, these same landscapes provide very little nesting and shrubby cover for bobwhites. During the winter, cover is limited to woody draws and idle areas. During extended periods of ice and snow cover, food and cover may be limiting factors in crop fields since the remaining waste grain is buried

under snow and ice. Poor habitat arrangement is a concern in large crop fields where nesting and shrubby cover are limited or completely lacking.

Solutions:

Increase the amount and enhance the quality of nesting, brood-rearing, and shrubby cover for bobwhites and other grassland wildlife on agricultural lands, through the establishment and/or management of native warm-season grasses, forbs and shrubs and renovation of hedgerows and woodland edges.

Habitat Enhancements:

Native grass/shrub buffers improves water quality/wildlife habitat - photo by Tim Kavan MDC

Field Borders and Buffers – The typical "hard" edge between crop fields and woodlands offer little habitat for quail. Establishing native grass and wildflower field borders and buffers or allowing the area to naturally revegetate in grasses and seedy plants provides excellent nesting and roosting cover for bobwhites.

Field borders should be at least 35 feet wide (fits criteria of many cost-share programs) and preferably 60 to 120 feet wide. Field borders and filter strips reduce soil erosion and trap sediment, pesticides and nutrients contained in agricultural fields. Popular Continuous CRP practices such as CP33 Habitat Buffers for Upland Birds offer economic incentives and annual soil rental rates for temporarily retiring field edges. CP21 Filter Strips and CP22 Riparian Buffer offer similar economic incentives and rental payments and can provide good cover for quail

when native grasses are planted in the buffer. Filter strips should be at least 35 feet wide and adjacent to low-growing woody cover.

Consider planting 2 or 3 rows of low-growing shrubs and adjacent native grass field borders on the outside edges of riparian buffers to improve quail habitat. Establishing contour buffer strips in crop fields through continuous CRP is an effective way to improve habitat arrangement for quail in intensive agriculture landscapes. Contour buffer strips should be 20 to 30 feet wide and established to native warm-season grasses, wildflowers and legumes. Where feasible, plant shrub thickets, or allow the development of native thickets, in or along the contour buffer strips to provide suitable protective cover.

Controlling undesirable vegetation before edge feathering – photos by Jef Hodges NBCI

Woody Draws and Small Woodlots – Hedgerows, woody drainages and small woodlots provide critical shrubby cover for quail. Over time, shrubby draws and fencerows have grown up into mature trees, often with an understory of sod forming grassing such as tall fescue, smooth brome or Bermuda grass. Cut down mature trees in woody fencerows, hedgerows and drainages to enhance native shrubs and low-growing woody cover. Spray around and underneath trees prior to cutting to remove sod forming grasses. This practice is also known as "edge feathering" or "chop and drop". Renovated edges should be at least 35 feet wide and 1,500 square feet in size. Periodically cut different areas to maintain quality low-growing woody cover. Small woodlots can be enhanced for bobwhite quail by edge feathering or conducting timber stand improvement in the interior. Combining field borders with enhanced woody draws and hedgerows provides excellent habitat arrangement for northern bobwhite.

Idle Fields and Corners – Many farms have small areas that are left undisturbed because they cannot be cropped, grazed or hayed efficiently. Idle areas can offer the right mix of nesting,

brood-rearing and shrubby cover for quail. Enhance these areas with periodic disturbances, controlling invasive plants and unwanted woody vegetation. Improve fallow areas by interseeding desirable native grasses, forbs and legumes after a disturbance.

Management Practices:

Native forb/grass response after fescue controlled by spraying – photo courtesy of IDNR

Establish Native Grasses and Wildflowers in Field Borders and Idle Areas – Establish native grasses, wildflowers, and legumes in field borders, buffers or idle areas to enhance nesting and brood-rearing cover for quail and other wildlife. Bunch grasses such as little bluestem, broomsedge and Indian grass can provide ideal habitat structure for quail in agricultural landscapes where this important cover type is lacking. Federal and state conservation programs and NGO grants may provide cost share and incentives for establishing native grasses and wildflowers.

Lighter seeding allows greater forb diversity – photo by Ben Robinson, KDFWR

Light seeding rates (3 to 5 PLS pounds of seed per acre) are preferred over traditional, heavy native grass seeding rates (8 to 12 PLS pounds of seed per acre). Lighter rates provide more room for native wildflowers, legumes and annual seedy plants such as ragweed and croton. Shorter native grasses such as little bluestem and broomsedge are preferred over taller native grasses such as big bluestem, Indian grass and switchgrass for a variety of reasons. "Shorter" native grasses and low seeding rates provide better habitat structure (the interspersion of nesting and brood-rearing cover together) and they may require less frequent disturbances from prescribed fire or strip disking than sites established with "taller" grasses at heavy seeding rates. Establishing a diverse mix of native wildflowers and/or legumes improves plant diversity, thereby attracting more insects and creating better habitat structure. Below are some suggested native grasses and wildflower seeding rates for Midwest field borders. Species and rates can vary a great deal across the bobwhite's range, so consult local experts on what is best in your area. Heavy seeding rates may be required on other buffer practices.

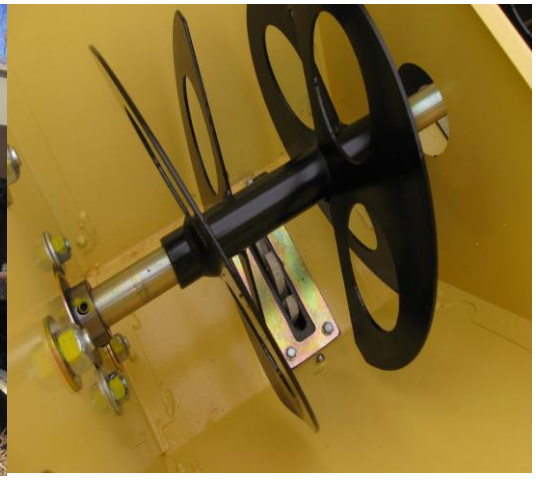
2.7 pls lb. Little Bluestem
1.4 pls lb. Sideoats Grama
3.0 pls lb. 10-Species native forbs/legumes
OR

2.7 pls lb. Little Bluestem
1.4 pls lb. Sideoats Grama
2.0 pls lb. Alfalfa or other cool season legume
3.0 pls lb. 10-Species native forbs/legumes

The key to establishing native grasses and wildflowers is to prepare a seedbed free of plant competition. Often multiple herbicide applications are necessary if sod forming grasses are present. If desirable native vegetation such as bunchgrasses and wildflowers are present consider managing the existing stand instead of establishing more native grasses. Remnant stands can be rescued by eradicating undesirable cool-season grasses with glyphosate in the fall after a killing frost or by applying selective herbicides during the growing season. Make sure to read and follow label directions when applying herbicides. It is difficult and expensive, if not impossible to salvage native vegetation on sites infested with exotic warm-season grasses.

Sprayed twice and burned before planting – photo by Andrew Rosenberger, VDGIF

Crop fields provide good planting conditions and will only require one herbicide application before planting native grasses and wildflowers. Land managers may want to consider farming sites for one or two years with herbicide-resistant crops to eradicate any unwanted vegetation and to reduce costs. This method is commonly used in the Midwest for prairie reconstruction projects where cool-season grass fields are farmed for one or two years and then established to a diverse mix of native grasses and wildflowers. This method will help lower overhead costs and is effective at controlling undesirable vegetation and depleting its seeds in the seedbank.



A special planter, often with multiple seed boxes and an agitator that allows the use of fluffy seeds, is needed for planting many native grasses and forbs – photos by Jef Hodges, NBCI

Native grasses and wildflowers may be established during the dormant season or spring. The light, fluffy seeds will require special seeding equipment or unique seeding methods such as the winter planting shown in **Scott James', Quail Forever photo** below to effectively distribute the seed across the field. Good results can be expected when seeds are broadcast or planted with a no-till drill if proper seedbed preparation and adequate rainfall occur. Newly established native grass and wildflower plantings should be periodically mowed to a height of 6 to 10 inches during the first year to reduce weed competition and promote their growth. Warning: Mowing should not be used as a long-term management practices as mowing does not create favorable habitat conditions and plant structure for quail. Selective herbicides can help reduce weed competition and thereby reduce stand establishment. Warning: Imazapyr can damage some native grasses and wildflowers. A good stand can be expected by the 2, 3 or 4 growing season depending on weed control measures, site conditions and climate.

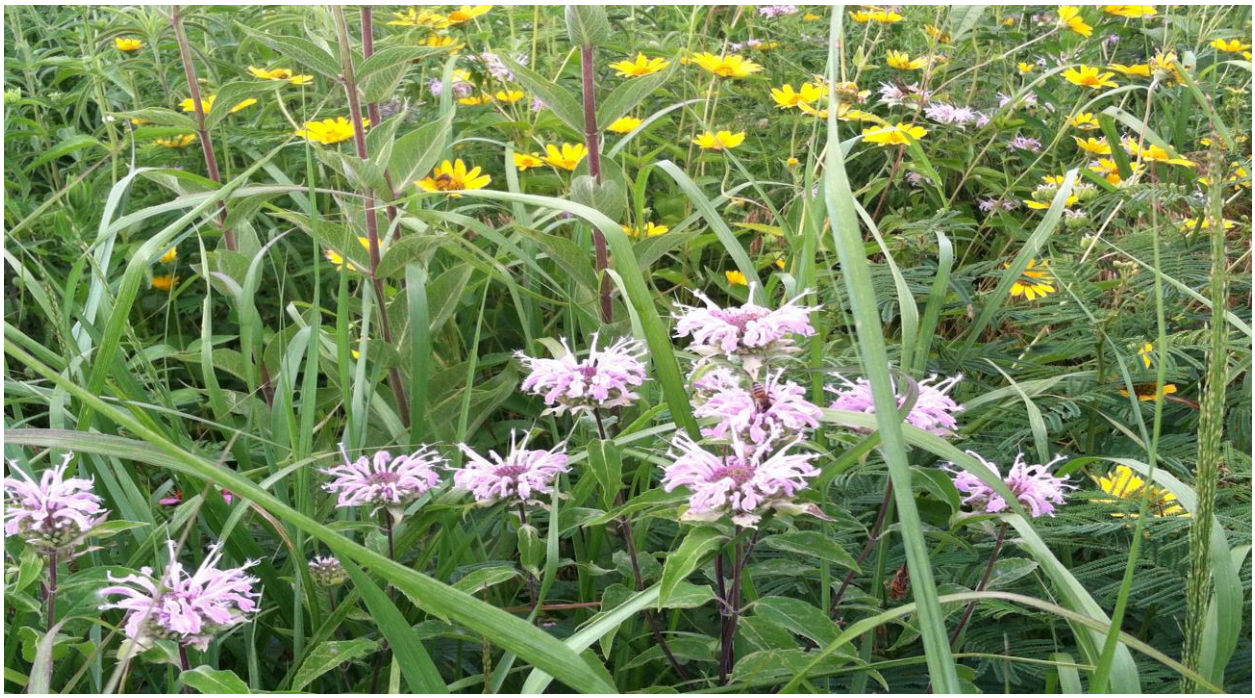
Midwest fallow wheat field with good food and cover for quail – photo by John Laux NGPC

Fallowing – Land managers should consider idling field edges or whole fields for one to five years to provide high quality cover. Fallowing fields is an effective and economical way to provide high quality cover at little or no cost. Idle field borders should be at least 30 feet wide and preferably 60 to 180 feet wide. In most cases idle areas should be allowed to revegetate in annual plants; however a light seeding of annual lespedeza or alfalfa can improve brood-rearing habitat. Land mangers interested in maximizing quail habitat should periodically fallow entire crop fields. Fallow field borders and crop fields should be periodically farmed to setback plant succession. To be more effective, fallow areas should be adjacent to shrubby cover.

Southeast fallow field with good annual plants overhead cover - photo by Billy Dukes SCDNR

Pollinator plantings have many benefits – top photo by Jef Hodges NBCI, bottom Chris McLeland, MDC

Pollinator Plantings – Planting combinations of grasses and flowering forbs can benefit both quail and crops by attracting pollinators and predatory insects. This practice can be cost shared through a variety of farm bill programs including continuous CRP, EQIP and CSP. It's important to protect pollinator plantings from pesticide applications that are applied to adjacent crop fields. Such plantings should be located between crop fields and other preferred cover and consist of combinations of plants whose flowering times are staggered throughout the year.



Unharvested corn is available for wildlife even after snowfall but provides little overhead cover - Photo by Stan McTaggart, ILDNR

Crop Field Management – Leftover grain, weed seeds and insects are food sources for quail in crop fields. In the summer no-till crop fields provide suitable brood-rearing cover while conventional tilled crop fields with heavy herbicide usage offer poor brood-rearing cover. Land managers should consider adopting no-till farming practices to improve habitat conditions. At the very least, consider using other conservation tillage practices and avoid fall tillage and plowing.

In the winter, waste grain and weed seeds on crop field edges are good food sources for quail. However, coveys feeding in small grain, corn or soybean fields are exposed to a variety of predators due to the lack of overhead cover. Generally, milo fields provide better feeding cover than other crop fields. During severe winter weather, especially deep snow or ice storms, waste grain may be unavailable for quail. Landowners interested in adopting quail-friendly practices should consider leaving four to eight rows of unharvested grain next to low-growing woody or grassy cover. Leave 1/4 to one acre of harvested grain on each 40 acres of crop field. If unharvested grain is left, consider idling these areas for one or two years to provide additional cover. When feasible, land managers should consider reducing herbicide usage on crop field edges to allow the growth of annuals.

Prescribed burning benefits odd corners of habitat – photo by Jef Hodges NBCI

Prescribed Burning – Should be used to maintain desired cover in field borders, buffers and idle corners. Prescribed burning helps stimulate quail-food plants and plant structure. As a general rule of thumb, no more than 1/3 of field borders or idle areas should be burned each year, especially in agricultural landscapes where nesting cover may be a limiting factor for quail. Depending on the vegetative cover field borders, buffers and idle areas may be burned any time of the year, with the exception of during the spring and early summer nesting season.

Spring burns help stimulate the growth of native grasses while suppressing the growth of cool-season grasses and woody vegetation. Spring burns are not recommended for rank stands of native grass unless additional management practices will be performed (i.e. strip disking or patch burn grazing). Summer and early fall prescribed burns are effective at setting back rank stands of native warm-season grass and excessive woody growth. Summer and early fall burns will also stimulate the growth of cool-season grasses. Warm-season grass fields infested with cool-season grasses should only be burned in the summer or fall if a follow up herbicide application to control cool-season grasses is planned. Winter burns help stimulate the growth of native forbs and legumes.

Fall strip disking encourages forb growth – photo by Josh Rusk, IDNR

Strip Disking (Wildlife Disking) – Fall or winter strip disking of planted or fallow field borders and idle corners creates a mosaic of disturbed and undisturbed areas. Once the field border is well established disturb 1/3 of the field border or idle areas each year. No more than 1/3 of the area should be disturbed annually since nesting cover is often a limiting factor in agricultural landscapes.

Wildlife disking reduces residue, creates bare ground, and promotes desirable broadleaf plants that produce seed and attract insects. To be effective, complete light disking in grassland habitats next to areas of useable shrubby cover. Disked strips should be 25 to 75 feet wide and separated from each other by an area of undisturbed vegetation twice as wide as the disked strip. Disking should occur with the contour of the field to reduce soil erosion. Disking may be completed in blocks instead of strips on relatively flat ground and in field borders where soil erosion is not a concern.

Disking should result in 30 to 70% bare soil. Late summer, fall, or winter disking tends to favor broadleaves such as ragweed and croton, while spring disking tends to favor less desirable annual grasses such as foxtail and crabgrass. The disked areas will produce succulent forbs and legumes, which attract insects and produce abundant seed, while the adjacent undisked areas

will provide nesting and roosting cover. Some programs require disking only during specified dates.

Herbicide Applications – Herbicides can be applied to rank stands of native grass to promote desirable forbs and legumes and to improve habitat structure. Selective or non-selective herbicides should be applied at labeled rates. Herbicide applications can be applied in strips 25 to 75 feet wide. Generally, no more than 1/3 of the area should be treated annually. Herbicide applications are most effective when combined with other management practices such as prescribed burning, strip disking and/or interseeding.

Interseeding used to increase forbs in a native grass stand – photo by John Laux, NGPC

Interseeding – In established field borders and buffers interseed native wildflowers (5 to 20 species mix) and/or legumes such as alfalfa, partridge pea and annual lespedeza to improve plant diversity. Native wildflowers and desirable legumes provide ideal brood-rearing cover and excellent food sources. Best success occurs immediately after a disturbance such as prescribed burning, strip disking, managed grazing or herbicide application. Native wildflowers and legumes can be seeded by broadcast methods or with a no-till drill. Native wildflowers should be planted at the rate of 1 to 5 PLS pounds per acres and dormant seedings are preferred over spring seedings. Legumes should be seeded at the rate of 1 to 3 PLS pounds per acre.

Invasive Plant Control – Sod forming grass and exotic vegetation such as sericea lespedeza, kudzu and Japanese honeysuckle and stilt grass should be controlled with appropriate herbicides or management techniques. Invasive plants crowd out important quail friendly

plants, negatively impacting habitat structure. Infested sites should be annually checked for new stands of unwanted plants. If left uncheck, invasive cool- and warm-season grasses can quickly overtake native grass field borders and buffers. Invasive grasses often move into field borders and buffers from adjacent fencerows and hedgerows. Invasive grasses can easily be controlled in these areas with a well-timed herbicide application.

Buffers infested with cool-season grasses can easily be improved by a well-timed fall or early spring herbicide application. Buffers infested with invasive warm-season grasses can only be improved for quail by eradicating all existing vegetation, including native grasses and wildflowers. Native grasses and wildflowers can be reestablished once the invasive vegetation has been eradicated. To prevent future reinfestations, land managers are encouraged to spray areas adjacent to the field border and underneath trees and shrubs. Use of a boomless sprayer is an effective way to target invasives in these areas.

Flame leaf sumac thickets make great escape/loafing cover – photo by Chuck Kowaleski, TPWD

Shrubby Cover Enhancement – Improve shrubby cover by edge feathering woody draws and fencerows, renovating hedgerows, or establishing woody corridors in areas where this important cover is lacking. Winter coveys will often establish a headquarters area and loafing site around one or more shrub or low-growing woody cover sites. Patches of shrubby or woody

cover should be at least 30 to 50 feet wide and spaced 20 to 100 yards apart. Where quail habitat is the primary objective, crop fields wider than 100 yards should be divided with tree or shrub corridors for maximum bobwhite benefits. Shrub rows should be at least 10 to 30 yards wide. Native shrubs such as wild plum, sumac, shrub dogwood, blackberry and hazelnut make excellent shrubby cover for bobwhites.

Edge feathering a field – photo courtesy of IDNR

Edge feathering is used to create woody escape cover along woodland edges, existing tree lines, woody draws, and hedgerows. This creates a transition zone of shrubs, vines, and herbaceous vegetation between cropland or grassland and wooded area. To be effective, edge feathering should be completed next to early successional vegetation such as managed wildlife friendly grasses/legumes, field borders, food plots or cropland. As a rule of thumb, cutback borders should be at least 30 to 50 feet deep into the wooded area and at least 1,500 feet in size. Edge feathering may be completed in blocks or in long linear strips along the field edge. Kill existing grass/vegetation (regardless of type) before edge feathering with an approved herbicide. This provides good growing conditions for annual food plants and shrubs. All trees over 15 feet tall in the area should be felled, making sure native shrubs are left undisturbed. An occasional tree may be left to preserve valuable timber or mast producing species. Generally,

treat all cut stumps with an approved herbicide to prolong the benefits of edge feathering. If possible, leave felled trees where they fall. Edge feathered trees may be dropped parallel to the fence line/field edge or cut and loosely stacked along the edge of the field. Do not push the downed trees into a dense brush pile. Edge feathering may be completed with a chainsaw or mechanical clipper.

Planting a native shrub thicket – photo by Jef Hodges NBCI

Native shrub thickets can be established from seed, bare root or container grown plants. In all cases, preparing the site by eradicating all existing vegetation is critical. Land managers should maintain adequate weed control for 2 to 5 years after planting, or until shrubs are well established. Newly planted shrub thickets can be enhanced by adding large, downed trees. The cut trees provide suitable protective cover until the shrubs are well established.

Existing shrub coverts can be enhanced by protecting small patches from prescribed fire and other disturbances for several years or until well-established, by controlling sod-forming grass such as fescue or brome underneath and around coverts, and by cutting down overstory trees.

Quail Management Practices for Pastureland

Pastureland *– Increase the amount and enhance the quality of nesting, brood-rearing, and shrubby cover for bobwhites and other grassland wildlife on pasture by establishing native warm-season grasses, forbs and shrubs and renovating woodland edges. Modify haying and grazing to improving nesting and brood-rearing cover and improve native plant communities beneficial to bobwhites.*

Problem:

Pastures and hay fields established to "tame" grasses such as tall fescue, smooth brome, Bermuda grass, and bahia grass provide extremely poor habitat for quail because these forages do not provide adequate structure for nesting and brood-rearing. Current intensive grazing systems using monocultures of introduced grass do not provide adequate nesting cover, plant diversity and bare ground for brood cover. –In addition, most intensive grazing systems are grazed too frequently or at too high stock density for a hen quail to nest, lay 12-15 eggs, and incubate them for 21-23 days without either being trampled by livestock or having all the cover removed. Another common problem is nesting cover may not be located near brooding cover – if successful, a quail may have nowhere to take a young brood after they hatch (consider what biologists learned from the radio collared quail and the fact that a day old quail chick is no bigger than a quarter). -Continuous, severely grazed pastures normally will not provide nesting or brooding cover for quail. –Introduced sod forming grasses also become too dense when rested to allow movement by quail chicks and their lack of diversity provides little in the way of the weed seeds and insects that the chicks need.

Frequently harvested fescue hay pasture - photo by Marc Puckett, VDGIF

Many cool- and warm-season grass and legume hay fields are also cut during the peak of the quail nesting and brood-rearing season (June through August), resulting in lost nests, young and

adult birds. -Intensively grazed or hayed pastures do not provide adequate winter habitat for bobwhites.

Solutions:

Increase the amount of native grass and wildlife-friendly forbs and legume plantings in pastures and hayfields to provide adequate nesting and brood-rearing cover. Delay or modify haying and grazing practices to allow adequate time for nesting and brood-rearing. Enhance shrubby cover and woodland edges for bobwhites.

Brushy draws in pastureland settings provide needed cover – photo courtesy of IDNR

Habitat Enhancements:

Woody Draws and Small Woodlots – Hedgerows, woody drainages and small woodlots provide critical shrubby cover for quail. Overtime, shrubby draws and fencerows have grown up into mature trees with an understory of sod forming grassing such as tall fescue, smooth brome or Bermuda grass. Cut down mature trees in woody fencerows, hedgerows and drainages to enhance native shrubs and low-growing woody cover. Spray around and underneath trees prior to cutting to remove sod forming grasses. This practice is also known as “edge feathering” or “chop and drop”. Renovated edges should be at least 30 feet wide and 1,500 square feet in size. Periodically cut different areas to maintain quality low-growing woody cover. Small woodlots can be enhanced for bobwhite quail by edge feathering or conducting timber stand improvement in the interior. Exclude livestock from continuous grazing woody draws,

hedgerows and woodlots to provide critical habitat for quail and other wildlife. Along streams and eligible bodies of water, land managers should take advantage of continuous CRP marginal pastureland practices such as CP22 Riparian Forest Buffer and CP29 Marginal Pastureland Wildlife Habitat Buffer to establish favorable nesting and brooding cover.

Landowner often willing to restore native habitat in odd corners – photos by Aimee Coy, MDC

Idle Fields and Corners – Many farms have small areas that are left undisturbed because they cannot be grazed or hayed efficiently. Idle areas can offer the right mix of nesting, brood-rearing and shrubby cover for quail. Enhance these areas with periodic disturbances, controlling invasive plants and unwanted woody vegetation. Improve fallow areas by interseeding desirable native grasses, forbs and legumes after a disturbance. Along streams and eligible bodies of water, land managers should take advantage of continuous CRP marginal pastureland practices such as CP22 Riparian Forest Buffer and CP29 Marginal Pastureland Wildlife Habitat Buffer to establish favorable nesting and brooding cover.

Management Practices:

Conversion – Improve pasture diversity and quail habitat by converting exotic cool-season grass (tall fescue, orchard grass and smooth brome) and introduced warm-season grass (Bermuda grass or bahia grass) pastures to native warm-season grasses, wildflowers and legumes. Native warm-season grass pastures provide quality summer forage for livestock and if grazed properly, provide good nesting cover for quail and grassland birds.

Spraying introduced grass pasture prior to reseeding with natives – photo by Jef Hodges, NBCI

The key to establishing native grasses and wildflowers is to prepare a seedbed free of plant competition. Often multiple herbicide applications are in necessary if sod forming grasses are present. Specialty herbicides such as Imazapyr or Imazapic (when used in combination with glyphosate) are effective at controlling unwanted vegetation. Land managers may want to consider farming sites for one or two years with glyphosate-resistant crops to eradicate any unwanted vegetation and to reduce costs. This method is commonly used in the Midwest for prairie reconstruction projects, with excellent results.

Native grasses and wildflowers may be established during the dormant season or spring. When planting for grazing it may be preferred to plant during the spring, after soil temperature reaches 65˚F but early enough to take advantage of spring rains for quicker establishment time. The light, fluffy seeds will require special seeding equipment or unique seeding methods to effectively distribute the seed across the field. The best results can be expected when seeds are planted with a properly calibrated no-till drill. New native grass plantings should be periodically mowed and excluded from grazing during the first year of establishment to reduce weed competition and promote the growth of native grasses and wildflowers. Mow new plants to a height of 6 to 10 inches. Warning: Mowing should not be used as a long-term management practices as mowing does not create favorable habitat conditions and plant structure for quail. Land managers should consider using a selective herbicide such as Imazapyr or Imazapic to help reduce weed competition and improve stand establishment. Warning: Imazapyr can damage some native grasses and wildflowers. A good stand can be expected by the 2, 3 or 4 growing season depending on rainfall, weed control measures, site conditions and climate. Under ideal

circumstances; proper seedbed preparation, quality seed, proper planting depth, weed control and beneficial weather, native grasses can become established in one growing season. Despite good growth the first growing season, native grasses should not be hayed or grazed during Year 1, unless to achieve a very specific management objective (weed control). If they are grazed it should only be under very controlled circumstances with no more than 50% of their leaf surface area being removed. It is important during the first two growing seasons that native grasses not be over stressed by removing too much leaf surface area during the growing season, since during this time roots are developing. Roots will be fully developed by the end of the second or third growing season and normal use is acceptable at that time.

Using native buffers near woods reduce competition with crops – photo by Tim Kavan, MDC

Native grasses and wildflowers should be established in idle areas and in buffers along streams and wooded edges. If possible, light seeding rates (3 to 5 PLS pounds of seed per acre) are preferred over traditional, heavy native grasses seeding rates (8 to 12 PLS pounds of seed per acre). Higher rates of 6 – 8 PLS pounds of seed per acre are acceptable for grasses that will be grazed. Lighter rates provide more room for native wildflowers, legumes and early successional plants such as ragweed and croton. Shorter native grasses such as little bluestem and broomsedge are preferred over taller native grasses such as big bluestem, Indian grass and switchgrass for a variety of reasons. “Shorter” native grasses and low seeding rates provide better habitat structure (the interspersion of nesting and brood-rearing cover together) and they may require less frequent disturbances from prescribed fire or grazing than sites established with “taller” grasses at heavy seeding rates. Taller grasses will work if grazed properly. Establishing a diverse mix of native wildflowers and/or legumes improves plant diversity, thereby attracting more insects, including pollinators and other beneficial insects, and

creating better habitat structure. Heavy seeding rates may be required on other buffer practices, especially those used for nutrient or sediment control.

If desirable native vegetation such as native grasses and wildflowers are present consider managing the existing stand instead of establishing more native grasses. Remnant stands can be rescued by eradicating undesirable cool-season grasses in the fall after a killing frost or by applying selective herbicides such as Imazapyr or Imazapic on introduced warm season grasses during the growing season. Make sure to read and follow label directions when applying herbicides. It is difficult and expensive, if not impossible to salvage native vegetation on many sites infested with exotic warm-season grasses.

Using prescribed burning to maintain a field border - Photo by Jef Hodges NBCI

Prescribed Burning – Should be used to maintain desired cover in field borders, buffers and idle corners. Prescribed burning helps stimulate quail-food plants and improve plant structure. As a general rule of thumb, late winter or spring prescribed burns are used to enhance native grass production and to suppress undesirable woody vegetation. Winter burns help stimulate the growth of native forbs and legumes. Land managers should pay close attention to maintaining areas of grass cover at least 8 inches tall for nesting and brood-rearing cover. Undisturbed areas should be at least 1 to 5 acres in size depending on surrounding habitat structure and quality.

Proper grazing provides the bare ground needed for quail to move around while retaining diversity and overhead cover – photo by Chuck Kowaleski TPWD

Managed Grazing and Haying – Managed grazing for quail often requires diligent work and oversight by the land manager. Care should be taken to minimize grazing activities during the nesting season and to maintain adequate vegetation heights for nesting, brooding and roosting cover. Land managers should pay close attention to vegetative responses from grazing and the impact to critical shrubby cover.

Applied properly, grazing can create and maintain quality quail habitat, which includes the interspersion of nesting, brooding and shrubby cover. Ideally, a pasture should be left undisturbed from grazing or haying activities for a minimum of 60 days during the nesting season to provide adequate nesting structure and time for a hen to initiate and hatch a nest.

Rotational grazing, patch burn grazing or lower than normal stocking rates during the nesting season in a continuous system are other techniques that can be used to minimize impacts on nesting quail.

In hay pastures consider delaying harvest until 30 days after average peak hatching date to avoid destroying quail nests and young birds. Land managers interested in enhancing quail

numbers should refrain from haying corners and odd areas, or leave a 30 to 120 foot wide unharvested border around the edge of the field.

Stubble heights following removal by haying or grazing should be no less than 8 to 12 inches for native warm season grasses. Once the grasses are grazed to that height the cattle should be removed. Hay harvesting equipment will need to be modified to keep cutter blades that high above ground.

Another effective grazing technique is high intensity/low frequency stocking. Under this managed grazing system, animals are stocked at such a high density that nearly all the vegetation is grazed in the paddock. With this system livestock are constantly moved and may only graze a paddock 1 or 2 times per year. The results are a mix of grazed and ungrazed paddocks that provide adequate forage for livestock. The rested paddocks provide good nesting cover and after a couple weeks the heavily grazed paddocks are a mix of new grass growth, forbs, and legumes that provide good brooding cover. Because each paddock is only a few acres in size there is always a good mix of nesting cover (rested paddocks) adjacent to good brooding cover (recovering paddocks).

Patch Burn Grazing creates a diverse pattern of vegetation; irregular burns would allow even more diversity by creating additional edges – photo by Jef Hodges NBCI

Patch Burn Grazing – Is the application of prescribed fire to focus livestock grazing on a portion of a single grazing unit where the objective is to increase the diversity and structure of the vegetation in a way to benefit wildlife and maintain livestock production. Patch burn grazing is a

grassland management practice for landowners primarily interested in improving habitat for wildlife while still maintaining cattle production on their land. This management practice creates a mosaic of heavily grazed and lightly grazed areas that provide a diverse vegetative structure and increase plant diversity in the same grazing unit. Instead of depending on interior fencing to focus grazing in a portion of a unit, a manager instead uses post-fire re-growth to attract cattle to selected areas. At the same time, other portions of the unit remain open to grazing but are underutilized, thereby allowing plants to rest while root reserves build-up.

Interseeding with legumes like partridge pea benefits quail – photo by Chuck Kowaleski TPWD

Interseeding – Consider interseeding native wildflowers (5 to 20 species mix) and/or legumes such as alfalfa, partridge pea and annual lespedeza into native pastures to improve plant diversity. Legumes such as annual lespedeza, alfalfa and red clover can be interseeding into cool-season grass pastures. However, benefits for quail will be marginal if adequate nesting and brood-rearing cover are not maintained.

Native wildflowers and desirable legumes provide ideal brood-rearing cover and excellent food sources. Best success occurs immediately after a disturbance such as prescribed burning or managed grazing. Native wildflowers and legumes can be seeded by broadcast methods or with a no-till drill. Native wildflowers should be planted at the rate of 1 to 5 PLS pounds per

acres and dormant seedings are preferred over spring seedings. Legumes should be seeded at the rate of 1 to 5 PLS pounds per acre.

Livestock Exclusion – Protect idle areas, woodlots, woody draws and food patches from heavy or continuous livestock grazing. Allowing desirable native grasses, forbs and shrubs to develop can provide good nesting, brood-rearing and protective loafing cover along the edges of pastures and hayfields.

Site invaded by reed canary grass – photo by Keith Krantz, WVDNR

Invasive Plant Control – Sod forming grass and exotic vegetation such as sericea lespedeza, kudzu, knapweed, reed canary grass and others should be controlled with appropriate herbicides or other management techniques. Invasive plants crowd out quality forage and important quail friendly plants, negatively impacting habitat structure and pasture productivity. Infested sites should be annually checked for new stands of unwanted plants. If left uncheck, invasive cool- and warm-season grasses can quickly overtake pastures. Invasive grasses often move into field borders and buffers from adjacent fencerows and hedgerows. Invasive grasses can easily be controlled in these areas with a well-timed herbicide application.

Invasive plants in pastures can be controlled with well-timed herbicide applications, mowing and/or grazing. Native grass pastures infested with exotic warm-season grasses can only be

improved for by eradicating all existing vegetation, including native grasses and wildflowers. Native grasses and wildflowers can be reestablished once the invasive vegetation has been eradicated. To prevent future reinfestations, land managers are encouraged to spray areas adjacent to the field border and underneath trees and shrubs. Use of a boomless sprayer is an effective way to target invasives in these areas.

Previous year's food plot with excellent brood habitat – photo by Stan McTaggart ILDNR

Food Plots and Patches – Provides high-energy food to help quail survive during severe winter weather. Weedy food plots provide excellent brooding and loafing cover for young quail during the summer months. Establishing food plots or patches generally does not produce more quail on a property. Land managers often overemphasize the importance of food plots while overlooking other management needs. Generally, a quarter acre food plot or patch planted to corn, milo, millet, forage sorghum, soybeans, cowpeas or other grains is sufficient on each 40 acres of habitat. Consider rotating food strips across the area each year by leaving half of each plot idle and planting the other half. The idle area provides excellent brooding cover. Food plots in pasture settings or in areas with a high deer or feral hog populations must be fenced from livestock and are best suited on the edges of fields in marginally productive areas. Food plots are most effective when established adjacent to protective woody cover and diverse grass and wildflower stands.

Shrubby Cover Enhancement – Winter coveys will often establish a headquarters area and loafing site around one or more shrub or low-growing woody cover sites. Patches of shrubby or woody cover should be spaced 50 to 100 yards apart and at least 30 to 50 feet wide. Native shrubs such as wild plum, shrub dogwood, blackberry and hazelnut make excellent shrubby cover. Shrubby cover should be fenced from livestock to avoid degrading this important cover type. Land managers should take advantage of continuous CRP marginal pastureland practices such as CP22 Riparian Forest Buffer and CP29 Marginal Pastureland Wildlife Habitat Buffer to establish favorable shrubby cover patches.

Edge feathering next to a disked area increases benefits – photo by Josh Rusk, IDNR

Edge feathering is a technique that creates a transition zone of shrubs, vines, and herbaceous vegetation between cropland or grassland and wooded areas that provides additional low woody brood and escape cover for bobwhites. To be effective, edge feathering should be completed next to early successional vegetation such as managed wildlife friendly grasses/legumes, field borders, food plots or cropland. As a rule of thumb, edge feathering can extend at least 30 to 50 feet deep into the wooded area and at least 1,500 feet in length. Edge feathering may be completed in blocks or in long linear strips along the field edge. Kill existing grass (regardless of type) with an approved herbicide before edge feathering. This provides good growing conditions for annual food plants and shrubs. All trees over 15 feet tall in the area should be felled, making sure native shrubs are left undisturbed. An occasional tree may be left to preserve valuable timber or mast producing species. Generally, treat all cut stumps with an approved herbicide to prolong the benefits of edge feathering. If possible, leave felled trees where they fall. Edge feathered trees may be dropped parallel to the fence line/field edge

or cut and loosely stacked along the edge of the field. Do not push the downed trees into a dense brush pile. Edge feathering may be completed with a chainsaw or mechanical clipper.

Native shrub planting in a recently farmed field – photo by Chuck Kowaleski, TPWD

Native shrub thickets can be established from seed, bare root or container grown plants. In all cases, preparing the site by eradicating all existing vegetation is critical. Land managers should maintain adequate weed control for 2 to 5 years after planting, or until shrubs are well established. Newly planted shrub thickets can be enhanced by adding large, downed trees. The cut trees provide suitable protective cover until the shrubs are well established.

Existing clumps of shrubs can be enhanced by protecting small patches from prescribed fire and other disturbances for several years or until well-established, by controlling sod-forming grass such as fescue or brome underneath and around these groups of shrubs and by cutting overstory trees.

Quail Management Practices for Grassland (including CRP grasslands)

Grasslands *– Preserve and enhance the quality of grassland by utilizing vegetation establishment and management practices that favor the retention and improvement of CRP and other grasslands beneficial to bobwhites and other wildlife. Establish and enhance beneficial shrubby cover or renovate woodland edges.*

Problem:

Monoculture fescue field provides no food or brood cover– photo by Keith Krantz, WVDNR

Both cool- and warm-season grasslands can provide excellent habitat for quail and grassland birds; however, if left undisturbed these fields become too dense for quail. Dense, rank stands of cool-season grass or planted native warm-season grass crowd out desirable native forbs and legumes and eliminate most brood-rearing cover. The Conservation Reserve Program has successfully resulted in millions of acres of planted introduced cool-season grass and native warm-season grasslands that help reduce soil erosion improve air and water quality and enhance wildlife habitat. During the first few years after establishment, these fields provide ideal cover for quail and grassland birds. However, with a lack of disturbance, these fields grow too dense and rank for quail and most grassland birds. In many cases shrubby cover is lacking or is limited to the edge of CRP grasslands.

Solutions:

Increase the amount and enhance the quality of nesting, brood-rearing, and roosting cover for bobwhites and other grassland wildlife on grassland fields, through the conversion of cool-season grass fields to diverse native grass and forb seedings at wildlife friendly seeding rates. Increase and enhance beneficial disturbances such as prescribed burning, strip disking, managed grazing and herbicide applications to maintain quality nesting and brood-rearing cover for bobwhites and grassland birds. Establish and/or enhance shrubby cover in landscapes where this cover is lacking.

Habitat Enhancements:

Cut down mature trees in woody fencerows to enhance cover – photo by Jef Hodges NBCI

Woody Draws and Small Woodlots – Hedgerows, woody drainages and small woodlots provide critical shrubby cover for quail. Over time, shrubby draws and fencerows have grown up into mature trees with an understory of sod forming grassing such as tall fescue, smooth brome or Bermuda grass. Cut down mature trees in woody fencerows, hedgerows and drainages to enhance native shrubs and low-growing woody cover. Spray around and underneath trees prior to cutting to remove sod forming grasses. This practice is also known as “edge feathering” or “chop and drop”. Renovated edges should be at least 30 feet wide and 1,500 square feet in

size. Periodically cut different areas to maintain quality low-growing woody cover. Small woodlots can be enhanced for bobwhite quail by edge feathering or conducting timber stand improvement in the interior. Exclude livestock from woody draws, hedgerows and woodlots to provide critical habitat for quail and other wildlife. Along streams and eligible bodies of water, land managers should take advantage of continuous CRP marginal pastureland practices such as CP22 Riparian Forest Buffer and CP29 Marginal Pastureland Wildlife Habitat Buffer to establish favorable nesting and brooding cover.

Native Remnant Prairie and Savanna – Throughout the Midwest, remnant prairies can still be found. Remnant oak savanna is extremely rare since most have been converted to crop fields, pastureland or have been invaded by woody vegetation. These small native grasslands can support over 300 plant species. As a rule of thumb, plant diversity is higher on larger prairie tracts than smaller remnants. Many remnant prairies are used to graze livestock, produce high quality hay forage or occur in railroad or highway right-of-ways. Land managers fortunate enough to have remnant prairie tracts should manage these grasslands for long-term sustainability with an emphasis on grassland wildlife. Invasive plants such as knapweed and sericea lespedeza and woody encroachment by "weedy" trees are a constant threat on small remnant prairie tracts. Land managers with an interest in improving quail habitat should consider modifying haying and grazing regimes to maintain suitable nesting and brood-rearing cover. Prescribed burning is an essential management tool on prairie remnants for maintaining floristic diversity and setting back woody vegetation. Land managers should consider enrolling prairie remnants in the Agricultural Lands Easement Program (ALE).

Management Practices:

Establish Native Grasses, Wildflowers and Legumes on Grasslands – Establish native grasses, wildflowers, and legumes in grasslands to enhance nesting and brood-rearing cover for quail and other wildlife. Bunch grasses such as little bluestem, broomsedge and Indian grass can provide ideal habitat structure for quail.

Light seeding rates (3 to 5 PLS (Pure Live Seed) pounds of seed per acre) are preferred over traditional, heavy native grasses seeding rates (8 to 12 PLS pounds of seed per acre). Lighter rates provide more room for native wildflowers, legumes and annual seed producing plants such as ragweed and croton. Shorter native grasses such as little bluestem and broomsedge are preferred over taller native grasses such as big bluestem, Indian grass and switchgrass for a variety of reasons. "Shorter" native grasses and at low seeding rates provide better habitat structure (the interspersion of nesting and brood-rearing cover together) and they may require less frequent disturbances from prescribed fire or strip disking than sites established with "taller" grasses at heavy seeding rates. Establishing a diverse mix of native wildflowers and/or

legumes improves plant diversity, thereby attracting more insects and creates better habitat structure. Below are some suggested native grasses and wildflower seeding rates for Midwest field borders.

2.7 pls lb. Little Bluestem
1.4 pls lb. Sideoats Grama
3.0 pls lb. 10-Species native forbs/legumes
OR
2.7 pls lb. Little Bluestem
1.4 pls lb. Sideoats Grama
2.0 pls lb. Alfalfa
3.0 pls lb. 10-Species native forbs/legumes

Replace introduced grasses with native grass and forb mix – photo by Jef Hodges, NBCI

Conversion or Controlling Invasive Grasses and Vegetation

The key to establishing native grasses and wildflowers is to prepare a seedbed free of plant competition. Often multiple herbicide applications are necessary if sod forming grasses are present. Specialty herbicides such as Imazapyr or Imazapic (when used in combination with glyphosate) are effective at controlling unwanted vegetation such as tall fescue or Bermuda grass. If desirable native vegetation such as broomsedge and wildflowers are present consider

managing the existing stand instead of establishing more native grasses. These can be accomplished by eradicating undesirable cool-season grasses in the fall after a killing frost with glyphosate or by applying selective herbicides such as Imazapyr or Imazapic during the growing season. It is difficult, if not impossible to salvage native vegetation on sites infested with exotic warm-season grasses.

Land managers may want to consider farming sites for one or two years with glyphosate-resistant crops to eradicate any unwanted vegetation and to reduce costs. This method is commonly used in the Midwest for prairie reconstruction projects where cool-season grass fields are farmed for one or two years and then established to a diverse mix of native grasses and wildflowers. This method will help lower overhead costs and is effective at controlling undesirable vegetation.

Native grasses and wildflowers may be established during the dormant season or spring. The light, fluffy seeds will require special seeding equipment or unique seeding methods to effectively distribute the seed across the field. Good results can be expected when seeds are broadcast or planted with a no-till drill. Newly established native grass and wildflower plantings should be periodically mowed to a height of 6 to 10 inches during the first year of establishment to reduce weed competition and promote the growth of native grasses and wildflowers. Warning: Mowing should not be used as a long-term management practices as mowing does not create favorable habitat conditions and plant structure for quail. Selective herbicides such as Imazapyr or Imazapic help reduce weed competition and thereby reduce stand establishment. Warning: Imazapyr or Imazapic can damage some native grasses and wildflowers. A good stand can be expected by the 2, 3 or 4 growing season depending on weed control measures, site conditions and climate.

Prescribed Burning – Burning should be used to maintain desired cover in native grasslands and CRP fields. Depending on climate, productivity and species composition, grasslands should be periodically burned every 2 to 5 years to maintain good nesting and brooding cover. For example, grasslands in the southeast United States are burned every one or two years for optimal habitat conditions, while Midwest grasslands are burned every two to four years. Grasslands in the southern Great Plains might only need to be burned every three to six years.

As a general rule of thumb, no more than 1/3 of grass field should be burned each year, especially in landscapes where nesting cover may be a limiting factor for quail. Care should be taken to leave desired nesting cover each year. Generally, prescribed burn units should be less than 20 acres in size; however, good quail habitat can be maintained in larger burn units (80 acres or larger) if undisturbed upland sites (1 to 5 acres in size) are maintained throughout the burn unit. Ideally, 25 to 50% of the site should provide quality nesting cover.

Depending on the vegetative cover native grasslands and CRP fields may be burned any time of the year, with the exception of during the spring and early summer nesting season. Land managers should apply fire to the landscape at different times of the year so that portions of fields and grasslands provide suitable cover throughout the year. Excessive burning all at once can negatively impact quail.

Spring burning can increase usable habitat – photo by Andy Rosenberger, VDGIF

Spring burns help stimulate the growth of native grasses while suppressing the growth of cool-season grasses and woody vegetation. Spring burns are not recommended for rank stands of native grass, unless additional management practices will be performed (i.e. strip disking or patch burn grazing). Summer and early fall prescribed burns are effective at setting back rank stands of native warm-season grass and excessive woody growth, while promoting the growth of desirable forbs and legumes. Summer and early fall burns will also stimulate the growth of cool-season grasses. Warm-season grass fields infested with cool-season grasses should only be burned in the summer or fall if a follow up herbicide application to control cool-grasses is planned. Winter burns help stimulate the growth of native forbs and legumes.

Strip Disking (Wildlife Disking) – Fall or winter strip disking of planted grassland creates a mosaic of disturbed and undisturbed areas. Once the grassland is well established, disturb 1/3 of the field or idle areas each year. No more than 1/3 of the area should be disturbed annually

since nesting cover is often a limiting factor in agricultural landscapes. If possible, disking should be completed at different times of the year to avoid removing too much cover at once. Wildlife disking should not be used on prairie or savanna remnants.

Wildlife disking reduces residue, creates bare ground, and promotes desirable broadleaf plants that produce seed and attract insects. To be effective, complete strip disking in grassland habitats next to areas of useable shrubby cover. Disked strips should be 25 to 75 feet wide and separated from each other by an area of undisturbed vegetation twice as wide as the disked strip. Disking should occur with the contour of the field to reduce soil erosion. Where soil erosion is not a concern, disking may be completed in blocks instead of strips.

Disking should result in 30 to 70% bare soil. In many cases, dense, rank stands of vegetation must be burned, hayed or mowed prior to disking. The combination of management activities will help create different plant responses and vegetative structure in the grassland. Late summer, fall, or winter disking tends to favor broadleaves such as ragweed and croton, while spring disking tends to favor less desirable annual grasses such as foxtail and crabgrass. The disked areas will produce succulent forbs and legumes, which attract insects and produce abundant seed, while the adjacent undisked areas will provide nesting and roosting cover. Some programs require disking only during specified dates.

Periodic disking and burning has many benefits – photo by Jef Hodges NBCI

When possible, consider combining disturbance practices to improve habitat structure and prolong habitat benefits for wildlife. For example, consider implementing a prescribed fire and follow up with strip disking or an herbicide application in the same portion of the field. Land managers should also consider combining prescribed fire with managed grazing to create patch burn grazing systems.

Use selective herbicides to control undesirable vegetation – photo by Jef Hodges NBCI

Herbicide Applications – Herbicides can be applied to rank stands of native grass to promote desirable forbs and legumes and to improve habitat structure. Selective or non-selective herbicides should be applied at label recommend rates. Herbicide applications can be applied in strips 25 to 75 feet wide. Generally, no more than 1/3 of the area should be treated annually. Herbicide applications are most effective when combined with other management practices such as prescribed burning, strip disking and/or interseeding.

Interseeding CRP to increase plant diversity - photo by Kyle Brazil, WHF

Interseeding – In native grasslands and established CRP fields interseeding native wildflowers (5 to 20 species mix) and/or legumes such as alfalfa and annual lespedeza will improve plant diversity. Native prairie and savanna remnants should only be overseeded with local ecotype seed. Native wildflowers and desirable legumes provide ideal brood-rearing cover and excellent food sources. Best success occurs immediately after a disturbance such as prescribed burning, strip disking, managed grazing or herbicide application. Native wildflowers and legumes can be seeded by broadcast methods or with a no-till drill. Native wildflowers should be planted at the rate of 1 to 5 PLS pounds per acres and dormant seedings are preferred over spring seedings. Legumes should be seeded at the rate of 1 to 5 PLS pounds per acre.

Managed Grazing – Managed grazing for quail often requires diligent work and oversight by the land manager. Care should be taken to minimize grazing activities during the nesting season and to maintain adequate vegetation heights for nesting, brooding and roosting cover. Land managers should pay close attention to vegetative responses from grazing and the impact to critical shrubby cover.

Applied properly, grazing can create and maintain quality quail habitat, which includes the interspersion of nesting, brooding and shrubby cover. Quail prefer to nest in clumps of undisturbed grass with the previous year's growth and at least 8 inches tall to conceal nests and in close proximity to brood-rearing cover. Ideally, a pasture should be left undisturbed from grazing or haying activities for a minimum of 60 days during the nesting season to provide adequate nesting structure and time for a hen to initiate and hatch a nest.

Another effective grazing technique is high intensity/low frequency stocking. Under this managed grazing system, animals are stocked at such a high density that nearly all the vegetation is grazed in the paddock. With this system livestock are constantly moved and may only graze a paddock 1 or 2 times per year. The results are a mix of grazed and ungrazed paddocks that provide adequate forage for livestock. The rested paddocks provide good nesting cover and after a couple weeks the heavily grazed paddocks are a mix of new grass growth, forbs, and legumes that provide good brooding cover. Because each paddock is only a few acres in size there is always a good mix of nesting cover (rested paddocks) adjacent to good brooding cover (recovering paddocks).

Rotational grazing, patch burn grazing or lower than normal stocking rates during the nesting season in a continuous system are other techniques that can be used to minimize impacts on nesting quail. Stubble heights following grazing should be no less than 8 to 12 inches for native warm season grasses. Once the grasses are grazed to that height the cattle should be removed.

Managed Haying or Biofuel Harvest – Like mowing, haying or biofuels harvest are not desirable management activities for quail since these activities result in a homogenous stand of vegetation, promote the growth or use of undesirable grasses, leave little nesting or winter cover, and physically destroys nests and birds. CRP grass fields may be periodically hayed through special managed or emergency haying and grazing provisions. CRP grass fields and other grasslands are also seen as potential biomass sources for biofuels production.

In hay pastures consider delaying harvest until 30 days after average peak local hatching date to avoid destroying quail nests and young birds. CRP restricts haying and grazing until after the primary nesting season. Land managers interested in enhancing quail numbers should refrain from haying corners and odd areas, or leave a 30 to 120 foot wide unharvested border around the edge of the field. In addition, land managers should leave unharvested blocks to provide winter cover and nesting cover for the following year. Large undisturbed blocks of cover are preferred over narrow strips of unharvested grass scattered throughout the field. Stubble heights should be raised to a minimum of 8 inches to provide adequate winter cover and nesting cover for quail and plant vigor for native warm season grasses.

Native grass/forb biomass planting with pollinator benefits in Missouri - MDC

Where biofuels harvest will be considered, land managers should minimize annual needs for inputs (eg. fertilizer, pesticides) by selecting native grass and forb plantings. Consider planting or interseeding legumes to fix nitrogen in the soil, increase diversity in plantings, and provide pollinator habitat.

Patch Burn Grazing – Patch burn grazing is the application of prescribed fire to focus livestock grazing on a portion of a single grazing unit where the objective is to increase the diversity and structure of the vegetation in a way to benefit wildlife and maintain livestock production. Patch burn grazing is a grassland management practice for landowners primarily interested in improving habitat for wildlife while still maintaining cattle production on their land. This management practice creates a mosaic of heavily grazed and lightly grazed areas that provide a diverse vegetative structure and increase plant diversity in the same grazing unit. Instead of depending on interior fencing to focus grazing in a portion of a unit, a manager instead uses post-fire re-growth to attract cattle to selected areas. At the same time, other portions of the unit remain open to grazing but are underutilized, thereby allowing plants to rest while root reserves build-up.

Invasive Plant Control – Sod forming grass and exotic vegetation such as sericea lespedeza, kudzu, knapweed and others should be controlled with appropriate herbicides or other management techniques. Invasive plants crowd out important quail friendly plants, negatively impacting habitat structure for quail. Infested sites should be annually checked for new stands of unwanted plants. If left unchecked, invasive cool- and warm-season grasses can quickly overtake native grasslands and CRP fields. Invasive grasses may move into native grasslands and CRP fields from adjacent fields, roads and woodland edges. Invasive grasses can easily be controlled in these areas with a well-timed herbicide application. In many cases, poor site preparation that fails to eliminate invasive species during the native plant establishment phase results in reinfestations of undesirable vegetation and unsatisfactory stands of native grass, wildflowers and habitat structure.

Native grass plantings infested with exotic warm-season grasses can only be improved by eradicating all existing vegetation, including native grasses and wildflowers. Native grasses and wildflowers can be reestablished once the invasive vegetation has been eradicated. To prevent future reinfestations, land managers are encouraged to spray areas adjacent to the field border and underneath trees and shrubs. A boomless sprayer is an effective way to target invasives in these areas.

Food Plots and Patches – Food plots provide high-energy food to help quail survive during severe winter weather. Weedy food plots provide excellent brooding and loafing cover for young quail during the summer months. Establishing food plots or patches generally do not produce more quail on a property. Land managers often overemphasize the importance of food plots while overlooking other management needs. Generally, a quarter acre food plot or patch planted to corn, milo, millet, forage sorghum, soybeans, cowpeas or other grains is sufficient on each 40 acres of habitat. Whenever feasible it's better for plant long, linear food plots over simple block plantings. Consider rotating food strips across the area each year by leaving half of each plot idle and planting the other half. The idle area provides excellent brooding cover. Food plots in grazed grasslands must be fenced from livestock, feral hogs and deer. Food plots are most effective when established adjacent to protective woody cover and diverse grass and wildflower stands.

Shrubby Cover Enhancement – During the winter, coveys will often establish a headquarters area and loafing site around one or more shrub or low-growing woody cover sites. Patches of shrubby or woody cover should be spaced 50 to 100 yards apart and at least 30 to 50 feet wide. Where quail habitat is the primary objective, native grasslands and CRP fields wider than 100 yards should be divided with tree or shrub corridors for maximum bobwhite benefits. Shrub rows should be at least 10 to 30 yards wide. Native shrubs such as wild plum, shrub dogwood, blackberry and hazelnut make excellent shrubby cover. Shrubby cover should be fenced from livestock to avoid degrading this important cover type. Land managers should take advantage of continuous CRP marginal pastureland practices such as CP22 Riparian Forest Buffer and CP29 Marginal Pastureland Wildlife Habitat Buffer to establish favorable shrubby cover patches.

Example of edge feathering – photo by Scott James, Quail Forever

Edge feathering is a technique that creates a transition zone of shrubs, vines, and herbaceous vegetation between cropland or grassland and wooded areas that provides additional low woody brood and escape cover for bobwhites. To be effective, edge feathering should be completed next to early successional vegetation such as managed wildlife friendly grasses/legumes, field borders, food plots or cropland. As a rule of thumb, edge feathering can extend at least 30 to 50 feet deep into the wooded area and at least 1,500 feet in length. Edge feathering may be completed in blocks or in long linear strips along the field edge. Kill existing grass (regardless of type) with an approved herbicide before edge feathering. This provides good growing conditions for annual food plants and shrubs. All trees over 15 feet tall in the

area should be felled, making sure native shrubs are left undisturbed. An occasional tree may be left to preserve valuable timber or mast producing species. Generally, treat all cut stumps with an approved herbicide to prolong the benefits of edge feathering. If possible, leave felled trees where they fall. Edge feathered trees may be dropped parallel to the fence line/field edge or cut and loosely stacked along the edge of the field. Do not push the downed trees into a dense brush pile. Edge feathering may be completed with a chainsaw or mechanical clipper.

Assorted native shrubs in planting tubes – photo by Chuck Kowaleski, TPWD

Native shrub thickets can be established from seed, bare root or container grown plants. In all cases, preparing the site by eradicating all existing vegetation is critical. Land managers should maintain adequate weed control for 2 to 5 years after planting, or until shrubs are well established. Newly planted shrub thickets can be enhanced by adding large, downed trees. The cut trees provide suitable protective cover until the shrubs are well established.

Existing clumps of shrubs can be enhanced by protecting small patches from prescribed fire and other disturbances for several years or until well-established, by controlling sod-forming grass such as fescue or brome underneath and around these groups of shrubs and by cutting overstory trees.

If enrolling or re-enrolling CRP, consider the CP4D practice which specifies shrubs to be planted and typically has the same EBI score as the other highest scoring options.

Quail Management Practices for Rangelands

This section written by Aaron Jefferies with comments from Chuck Kowaleski Texas Parks and Wildlife Department (TPWD), Jason Hardin TPWD, Steve Nelle NRCS, Dr. Leonard Brennan Caesar Kleberg Wildlife Research Institute (CKWRI), Dr. Steve Demaso (CKWRI), Joseph Sands (CKWRI), Jim Willis Wildlife Habitat Federation (WHF), Chip Ruthven (TPWD).

Rangeland *– Conserve, enhance and restore the quality of rangeland by utilizing vegetation management practices that favor the retention and improvement of native plant communities beneficial to bobwhites and other wildlife.*

Problem:

Well managed native rangelands in the southern Great Plains still support huntable quail densities as a result of droughty conditions and favorable habitat management practices and grazing regimes. Threats which may negatively influence quail populations on native rangelands include overgrazing, excessive brush control, woody encroachment and drought.

Strategic Solutions:

Enhance the quantity and quality of nesting, brood-rearing, and other food and cover requirements for bobwhites and other grassland wildlife on native rangelands by fine-tuning grazing management practices and brush management techniques.

Tactical Management Practices:

Managed Grazing – Lack of suitable nesting cover is a widespread limiting factor for quail on native rangelands. Since livestock grazing is the prevailing land use on native rangelands, proper application of grazing can create, restore or maintain quality quail habitat. Such habitat requires an interspersion of nesting, brooding and shrubby cover. Proper grazing promotes desirable successional food plants such as western ragweed and croton, increases insect production and provides favorable habitat conditions at ground level in the form of bare ground, forb and grass production and overhead cover for brood range while maintaining plentiful grass clumps for nesting.

Well managed native rangeland – photo by Chuck Kowaleski, TPWD

Land managers interested in enhancing and maintaining habitat for quail should consider conservative stocking rates, especially in areas of low annual rainfall, in order to maintain this mix of good vegetative structure. Research indicates nesting quail select areas with taller, denser grass clumps. Cattle should be deferred from rangelands when native bunchgrasses are reduced to less than 200 clumps per acre and/or are less than 8 inches tall. Grazing strategies that maintain at least 700 grass clumps/acre over 10 inches tall are ideal. On rangelands where the species composition does not currently support desired grasses for nesting cover, more intensive restoration methods may needed. These include specialized grazing management designed to restore mid and tall grasses – such as multi pasture single herd rotations (4 Pasture – 1 Herd), complete destocking of livestock for a period of time, control of invasive grasses or woody species, reseeding native grass species and brush management. If a suitable density of desired grass species exists, then a lower level of grazing management may suffice to maintain the desired density of ground cover. Periodic destocking may still be necessary to maintain desirable nesting cover depending on local conditions.

Cool season prescribed burn to invigorate native grass and forb production and reduce invasive mesquite at TPWD's Matador WMA - photo by Chuck Kowaleski TPWD

Prescribed Burning – This is an economical tool to control excessive brush and maintain favorable habitat conditions for quail and forage for livestock in regions of sufficient rainfall (>20"). However, improperly applied large scale burning on native rangelands may negatively impact quail densities by limiting the amount of nesting cover. Larger burns can be performed if they are patchy in nature or contain small 1 to 5 acre upland sites that are left with adequate nesting cover (at least 8-10 inches tall) scattered throughout the burn unit. Care should be taken to protect shrubby escape or loafing cover and other desirable woody plants through the use of fire breaks or black lines. Land managers interested in enhancing and improving quail habitat should avoid annual burning on the same acreage. Burning on a two to six year rotation is generally recommended based on climate, soil fertility and grazing rotations. Prescribed burns from late winter to "green-up' provide the most benefit for native warm season grass stands. May-September burns are preferred for controlling invasive woody species although winter burns are also effective at reducing woody plant cover. Young stands of non-sprouting species such as eastern red cedar and Ashe juniper are most effectively managed with prescribed fire, whereas resprouting species including mesquite and red berry juniper will require maintenance treatments. Early winter burns, after the first frost, are best for

encouraging spring forb production. Land managers should apply fire in such a manner that sufficient residual cover remains to sustain quail populations throughout the year. Ideally, during any given year, 25 to 50% of a given area should provide adequate grass cover for nesting quail during spring and early summer.

Note the lack of diversity in this CRP introduced grass field - photo by Chuck Kowaleski TPWD

Invasive Plant Control – If left unchecked in some areas, invasive plants can quickly diminish habitat diversity and structure for quail. Non-native "improved" pasture grasses are a serious threat to native rangeland where quail habitat management is planned. Most introduced grasses, especially sod forming varieties, do not provide a useable combination of nesting and brood-rearing cover for quail. Exotic, warm-season grasses are difficult if not impossible to fully control in native warm-season grass stands. Where introduced grasses dominate, heavy tillage or herbicides are needed to correct the problem. This can involve species specific herbicides, spot spraying or even complete eradication of all vegetation before replanting with natives.

Other plants such as sericea lespedeza, Russian thistle and others also crowd out important quail friendly plants and degrade habitat structure. A combination of mechanical (i.e. mowing, bulldozing, disking) and chemical treatments are often necessary to control invasive plants. Prescribed fire can be a double edged sword as it is effective at controlling some invasive plants while promoting the growth of others. Land managers should periodically scout sites to check

for reinvading plants or new colonies. Early detection and spot treatments are the most effective and economical means of controlling invasive vegetation.

Controlling dense woody stands can get very expensive – photo by Chuck Kowaleski, TPWD

Brush Control – Invasion of woody plants, such as eastern red cedar, juniper, mesquite, salt cedar and/or various oaks caused by overgrazing, temporary cultivation, or a reduction in prescribed burning is another underlying cause of declining rangeland condition for quail and livestock. If left unchecked, thick stands of brush can reduce favorable native plant diversity and structure for quail. A combination of chemical, biological and/or mechanical treatments with or without prescribed fire is necessary to restore native rangeland for managed grazing and quail habitat. Although heavy stands of brush are undesirable for quail and livestock, so is the complete removal of brush. Quail can tolerate a wide range of brush cover, anywhere from 5 to more than 50%. In areas of low shrub cover, grasses that provide sufficient overhead cover can result in useable space for quail. In areas of denser shrub cover, adequate areas of grasses and forbs for nesting and brood rearing become more critical in providing suitable quail habitat.

Selected brush removal combined with careful grazing – photo by Chuck Kowaleski, TPWD

Land managers interested in enhancing quail habitat should fine tune brush control practices by selectively removing brush across the landscape while maintaining patches of protective woody cover. As a rule of thumb, patches of shrubby cover should be scattered across the landscape with no more than 50 yards between clumps. Species that provide good protective cover as well as seasonal food include sumac, dewberry, shin oak, wild plum, lotebush, sand sagebrush and mesquite. Care should be used in broadcast applications of herbicides for brush control. Many herbicides are nonselective and may eliminate broadleaf forbs critical for seed and insect production and desirable woody loafing and escape cover. Ideally herbicides should only be applied to the targeted invasive species. If that is not feasible consider applying herbicides in alternating strips or crosshatching (think tic-tac-toe) with untreated and partially treated areas left between the treated overlapping junctions.

Quail Management Practices for Southern Pine Forests

Pine Forests *- Enhance and increase nesting and brood-rearing habitat in pinelands and mixed pine-hardwood forests by thinning, controlled burns, site preparation and forest regeneration in a fashion that benefits bobwhites and other wildlife.*

Overstocked Pine Plantation with closed canopy - photo by Billy Dukes SCDNR

Problem:

Most natural pine forests are overstocked with a mix of pine and hardwood tree species as a result of many years of fire suppression. Pine plantations are planted at high stocking rates resulting in a dense overstory canopy with very little ground cover. Overstocked pine forests with closed canopies shade out desirable herbaceous plants that provide nesting and brood-rearing cover and native shrubs for protective cover.

Solutions:

Enhance nesting, brood-rearing, and shrubby cover for bobwhites and other early succession wildlife on southern pine forests by periodic thinning coupled with frequent prescribed burning, selective mowing, herbicide treatments and management of fallow openings.

Logging operation – Photo by Billy Dukes SCDNR

Management Practices:

Forest Thinning – Closed canopy pine forests and pine plantations provide poor habitat for quail. Through the use of periodic heavy thinning and prescribed burning, southern pine forests can be restored to excellent habitat. Depending on the forest type, climate and site productivity, optimal habitat conditions can be maintained within pine forests with basal areas in the range of 40 to 70 square feet per acre. The forest canopy should be open enough to allow half of the ground area to receive full sunlight at mid-day. Longleaf pine is better suited for quail management due to the sparse open crown compared to shortleaf, slash or loblolly, and the ability to use prescribed fire early in the stand rotation. Generally, longleaf pine stands can be managed at higher basal areas (up to about 70 square feet per acre) compared to other southern pine species. Shortleaf and loblolly have large spreading crowns and should be managed at lower stocking rates (about 40 square feet per acre) for optimal habitat conditions. Ideally the canopy should be open enough for 60% of the ground to receive direct sunlight. That should be coupled with frequent prescribed burning (i.e. 2-year rotation on all but the most infertile sites e.g. deep sands). Young longleaf stands should be burned after their first growing season and then burned on a 2-year frequency to enhance ground cover and naturally prune lower limbs which enhances growth form, reduces shading and improves future timber value.

WHAT DIFFERENT BASAL AREAS AND MANAGEMENT TREATMENTS LOOK LIKE

Unthinned & Unburned >120 ft^2 basal area - photo by Reggie Thackston GADNR

Closed canopy and unburned pine stands represent the greatest management need for bobwhites and grassland wildlife in Georgia. It is critically important to couple thinning with frequent burning. Burning this stand would provide little to no wildlife benefit due to the overstory canopy which prevents sunlight from reaching the forest floor.

Thinned & Burned, 80-100 ft^2 basal area - photo by Reggie Thackston GADNR

Typical results of 5th-row thinning when timber management is the main objective. Increased sunlight penetration in take-out rows allows for increased ground cover but ground cover is too thin between other rows, which decreases food and cover and increases vulnerability to predation. Burning this stand results in some wildlife benefits but more sunlight is needed produce and sustain quality ground cover. A heavy within-row selection of trees will be needed in the next thinning to restore and sustain ground cover

Thinned & Burned, 60-80 ft^2 basal area - photo by Reggie Thackston GADNR

This is an acceptable timber stocking for deer, turkeys and other habitat generalists. The increased sunlight coupled with frequent burning results in improved ground cover structure and composition, providing nesting and brooding cover for turkeys and quality forage and fawning cover for deer. Gaps in ground cover are still predominant, which makes bobwhites vulnerable to predation especially during winter months. Ground cover will decrease as tree canopy quickly closes and reduces sunlight with the end result being limited value to bobwhites.

Thinned & Burned, 40-60 ft^2 basal area - photo by Reggie Thackston GADNR

These photos exhibit preferred timber stocking for bobwhites and grassland wildlife. Ample sunlight reaches the ground floor to stimulate the desired ground cover while fuel for frequent prescribed burning is provided by native grasses and pine needle litter. This thinning intensity provides multi-season food and cover, and reduces vulnerability to predation. A 2-yr prescribe burn frequency is required for restoration and maintenance of this pine savanna type.

Loblolly Pine Savanna In Restoration – 60 ft^2 basal area and quality timber/bobwhite habitat - photo by Reggie Thackston GADNR

Loblolly CRP 50 ft^2 basal area, burned w/ 2-yr frequency and with quality ground cover - photo by Reggie Thackston GADNR

Mature Loblolly Pine Savanna showing intensive bobwhite management with less than 40ft^2 basal area, fallow fields and 2- year fire frequency - photo by Reggie Thackston GADNR

WHAT DIFFERENT PRESCRIBED BURNING REGIMES LOOK LIKE

CRP CPA 10 Years Old Never Burned – no ground cover and poor quality trees - photo by Reggie Thackston GADNR

5 Years Old CRP Burned Twice – enhanced ground cover and much improved longleaf growth form - photo by Reggie Thackston GADNR

9 Years Old CRP Burned Twice in the Last 4 Years – improved ground cover and lower limbs are being pruned to enhance tree quality – ground cover and tree quality could have been further enhanced if burning had begun in year 2 - photo by Reggie Thackston GADNR

The ideal - old growth longleaf/wiregrass pine tract burned every 2 years and averaging 45 ft^2 basal area, similar to historic conditions - photo by Reggie Thackston GADNR

Pine Regeneration – Quail densities generally increase the first 2 to 4 years after clear-cutting because of excellent plant diversity and habitat structure. After this time, stands usually develop a dense overstory canopy that shades out desirable native grasses and forbs. Land managers can prolong habitat benefits for quail by using different silvicultural practices. Generally, the more intensive the site preparation (slash and debris removal) the longer the

habitat will remain suitable for quail. A combination of treatments such as shearing, raking, piling and herbicide treatments can be used to prepare sites for future regeneration. Conducting a prescribed burn following site preparation will prolong habitat benefits by maintaining plant diversity and structure. Winter treatments often result in desirable food and cover conditions for quail. Today, herbicides are commonly used to control hardwoods on pine regeneration sites. Herbicides can be both beneficial and detrimental to plant diversity and habitat structure depending on herbicides applied and the application method. Land managers should consider selective herbicides that leave desired plants such as legumes, blackberries and native grasses.

When feasible, land managers should consider creating long, narrow clear-cuts instead of large, blocky cuts. Depending on objectives and goals, clear cuts should be at least 5 acres in size and connected to open canopy pine forests to benefit quail. Roads and firebreaks can also be managed to provide quail habitat. Land managers should consider managing these areas as brooding cover by promoting desirable plants such as native lespedezas, ragweed, and partridge pea by periodic disturbance. Planning new permanent forest openings is most practical if conducted in conjunction with timber harvest and site preparation. For optimal quail benefit, at least 20 percent of the stand should be developed into permanent openings that are three to five acres in size.

Pine forests can be regenerated through natural or artificial means and managed as even-aged or uneven-aged stands. Regardless of the regeneration and management method the key is to maintain a continuity of high quality grass/forb/shrub ground cover across space and time. To optimize results and minimize costs landowners should seek technical guidance from a wildlife biologist well versed in integrating bobwhite and forest management prior to initiating forest regeneration practices.

New plantings in pastures may require multiple herbicide applications to control exotic grasses such as Bermuda grass or Bahia grass and other undesirable vegetation. Herbicide applications to tree rows only are not adequate and will result in unsuitable quail habitat during the entire life of the stand if exotic grasses are not controlled prior to regenerating the stand.

Where bobwhite quail is an objective, land managers should consider wider tree row spacing's (8'x12') to allow for the establishment and maintenance of desirable native grasses, forbs, legumes and shrubs. Where quail is the primary objective and soil types are suitable, longleaf pine plantings should be considered. Longleaf pine plantings on 12'x12' or greater spacing, properly managed with prescribed fire, may provide excellent habitat conditions throughout the life of the stand. Natural regeneration by seed tree or shelterwood often results in dense seedling stands that out-compete native grasses and wildflowers.

Frequent burns are essential in pine forests – photo by Reggie Thackston, GADNR

Prescribed Burning – Frequent prescribed burns are essential in pine forests to control hardwood sprouts and encourage desirable native grasses, legumes, forbs and shrubs used by quail. Land managers should apply fire to a portion of pine woodlands annually to maintain suitable cover for quail. Mowing of invasive hardwoods immediately following burns and/or selective herbicide applications is often necessary for adequate control of undesirable vegetation. Whenever possible, land managers should use herbicides that minimize damage to desirable native grasses, forbs and shrubs. Across sites of moderate to high fertility prescribed fire should be applied on a 2 year frequency where 50% of the burnable woods are burned each year. On very infertile sites and especially during drought years a 3 year burn frequency may be sufficient. If left unchecked, hardwood sprouts can quickly shade out desirable plants, and will often require mechanical and chemical treatments once in the mid or overstory.

Care should be taken to leave desired nesting and escape cover each year of native grass and shrubs from the previous growing season. Generally, prescribed burn units should be less than 50 acres in size, adjoining a comparably sized unburned unit such that on the average about 50% of a managed pine forest property remains unburned each year.

Prescribed burns should be conducted in late winter through early spring. Occasional growing season or lightning season fires (late May or June) are effective at controlling hardwoods while still providing quail sufficient time for late season nesting. During the traditional late winter and early spring burn season, land managers should apply fire throughout the season instead of all at once to avoid removing too much cover at once.

Invasive Plant Control – A variety of nonnative grasses, forbs, shrubs, vines and trees continue to threaten southern pine forests. Invasive, nonnative plants such as Bermuda grass, sericea lespedeza, kudzu, bicolor lespedeza (on some soil types), privet, autumn olive, cogon grass, Japanese climbing fern and tallow tree can infest the forest interior and along woodland edges. Invasive plants hinder forest use and management activities, and degrade plant diversity and wildlife habitat. Invasive plants crowd out important quail friendly plants, negatively impacting habitat structure for quail. Land managers should constantly scout pine forests, interior roads and stream banks for invasive plants. Early detection and immediate treatment are the most effective and economical ways of controlling invasive vegetation. Large-scale infestations will often require a combination of mechanical and chemical applications. In some cases, large-scale conversion of the existing native and invasive vegetation is the only solution. Infested sites should be annually inspected for new colonies. Remnant stands should be spot treated with mechanical and/or chemical applications. Prescribed fire is effective at controlling some invasive plants while promoting the growth and spread of others.

Good example of well managed forested quail habitat – Photo by Billy Dukes SCDNR

Permanent Forest Openings – Create permanent forest openings within woodlands being managed for quail to augment nesting and brooding cover and feeding areas. Ideally, 20 to 40

percent of the quail range should be in 3 to 5 acre fields that are evenly distributed throughout the woodland. As a rule of thumb, land managers should aim for one forest opening per 10 to 20 acres. When creating new forest openings, all marketable timber should be harvested from the site. After harvest, fields should be cleared with heavy machinery, making sure stumps and unmarketable timber are piled and burned.

Well managed forest opening – Photo by Billy Dukes SCDNR

Fields can be managed primarily as brooding habitat; however, native grasses can be established around the perimeter of the field to provide nesting cover as well. These native grass field borders are less important if the surrounding woodlands are managed in an open condition with abundant native grass ground cover. Fields should be managed through winter disking to promote annual seed producing plants such as ragweed and partridge pea. Only a portion of each field should be disked in each fall or early winter to allow coveys to use the remaining portion of the field.

Quail Management Practices for Oak and Mixed Woodlands

Woodlands *- Enhance and increase nesting, brood-rearing, shrubby cover and winter feeding habitat in oak and pine-oak woodlands by thinning, controlled burns, in a fashion that benefits bobwhites and other wildlife.*

The word "woodland" is more than another general term for a forest. Ecologically, true open woodlands are a type of wooded community characterized as having a canopy cover of 30 to 80%, a poorly developed understory, and a diverse herbaceous layer of forbs, grasses, and sedges with 50 to 100% ground cover. Woodlands contain fire tolerant trees such as oak and hickory, often with wide spreading crowns. In some states, short-leaf pine, Virginia pine, pitch pine and table-mountain pine are common woodland canopy trees, often mixed with hardwoods. A variety of other fire tolerant trees also occur in woodlands.

Unlike forests or the altered woodlands we see today, high quality woodlands contain a diverse ground flora of herbaceous plants, shrubs and vines. Common shrubs and vines include lowbush blueberry, aromatic sumac, New Jersey tea, grape, and Virginia creeper. Characteristic herbaceous plants include little bluestem, big bluestem, Indian grass, wild rye, bottle brush grass, poverty grass, tick trefoils, wild bean, goat's rue, dittany, bristly sunflower, goldenrods, asters, and a variety of sedges.

Prior to European settlement, woodlands were maintained by fire which was set by Native Americans or lightning strikes. Historically, woodlands may have been as small as a few acres to well over 10,000 acres and included complexes of savanna and glades.

Problem:

Most woodland communities have been degraded due to extensive logging, fire suppression, overgrazing and other unnatural disturbances. In the absence of fire, woodlands may succeed to an overstocked, closed canopy community with little ground flora. Eastern red cedar is a good example of a tree that invades woodlands where natural fire regimes have been suppressed. Degraded woodland will often appear similar to a forest community because of a closed canopy and lack of ground flora. This is especially true on more productive woodland sites.

Solutions:

Increase the amount and enhance the quality of nesting, brood-rearing, foraging and shrubby cover for bobwhites and other grassland wildlife within oak and mixed woodlands by thinning and harvesting overstocked woodlands to create an open canopy. Prescribed fire is necessary

to restore and maintain woodland. Prescribed burning will promote herbaceous plants for nesting and brood-rearing cover and control excessive woody growth. Some use of herbicides may be required to adequately control hard wood stump / root sprouts and maximize the effectiveness of subsequent prescribed burning.

W**ildflower glade on a south facing slope above and rocky glade below** – photos from MDC

Habitat Enhancements:

Woodland/Glades Complex - Glades or barrens are found in Midwest and Appalachian states and are a part of the woodland complex. Generally, glades occur within woodlands on steep south and west facing slopes and hill tops where they are called "Balds". Glades characteristically have shallow, rocky soils with exposed bedrock and an abundance of wildflowers and native grasses with only a few trees and shrubs. Periodic fires, native herbivores and local conditions of topography, bedrock, and soil greatly influence glade development. Typically glades are surrounded by a savanna or open woodland. Trees found near glades are often stunted and express poor development because of shallow droughty soils and poor growing conditions. Like woodlands, glades have been degraded by fire suppression, overgrazing, and invasive plants like sericea lespedeza and knapweed. Glades should be managed as part of the woodland. Restoration involves thinning undesirable woody vegetation, controlling invasive plants and introducing prescribed fire.

Management Practices:

Recently heavily thinned woodland - photo provided by VDGIF

Oak and Pine-Oak Woodland Thinning – A variety of silvicultural practices can be used to restore degraded oak and pine-oak woodlands. As a general rule of thumb, woodland sites should be thinned to between 20 and 50 square feet of basal area/acre to provide favorable habitat conditions for northern bobwhite. An open woodland canopy should be open enough

to allow 50% full sunlight at ground level at mid-day (measured when leaves are on the trees). An open overstory and a sparse midstory are critical to promote native grasses, forbs and legumes for nesting and brood-rearing cover. Combinations of these cover types also produce seed bearing plants that provide winter feeding areas.

Thinned oak woodland with good light penetration - photo provided by MDC

Land managers should leave a variety of overstory tree species including red and white oak, hickory, black gum and pine. Streamside management zones (SMZs) should be used to protect water quality when harvesting near streams or water bodies. Each state's forestry agency has developed Best Management Practices (BMPs) that include Streamside Management Zones for various silvicultural practices. When feasible, tree laps should be chipped or removed from the site to reduce excessive fuel loads. Operators should be discouraged from leaving lap piles next to residual trees. Additional thinning can be completed with mechanical thinning methods (i.e. bullhog or forestry mulcher) or other treatments (i.e. chainsaw or hack and squirt).

For landowners who wish to speed up the process of creating open woodland, or potentially for landowners who are in a location where prescribed fire is not feasible, a forestry mulcher can be used in the thinned understory to reduce residual hardwood brush. A forestry mulcher is essentially an expanded stump grinder. They are usually mounted on a tracked vehicle or larger wheeled vehicle similar to a skidder used in forest harvesting. A high speed toothed grinder is used to "mulch" residual hardwood stumps, brush and debris. Operators under hardwoods

must use care not to grind too deep into the soil to avoid damaging roots of over story trees. It is an expensive process and not practical for everyone, but does offer an alternative to more traditional techniques.

Frequent prescribed fires reduce hardwood resprouting – photo by Reggie Thackston, GADNR

Prescribed Burning – Frequent prescribed fires are essential to maintaining quail habitat in thinned oak and pine-oak woodlands. Many hardwood species will sprout at the base of the tree stump or snag when topkilled. If left unchecked, hardwood sprouts can quickly shade out desirable herbaceous plants, and will often require mechanical, or herbicide treatments once in the mid or overstory. If used often enough and during the growing season (late March, April, early May, or in Fall – September and October), prescribed burns will control hardwood sprouts and maintain desirable native grasses, legumes, forbs and shrubs used by quail for nesting, brood-rearing, feeding, and loafing cover. Depending on the desired plant community, climate and site productivity, land managers should apply fire on a two to four year rotation to maintain good habitat structure for quail. Generally the more productive the site, the more frequently fire needs to be used to maintain desired plant communities. If a site has had more than 3 years growth since the last prescribed fire, or if this area has had only one or a few prescribed burn treatments, a site visit before the next planned burn is important to determine how vigorous hardwood and other shrub sprouting has occurred. A dense shrub understory can

produce more intense radiant heat than expected in the next burn, and could result in unintended mortality to overstory trees. Or the previous prescribed burn could have resulted in a number of midstory snags, increasing the dead and down fuel loading. In these situations, lighter intensity burns, either in the dormant season or very early growing season in cool weather conditions, can help knock back hardwood sprouts and consume dead and down fuels, while minimizing unintended overstory tree mortality. An additional consideration is during drought years and insect outbreaks. Prescribed burning will be an additional stress event to overstory trees during this time. Consider burning during the dormant season or very early growing season under cool weather conditions to minimize additional stress on trees during these events.

If the state you live in has a Prescribed Fire Council and right-to-burn legislation, there can be prescribed burn and smoke Best Management Practices and a process designed to minimize legal vulnerabilities during prescribed burning.

Note: Use of herbicides in the understory, following thinning and prior to burning, can greatly enhance the effectiveness of prescribed fire in controlling hardwood sprouts and promoting desirable vegetation. Care must be used to avoid herbicides that could harm residual overstory hardwoods. Chemicals commonly used to release pines cannot be used safely in a hardwood understory. Products like Arsenal AC®, or Chopper Gen 2® that contain Imazapic, or Imazapyr are active through the soil and tree roots for as much as 120 days after application and cannot be used in a hardwood understory setting. But foliar active, systemic herbicides can be safely and effectively used in such settings. A tank mix of Garlon 3A (a low volatility form of Triclopyr) and a Glyphosate product has proven effective in controlling hardwood and pine sprouts following heavy thinning in hardwood stands. Research is ongoing into the effectiveness of this method over the long term. The idea is to quickly gain control over sprouts and maximize the effectiveness of prescribed fire. Herbicides are applied using tractor, or skidder mounted spray rigs designed to spray in a low arc, covering undesirable understory species without contacting residual overstory trees. Spraying is generally done in late summer the year of thinning. However if thinning is completed late in summer, spraying can be used the following spring or summer. Once control has been gained over sprouts, a prescribed fire regimen can be incorporated to develop and maintain desirable quail cover. By using herbicides initially, the frequency with which fire must be used can be reduced. This is of particular concern for landowners who are fearful of fire, live in areas where fire is problematic, or cannot afford to have burning conducted every 2 years. In eastern deciduous woodlands, prescribed fire alone on a cycle of every 3 to 5 years will not control hardwood sprouts effectively regardless of the timing of burns.

Turkey nest in pine forest with 2 year fire rotation – photo by Reggie Thackston, GADNR

Care should be taken to leave desired nesting cover each year. Generally, prescribed burn units should be less than 60 acres in size; however, good quail habitat can be maintained in larger burn units (up to 80 acres) if undisturbed upland sites (1 to 5 acres in size) are maintained and well distributed throughout the burn unit. Ideally, 25 to 50% of the site should provide quality nesting cover. This can be accomplished by placing firelines around desired habitat patches within a burn unit. Some managers refer to these as "ring-arounds." Ring-arounds may also be used to maintain good patches of shrubby cover in small 50' by 50' foot "covey headquarters" areas distributed evenly within burn units. If you can picture a checker board, envision 1 in 5 of the squares, spread evenly through an area, maintained in good shrubby cover, 2 of 5 squares in good nesting cover, and 2 of 5 squares in good brood rearing cover, whether within woodlands, or in open land settings.

Initial prescribed burns on newly thinned sites should be conducted in late winter through early spring. Late fall burns are effective at setting back woody sprouts and enhancing native forbs and legumes. Late summer burns can also be applied on glade communities within larger woodland complexes. Care should be taken to avoid removing large areas of cover with prescribed fire. During the traditional late winter and early spring burn season, land managers should apply fire throughout the season instead of all at once.

Woodlands with excessive downed woody material, especially eastern red cedar, may need to season for one or two years to reduce fuel loads and to avoid damaging residual overstory

trees. Land managers can use different ignition techniques and weather conditions (high humidity and low winds) to minimize damage to desirable hardwoods. Avoid piling downed trees against or close to retained overstory trees.

Invasive purple loosestrife can spread rapidly in damp areas – photo by Keith Krantz, WVDNR

Invasive Plant Control – A variety of nonnative grasses, forbs, shrubs, vines and trees continue to threaten oak and pine-oak woodlands. Invasive plants such as Bermuda grass, sericea lespedeza, garlic mustard, purple loosestrife, kudzu, autumn olive, and eastern red cedar can infest the woodlands sites. Invasive plants hinder woodland use and management activities, and degrade plant diversity and wildlife habitat. Invasive plants crowd out important quail friendly plants and insects, negatively impacting habitat for quail.

Land managers should constantly scout restored woodlands, interior roads and stream banks for invasive plants. Early detection and immediate treatment are the most effective and economical ways of controlling invasive vegetation. Large-scale infestations will often require a combination of mechanical and chemical applications. In some cases, large-scale conversion of the existing native and invasive vegetation is the only solution. Infested sites should be annually checked for new colonies. Remnant stands should be spot treated with mechanical and/or chemical applications. Prescribed fire is effective at controlling some invasive plants while promoting the growth and spread of others. A combination of forestry mulching, prescribed burning, and/or rotational disking, along with understory herbiciding will effectively control invasives.

Quail Management Practices for Reclaimed Minelands

Reclaimed Mineland *- Enhance the quality of reclaimed mineland by utilizing vegetation establishment and management practices that favor the retention and improvement of native plant communities beneficial to bobwhites and other wildlife.*

Problem:

Reclamation sites offer unique challenges to establishing vegetation due to naturally low soil fertility, poor water-holding capacity, low organic matter, soil compaction and high soil acidity. These environmental factors make for poor growing conditions, limited seeding options, and complex establishment practices. Past reclamation activities have utilized introduced vegetation such as sericea lespedeza, Japanese honeysuckle and black locust that complicate subsequent habitat work due to the aggressive nature of these plants.

Solutions:

Increase the amount and enhance the quality of nesting, brood-rearing, and shrubby cover for bobwhites and other grassland wildlife on reclaimed mineland, through the establishment and/or management of native warm-season grasses, forbs and shrubs.

Management Practices:

Establish Native Grasses, Wildflowers and Legumes on Reclaimed Mineland – Reclaimed mineland can be enhanced by establishing native grasses, wildflowers, and legumes to enhance nesting and brood-rearing cover for quail and other wildlife. Bunch grasses such as little bluestem, broomsedge and Indian grass can provide ideal habitat structure for quail.

Native grasses often have a higher tolerance of acidic, droughty and low fertility soils found on reclaimed sites than do most introduced cool-season grasses. Shorter native grasses such as little bluestem and broomsedge should be preferred over taller native grasses such as big bluestem, Indian grass and switchgrass. Sites established with “shorter” native grasses will require less frequent disturbances from prescribed fire and will provide room for desirable native forbs and legumes (better habitat structure).

The light, fluffy seeds will require special seeding equipment or unique seeding methods to effectively distribute the seed across the field. Good results can be expected when seeds are broadcasted or planted with a no-till drill. Newly planted grass and forbs stands will need to be periodically mowed during the first year of establishment to reduce weed competition and promote the growth of native grasses and wildflowers.

Reclaimed mine site in Virginia with good structure for quail – photo by Marc Puckett VDGIF

Selective herbicides such as Imazapyr or Imazapic help reduce weed competition and thereby reduce stand establishment. Warning: as Imazapyr or Imazapic can damage some native grasses and wildflowers. A good stand can be expected by the 3 or 4 growing season depending on weed control measures, site conditions and climate.

The key to establishing native grasses and wildflowers is to prepare a seedbed free of plant competition. Often multiple herbicide applications are in necessary if sod forming grasses are present. Specialty herbicides such as Imazapyr (when used in combination with glyphosate) are effective at controlling unwanted vegetation. If desirable native vegetation such as broomsedge and wildflowers are present consider managing the existing stand instead of establishing more native grasses. This can be accomplished by eradicating undesirable cool-season grasses in the fall after a killing frost with glyphosate or by applying selective herbicides such as Imazapyr during the growing season.

Prescribed Burning – Prescribed burning should be used to maintain desired nesting and brood-rearing cover. Low productivity and droughty conditions may reduce the frequency of disturbances compared to surrounding native grasslands. Prescribed burning helps stimulate quail food plants and creates desirable plant structure. As a general rule of thumb, reclaimed mineland grass fields should be burned on a 3 to 5 year rotation.

As a general rule of thumb, no more than 1/3 of grass fields should be burned each year. Care should be taken to leave desired nesting cover each year. Generally, prescribed burn units should be less than 20 acres in size; however, good quail habitat can be maintained in larger burn units (up to 80 acres or larger) if undisturbed upland sites (1 to 5 acres in size) are maintained and well distributed throughout the burn unit. Ideally, 25 to 50% of the site should provide quality nesting cover.

Depending on the vegetative cover, reclaimed mineland grass fields may be burned any time of the year, with the exception of during the spring and early summer nesting season. Land managers should apply fire to the landscape at different times of the year so portions of fields provide suitable cover throughout the year. Excessive burning all at once can negatively impact quail.

Spring burns help stimulate the growth of native grasses while suppressing the growth of cool-season grasses and woody vegetation. Spring burns are not recommended for rank stands of native grass unless additional management practices will be performed (i.e. strip disking or patch burn grazing).

Summer burns accomplish different goals than cool season burns – photo by Jef Hodges, NBCI

Summer and early fall prescribed burns are effective at setting back rank stands of native warm-season grass and excessive woody growth. Summer and early fall burns will also stimulate the growth of cool-season grasses. Warm-season grass fields infested with cool-

season grasses should be burned in the summer or fall if a follow up herbicide application to control these grasses is planned. Winter burns help stimulate the growth of native forbs and legumes.

When possible, consider combining disturbance practices to improve habitat structure and prolong habitat benefits for wildlife. For example, consider implementing a prescribed fire and follow up with strip disking or an herbicide application in the same portion of the field. Land managers should also consider combining prescribed fire with managed grazing to create patch burn grazing systems.

Strip Disking – Where feasible, fall or winter strip disking can be applied to create a mosaic of disturbed and undisturbed areas. Disturb no more than 1/3 of the field each year. If possible, disking should be completed at different times of the year to avoid removing too much cover at once.

Disking reclaimed mineland promotes desirable plants – photo by John Morgan, KDFWR

Light disking reduces residue, creates bare ground, and promotes desirable broadleaf plants that produce seed and attract insects. To be effective, complete light disking in grassland

habitats next to areas of useable shrubby cover. Disked strips should be 25 to 75 feet wide and separated from each other by an area of undisturbed vegetation twice as wide as the disked strip. Disking should occur with the contour of the field to reduce soil erosion. On relatively flat ground and in field borders, disking may be completed in blocks instead of strips.

Disking should result in 30 to 70% bare soil. In many cases, dense, rank stands of vegetation must be burned, hayed or mowed prior to disking. The combination of management activities will help create different plant responses and vegetative structure in the grassland. Late summer or fall disking tends to favor broadleaves such as ragweed and croton, while spring disking tends to favor annual grasses such as foxtail and crabgrass. The disked areas will produce succulent forbs and legumes, which attract insects and produce abundant seed, while the adjacent undisked areas will provide nesting and roosting cover.

Managed Grazing and Haying – Applied properly, grazing can create and maintain quality quail habitat, which includes the interspersion of nesting, brooding and shrubby cover. Generally, a pasture should be left undisturbed from grazing and haying activities for a minimum of 60 days to provide adequate time for a hen to initiate and hatch a nest. Quail prefer to nest in clumps of undisturbed grass with the previous year's growth and at least 8 inches tall to conceal nests and in close proximity to brood-rearing cover. Land managers should consider deferring grazing in one or more paddocks during the spring and early summer nesting season. These paddocks can be reserved for late summer and winter forage.

Unhayed border left for wildlife – photo by Jef Hodges, NBCI

In hay pastures consider delaying harvest until early summer to avoid destroying quail nests and young birds. Land managers interested in enhancing quail numbers should refrain from haying corners and odd areas; leave large blocks or a 30 to 120 foot wide unharvested border around the edge of the field.

Interseeding can increase diversity – photo by Chris McLeland, MDC

Interseeding – On reclaimed sites consider interseeding native wildflowers (5 to 20 species mix) and/or legumes such as alfalfa and annual lespedeza to improve plant diversity in grass fields. Native wildflowers and desirable legumes provide ideal brood-rearing cover and excellent food sources. Best success occurs immediately after a disturbance such as prescribed burning, strip disking, managed grazing or herbicide application. Native wildflowers and legumes can be seeded by broadcast methods or with a no-till drill. Native wildflowers should be planted at the rate of 1 to 5 PLS pounds per acres and dormant seedings are preferred over spring seedings. Legumes should be seeded at the rate of 1 to 5 PLS pounds per acre.

Reclaimed mine valley fill planted in fescue and autumn olive – photo by Keith Krantz, WVDNR

Invasive Plant Control – Historically, a variety of nonnative and aggressive plants were planted on reclaimed mine lands. In the past, invasive species such as Japanese honeysuckle, sericea lespedeza, tall fescue, autumn olive and black locust were planted. Invasive plants crowd out important quail friendly plants, negatively impacting habitat structure for quail. Depending on management objectives, infested sites should be annually checked for new stands of unwanted plants. However, large-scale control measures may not be feasible due to past management. If left uncheck, invasive vegetation can overtake desirable vegetation and plant structure.

Food Plots and Patches – Establishing food plots may not be feasible on reclaimed mineland due to acidic soils, droughty conditions and low soil fertility. However, food plots may be feasible on some reclamation sites. Food patches provide high-energy food to help quail survive during severe winter weather. Weedy food plots provide excellent brooding and loafing cover for young quail during the summer months. Establishing food plots or patches generally do not produce more quail on a property. Land managers often overemphasize the importance of food plots while overlooking other management needs. Generally, a quarter acre food plot

or patch planted to corn, milo, millet, forage sorghum, soybeans, cowpeas or other grains is sufficient on each 40 acres of habitat. When feasible long, linear food plots are preferred over block plantings. Consider rotating food strips across the area each year by leaving half of each plot idle and planting the other half. The idle area provides excellent brooding cover. Food plots in grazed grasslands must be fenced from livestock. Food plots are most effective when established adjacent to protective woody cover and diverse grass and wildflower stands.

Edge feathering – photo by Scott James, Quail Forever

Shrubby Cover Enhancement – Improve shrubby cover on reclamation sites by edge feathering small woodlots or by establishing woody corridors in areas where this important cover is lacking. Winter coveys will often establish a headquarters area and loafing site around one or more shrub or low-growing woody cover sites. Patches of shrubby or woody cover should be at least 30 to 50 feet wide and spaced 20 to 100 yards apart. Shrub rows should be at least 10 to 30 yards wide. Native shrubs such as wild plum, shrub dogwood, blackberry and hazelnut make excellent shrubby cover for bobwhites.

Edge feathering is used to create woody escape cover along woodland edges, existing tree lines, and woody draws. This creates a transition zone of shrubs, vines, and herbaceous vegetation between cropland or grassland and wooded area. To be effective, edge feathering should be completed next to early successional vegetation such as managed wildlife friendly grasses/legumes, field borders, food plots or cropland. As a rule of thumb, cutback borders should be at least 30 to 50 feet deep into the wooded area and at least 1,500 square feet in size. Edge feathering may be completed in blocks or in long linear strips along the field edge.

A view of edge feathering from inside tree line – photo by Scott James, Quail Forever

Kill existing grass/vegetation (regardless of type) before edge feathering with an approved herbicide. This provides good growing conditions for annual food plants and shrubs. All trees over 15 feet tall in the area should be edge feathered, making sure native shrubs are left undisturbed. An occasional tree may be left to preserve valuable timber or mast producing species. Generally, treat all cut stumps with an approved herbicide to prolong the benefits of edge feathering. If possible, leave felled trees where they fall. Felled trees may be dropped parallel to the fence line/field edge or cut and loosely stacked along the edge of the field. Do not push the downed trees into a dense brush pile. Edge feathering may be completed with a chainsaw or mechanical clipper.

Native shrub thickets can be established from seed, bare root or container grown plants. In all cases, preparing the site by eradicating all existing vegetation is critical. Land managers should maintain adequate weed control for 2 to 5 years after planting, or until shrubs are well established. Newly planted shrub thickets can be enhanced by adding large, downed trees. The cut trees provide suitable protective cover until the shrubs are well established.

Existing shrub coverts can be enhanced by protecting small patches from prescribe fire and other disturbances for several years or until well-established, by controlling sod-forming grass such as fescue or brome underneath and around coverts, and by cutting down overstory trees.