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Changes in Vegetation and Bobwhite Quail and Eastern Cottontail Rabbit Use in a Converted Fescue Field

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Abstract

A pair of approximately 8.1 ha (20 acre) tall fescue (*Festuca arundinacea*) dominated fields at Kleber Wildlife Management Area (KWMA), Owen County, KY, were chosen to determine the effects of converting fescue-dominated vegetation to an orchard grass/legume mixture on bobwhite quail (*Colinus virginianus*) and eastern cottontail rabbit (*Sylvilagus floridanus*) habitat and utilization. One field was treated and 1 remained untreated for comparison. The treated field showed increased plant species diversity (66 spp. on untreated/101 spp. on treated), a higher percentage bare ground the year of treatment (10.4% on untreated/ 24.4% on treated), and a greater abundance of legumes (6 spp. of legumes on untreated, none having >1.0% total cover/8 spp. of legumes on treated, 6 having >1.0% total vegetative cover). The treated field had 27 plant species providing at least 1.0 per cent cover while the untreated field had 10 species. An index value was calculated to compare the value of the vegetation of the fields to bobwhite quail and eastern cottontails. The treated field was rated at 59 points and the untreated field rated at 14 points (the higher the index value, the better the habitat). Quail and rabbit use of the treated field increased while the untreated field remained unutilized. Costs involved to implement the fescue conversion and mosaic mowing were $182.15/ ha plus approximately 20 manhours/ha labor.

Introduction

Eastern cottontail rabbit and northern bobwhite quail are 2 of the most important game species in Kentucky. Recent data indicate the eastern cottontail rabbit to be the third most sought-after game species in the state with approximately 160,000 rabbit hunters harvesting 1.5 million cottontails annually (1, 2). Rabbit hunting provides an estimated 1.4 million mandays of recreation to Kentucky sportsmen while contributing about 23.7 million dollars to local economies (1, 2). The northern bobwhite quail is the number 1 game bird in Kentucky and ranks 6th in popularity as a Kentucky game species (1).

Northern bobwhite quail and eastern cottontail rabbit populations have shown long-term declines in Kentucky over the last 3 decades (3). These population trends are generally attributed to habitat losses due to major changes in land-use practices such as urban sprawl, intensification of commercial agricultural tillage practices, and widespread conversion of open lands, pastureland and hayland to "KY 31" tall fescue (*Festuca arundinacea*) dominated stands. Of the approximately 7.0 million acres of grassland in Kentucky, 5.5 million acres have been planted to "KY 31" tall fescue cover (4).

Wildlife biologists have long recognized the low wildlife habitat value provided by dense sod forming grasses such as "KY 31" tall fescue (5–13). The highly competitive and invasive growth of "KY 31" results in reduced plant species diversity within hayland/pastures and old fields. The dominance of "KY 31" over other pasture and old field species has resulted in an almost uniform coverage of Kentuc-

ky's open lands. A second problem noted with "KY 31" is the thick, rank growth habit characteristic of the species which restricts movements of wildlife species and retards plant succession.

More recent evidence has revealed a third problem associated with KY 31, or more appropriately, with the endophytic fungus (*Acremonium coenophialum*) which lives in "KY 31". Lacefield et al. (14) and Siegel et al. (4) reported nearly 80% of the tall fescue fields in Kentucky are infected with the endophyte, at a rate of 80% or higher. Data indicate a diet of endophyte-infected "KY 31" impacts the reproductive potential of laboratory animals and livestock (i.e., 15–21) through decreased sperm and egg counts, smaller than normal litter sizes, lowered lactation rates, poor weight gains, elevated body temperatures, and abortion or absorption of fetuses. Sadler (8) found cottontail rabbit reproduction and survival were reduced when rabbits were kept in outdoor pens vegetated with tall fescue. Betsill et al. (7) reported cottontails in North Carolina avoided areas containing fescue.

Recognizing that lowered reproductive potential reported in laboratory animals and livestock may apply to wild cottontails and other wildlife species living in fescue-dominated habitat, the Kentucky Department of Fish and Wildlife Resources (KDFWR) recommends conversion of "KY 31" tall fescue fields to other cover types by private landowners interested in improving wildlife habitat on their land. Terrain often dictates no-till conversion methods be used. In conjunction with fescue conversion, KDFWR often recommends mowing practices be implemented to improve interspersion of escape cover.

This study was initiated to determine the effect of converting "KY 31" tall fescue-dominated fields to another grass/legume mixture, coupled with mosaic pattern mowing to improve escape-cover interspersion, on northern bobwhite quail and eastern cottontail rabbit populations. The costs associated with no-till conversion of tall fescue were also documented.

Study Area

The Kleber Wildlife Management Area is located approximately 35.4 km northeast of Frankfort, within the Outer Bluegrass physiographic region, in Owen and Franklin counties, Kentucky. This 929 ha area is characterized by steep rolling hills with narrow flat ridge tops and narrow stream valleys. Elevations range from 198 to 274 m msl. Approximately 60% of the area is wooded, with eastern red cedar (*Juniperus virginianus*) dominated old fields and woodlands and oak-hickory dominated woodlots. The remaining 40% of the area is old-field type open lands dominated by tall fescue. Kleber Wildlife Management Area (KWMA) was chosen as a study site because habitat conditions were very similar to those typically found on privately owned land in many parts of the state.

Materials and Methods

Two fescue-dominated fields (1 control, 1 conversion), each about 8.1 ha in size, were chosen for study on KWMA. Baseline data documenting bobwhite quail and cottontail rabbit use and vegetative composition were gathered for both fields for 1-year prior to treatment (1987). A fescue conversion project was implemented on 1 field in 1988. Vegetative composition and quail and rabbit use were monitored on both fields through 1990.

Vegetative Sampling.—Vegetative sampling was conducted annually on both fields during September. These data were collected 1 year prior to treatment (1987) and for 3 years following treatment (1988–1990). Forty 1-m^2 sample plots were positioned at 30.5 m intervals along line transects. Transects were designed to bisect all slopes and aspects present and were marked with steel fence posts. A compass bearing from 1 post to the other was followed to make the yearly sample points as consistent as possible. Ocular estimates were made of per cent total vegetative cover, per cent bare ground, average vegetation height, and per cent total cover contributed by each plant species.

Individual species were ranked by per cent total cover contributed in each treatment type. Plant species with >4.0% total cover were assigned a subjective numerical rating of good (=2), fair (=1) or poor (=0) as food and cover for quail and rabbits based on literature review (i.e., 5, 11–13, 22–41). An overall numerical index value for each field was derived by summing index values for each plant species providing at least 4.0% total cover.

Quail and Rabbit Sampling.—Flush-drive censuses (42) were conducted in September for 1 season prior to treatment (1987), during the treatment year (1988) and for 2 years (1989–1990) following treatment. Surveys were conducted by spacing personnel approximately 6 m apart and traversing the fields in a manner to cover each area as entirely as possible. Number of quail coveys, total birds per covey and the number of rabbits flushed were determined. Efforts were made to watch the direction of flush and subsequent movement of animals to eliminate recounting.

Fescue Conversion.—One field served as a fescue-dominated control and the other field was converted from a fescue-dominated vegetative cover to a grass/legume mixture. On 5 March 1988, the treatment field was limed in accordance with soil test recommendations. On 28 March 1988, a prescribed fire was used on the entire treatment field to remove heavy litter and duff from the ground. On 14 April 1988, approximately 50% of the area was sprayed with glyphosphate (Roundup) at a rate of 3.9 liter/ha to kill the vegetation. Portions of the field were not sprayed due to steepness of the slopes. A no-till drill was used to plant a mixture of orchard grass (*Dactylis glomerata* at 5.8 kg/ha), ladino clover (*Trifolium repens* at 3.9 kg/ha), red clover (*Trifolium pratense* at 2.4 kg/ha) and Korean lespedeza (*Lespedeza striata* at 3.9 kg/ha) on 26 April 1988. Total costs were recorded and a cost/area rate determined.

Mosaic pattern strip-mowing was conducted during late July 1988 and late July 1990 on the treatment field to control woody plant encroachment and create a mosaic of herbaceous and early succession woody cover that would provide more optimum quail and rabbit habitat (9, 39).

RESULTS AND DISCUSSION

Baseline vegetative sampling, completed in September 1987, showed the 2 fields to be similar in vegetative composition prior to treatment. Both fields were dominated by "KY 31" tall fescue and bluegrass (*Poa pratensis*). The untreated field also had a fairly high component of prairie dropseed (*Sporobolus asper*).

A total of 115 plant species was identified from the vegetative sampling during all years of the study. Sixty six plant species were documented in the untreated field and 101 in the treated field (Table 1). Forty one (41) species were unique to the treated field and six species were only found in the control field (Table 1).

The fescue conversion to the chosen grass/legume mixture was completed in April 1988 and can be considered only a partial success. The kill on the fescue was not total, and fescue came back as a codominant cover species in the treated field during the study period. Germination and survival of the planted grass/legume mixture was poor due to the severe 1988 drought; orchard grass was essentially lost but clovers and Korean lespedeza survived better. Korean lespedeza survived the drought better, providing 10.6% and 6.7% vegetative cover in the treated field for 2 years following treatment. Legumes responded well to treatment, resulting in 6 species of legumes with at least 1% total cover on the treated area. No legumes documented in the control field provided 1% cover.

Conversion was successful at increasing overall plant diversity and the number of dominant plant species (Tables 1, 2). The treated field had 27 species of plants providing at least 1.0% cover compared to 10 species on the untreated field. Likewise, when looking at plant species providing 4.0% or more cover, the treated field had 11 species while the untreated field had 4 species (Table 2). An index to post-treatment quality of plant cover showed the untreated area to have an index of 4 for quail and 10 for rabbit; for an overall rating of 14. The treated area had an index of 27 for quail and 32 for rabbit; an overall rating of 59 (Table 2).

While the percentage of bare ground remained nearly constant and averaged 11.2% on the untreated site, bare ground increased from 14.4% pretreatment to 24.4% on the treated field the year immediately following treatment. However, during the 2 years post-treatment the per cent bare ground was lower (7.8%) on the treated field than in the untreated field. Ideal quail habitat should have been between 30% and 60% bare ground to provide adequate space for feeding and movement (39).

With the exception of the decrease in bare ground in years 2 and 3 following treatment, all the vegetation changes observed on the

TABLE 1. Plant species identified on fescue converted and control fields at the Kleber WMA, Owen County, Kentucky.

Species	Common name	Untreated	Treated
Acalypha rhomboidea	3-Seeded Mercury	x	x
Achillea millefolium	Yarrow	x	x
Agrimonia pubescens	Agrimony	x	x
Allium sp.	Wild Onion	x	–
Ambrosia artemisiifolia	Ragweed	x	x
Andropogon virginicus	Broomsedge	x	x
Antennaria plantaginifolia	Pussy-toes	–	x
Apocynum cannabinum	Indian Hemp	–	x
Asclepias syriaca	Big Milkweek	–	x
Asclepias tuberosa	Butterfly Weed	x	x
Aster ericoides	Aster	x	x
Aster patens	Aster	–	x
Barbarea sp.	Mustard	–	x
Blephilia ciliata	Blephilia	x	x
Campsis radicans	Trumpet Vine	–	x
Carex sp.	Sedge	x	x
Carya ovata	Shagbark Hickory	–	x
Celtis occidentalis	Hackberry	–	x
Chrysanthemum leucanthemum	Ox-eye Daisy	x	x
Cirsium arvense	Canada Thistle	x	x
Cirsium vulgare	Bull Thistle	–	x
Coreopsis lanceolata	Wingstem	–	x
Cornus obliqua	Silky Dogwood	–	x
Crataegus sp.	Hawthorn	–	x
Croton sp.	Doveweed	x	–
Dactylis glomerata	Orchard Grass	–	x
Danthonia spicata	Poor Man's Grass	x	–
Daucus carota	Queen Anne's Lace	x	x
Desmodium paniculatum	Tick Trefoil	x	x
Dianthus armeria	*Deptford Pink*	x	–
Digitaria sanguinalis	*Crabgrass*	–	x
Dipsacus sylvestris	*Teasel*	–	x
Elymus virginicus	*Wild Rye*	–	x
Eragrostis capillaris	*Love Grass*	x	x
Erigeron annuus	*Daisy Fleabane*	x	x
Euonymus americanus	*Strawberry Bush*	x	x
Eupatorium serotinum	*Boneset*	–	x
Euphorbia corollata	Flowering Spurge	x	x
Euphorbia maculata	Euphorbia	x	x
Festuca arundinacea	Tall Fescue	x	x
Fragaria virginiana	Wild Strawberry	x	x
Fraxinus americana	White Ash	–	x
Gleditsia triacanthos	Honey Locust	–	x
Gnaphalium obtusifolium	Gnaphalium	x	x
Helianthus mollis	Sunflower	–	x
Houstonia purpurea	Houstonia	–	x
Hypericum punctatum	St. John's Wart	x	x
Ipomoea pandurata	Morning Glory	x	x
Lespedeza procumbens	Trailing lespedeza	x	x
Lespedeza striata	Korean lespedeza	x	x
Lespedeza virginica	Virginian Lespedeza	x	–
Lonicera japonica	Honeysuckle	x	x
Ludwigia sp.	Rattlebox	–	x
Lysimachia quadrifolia	Whorled Loosestrife	–	x
Maclura pomifera	Osage Orange	–	x
Melilotus alba	White Sweet Clover	x	x
Melilotus officinalis	Yellow Sweet Clover	x	x
Monarda fistulosa	Monarda	x	x
Osmorhiza sp.	Sweet Sicily	–	x
Oxalis stricta	Wood Sorrel	x	x

TABLE 1. Continued.

Species	Common name	Untreated	Treated
Panicum capillare	Panic Grass	x	x
Panicum clandestinum	Deer Tongue	x	x
Panicum microcarpon	Panic Grass	x	x
Parthenocissus quinquefolia	Virginia Creeper	x	x
Paspalum sp.	Paspalum	x	x
Physalis sp.	Ground Cherry	x	x
Plantago lanceolata	Plantain	x	x
Plantago major	Plantain	x	x
Poa pratensis	Bluegrass	x	x
Potentilla simplex	Cinquefoil	x	–
Prunus serotina	Black Cherry	–	x
Quercus prinus	Chestnut Oak	–	x
Rhus copallinum	Winged Sumac	–	x
Rhus glabra	Smooth Sumac	x	x
Robinia psuedoacacia	Black Locust	–	x
Rosa carolina	Carolina Rose	x	x
Rosa multiflora	Multiflora Rose	x	x
Rubus sp.	Blackberry	x	x
Rubus flagellaris	Dewberry	x	x
Rubus pensilvanicus	Raspberry	x	x
Rudbeckia hirta	Black-eyed Susan	x	x
Ruellia caroliniensis	Wild Petunia	x	x
Rumex acetosella	Dock	x	x
Sanicula canadensis	Sanicula	–	x
Setaria glauca	Foxtail	x	x
Smilax bona-nox	Greenbriar	–	x
Solanum carolinense	Horse Nettle	x	x
Solidago altissima	Field Goldenrod	x	x
Solidago nemoralis	Gray Goldenrod	–	x
Spiranthes cernua	Ladies Tresses	x	–
Sporobolus asper	Prairie Dropseed	x	x
Symphoricarpos orbiculata	Coralberry	x	x
Toxicodendron radicans	Poison Ivy	x	x
Tridens flavus	Greasy Grass	x	x
Trifolium pratense	Red Clover	–	x
Trifolium procumbens	Yellow Hop Clover	x	x
Trifolium repens	White Clover	–	x
Ulmus alata	Winged Elm	–	x
Unknown mint	Sticky Purple Stuff	x	x
Verbascum thaspus	Woolly Mullein	–	x
Verbena simplex	Verbena	–	x
Verbesina occidentalis	Crownbeard	–	x
Vernonia altissima	Ironweed	x	x
Viburnum prunifolium	Black Haw	x	x
Viburnum rifidulum	Black Haw	x	x
Viola sp.	Violet	x	x
Vitis vulpina	Frosty Grape	–	x
Total species		66	101
			115

treated field would be considered beneficial to quail and rabbits utilizing the area.

The mosaic mowing pattern implemented on the treated field had a positive impact on vegetation important to quail and rabbit. Escape cover resulting from the establishment of species such as blackberries, raspberries, dewberries (*Rubus* spp.), coralberry (*Symphoricarpos orbiculatus*), goldenrod (*Solidago altissima*), sweet clover (*Melilotus officinalis*), and crown beard (*Verbesina occidentalis*) was developed in desired patterns by mowing the treated field. Herbicide treatment released woody species from the fescue domination.

TABLE 2. Plant species with >4.0% cover found in 1 m^2 plots on fescue converted and control fields at the Kleber WMA, Owen County, Kentucky indexed to indicate value for food or cover for bobwhite quail and cottontail rabbits.

Species	Food value		Cover value		Quail index	Rabbit index	Total index
	Quail	Rabbit	Quail	Rabbit			
Converted field							
Festuca arundinacea	poor	poor	poor	poor	0	0	0
Poa pratensis	poor	good	fair	good	1	4	5
Lespedeza procumbens	good	good	fair	fair	3	3	6
Lespedeza striata	good	good	fair	fair	3	3	6
Symphoricarpos orbiculata	fair	good	good	good	3	4	7
Solidago altissima	poor	poor	fair	good	1	2	3
Melilotus officinalis	good	good	good	good	4	4	8
Tridens flavus	fair	fair	fair	fair	2	2	4
Rubus spp.	fair	fair	good	good	3	3	6
Ambrosia artemisiifolia	good	good	good	good	4	4	8
Panicum capillare	good	good	fair	fair	3	3	6
					27	32	59
Control field							
Festuca arundinacea	poor	poor	poor	poor	0	0	0
Poa pratensis	poor	good	fair	good	1	4	5
Sporobolus asper	poor	good	good	good	2	4	6
Solidago altissima	poor	poor	fair	good	1	2	3
					4	10	14

Mowing controlled woody invasion and provided escape cover approaching the optimum distribution of within 100 m of other cover types (9, 39).

There was a change in utilization of the fields by quail and rabbits following fescue conversion; no use was detected in surveys prior to treatment. The fall following treatment, at least 1 covey of quail had become established on the treated field and 1 rabbit was flushed during the survey. The next fall, a covey of birds was again found on the treated area and 3 rabbits were flushed. During the last survey period no quail were found; however, 5 rabbits were observed. It is assumed these animals represent an increase to the local populations. The numbers should be considered conservative. Each year rabbits were flushed which could not be positively identified as different from a previously flushed rabbit and were not counted. The flush-survey method has been shown to find approximately 50% of a quail population (41). Therefore, there were likely 2 coveys of quail using the treated field for 2 years immediately following treatment.

After the initial year following treatment, habitat quality for quail declined due to the lack of bare ground (39). By the 1990 survey, the vegetation on the treated field may have become too thick for quail utilization: This suggests a need for vegetative disturbance on a 3-year rotation in order to keep ground level vegetation open enough for quail use.

No quail or rabbit use was found on the untreated field until the last survey. During that survey a pair of quail were flushed from a multiflora rose thicket in a draw crossing the field. It is hypothesized that these quail were simply using the brushy corridor to cross the area and were not residents of the field.

This single replication study cannot make conclusive statements on the value of no-till fescue conversion to rabbit and quail populations. However, the results support the practice of converting fescue to other plant cover types. Native and planted legumes, which are a major food source for quail and rabbits, (9, 12, 13, 22, 23, 26, 27, 30, 31, 36, 39, 43, 44), responded very favorably. Bare ground increased initially, to allow better movement and feeding by quail.

Cost analysis for the fescue conversion and mosaic pattern mowing are shown in Table 3. The costs for this project totaled $182.15/ha for chemicals, no-till equipment rental, and seed for the area treated. About 20 manhours/ha labor were required to accomplish the task.

The costs for seed and no-till drill rental on this project were more than half the total ex-

TABLE 3. Cost analysis of a no-till fescue conversion project on a field at Kleber WMA, Owen County, Kentucky. Costs based on 1988 prices.

Item	Direct $ cost	Manhours	Tractor fuel used
Prescribed fire		5 hr/ha	
Herbicide treatment			
Chemical	$81.90/ha 3.9 liters/ha "Roundup" $21/liter		
Spraying		7.5 hr/ha	0.4 ha/liter
No-till seeding			
Drill rental	$7.75/ha	7.5 hr/ha (seeding)	0.4 ha/liter
Seed	$92.50/ha per mix used on area		
Mowing		7.5 hr/ha/yr	0.4 ha/liter
Total costs	$182.15/ha	20 hr/ha (implementation) 7.5 hr/ha/yr (mosaic maintenance mowing)	

penses. Due to the extreme drought conditions experienced during the 1988 growing season, very little resulted from planting the orchard grass/legume mixture. However, the grasses, forbs and legumes released by the burning and spraying alone provided excellent cover and food for bobwhite quail and eastern cottontails. This suggests little need for planting a grass/legume mixture on fescue conversion sites where enhancing wildlife habitat is the primary objective.

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