Grassland Evaluation Contest
Study Guide

The Missouri Forage and Grassland Council, in cooperation with the Missouri Department of Conservation; University of Missouri Extension; local Soil and Water Conservation Districts; and, the USDA-Natural Resources Conservation Service sponsor the District, State and Mid-America Grassland Evaluation Contest. Many Natural Resource Professionals have contributed to this contest, which started in Missouri in 1991.

15th Edition: August, 2023

Grassland Evaluation Study Guide
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GRASSLAND EVALUATION
TEACHER'S GUIDE

Introduction

The Grassland Evaluation program consists of four sections: (1) Grassland Condition, (2) Soil Evaluation, (3) Wildlife Habitat and (4) Plant Identification. Each of these factors must be considered in evaluating pastures or grasslands to best utilize the resource and to help make useful management decisions.

NOTE TO INSTRUCTORS: See section "Suggested References" (pages 92 & 93) for additional sources of information to use with this Contest Guide.

Contest Layout

The judging site will be a typical pasture or area used for livestock grazing. Within the pasture area, a 50 by 50-foot plot will be marked-off with flags. Participants will not be allowed to walk into or touch plants within this plot. This area will be used by the participants to answer certain parts of the Wildlife, Soil Interpretation and Grassland Condition Score Cards. Additional flags at or near this site will also be used to determine the percent of slope as required on the Soils Score Card. Additional areas or sites may be designated by the Contest Officials as needed to complete the Contest.

A **"scenario with a landowner's goals for livestock and wildlife production"** will be provided at the Contest site. Appropriate soil survey information, aerial photos, maps, score cards and any other relative information will be made available to the contestants on the day of the Contest. This information must be considered to complete each Score card.

Plants marked for the Plant Identification portion of the Contest will be marked in the field or they may be displayed as mounted specimens. Depending upon the plants available, certain plants may be temporarily "transplanted" to the site for purposes of identification. Participants will not be allowed to touch the plants marked for plant identification purposes during the Contest.

Grassland Condition

Grassland evaluation is a process of appraising present conditions in a field and making decisions to correct problems or to utilize the resource in a manner that better suits the landowner's goals.

Many problems in grasslands and pastures develop from mismanagement or lack of planning. In order to correct problems you must first determine the condition of the field then make corrective decisions that are based on sound agricultural practices compatible with the landowners goals. The landowner's goals will be provided for each judging site. Livestock production should be the primary interest for the field when filling out the Grassland Condition Management scorecard with wildlife production only as a secondary goal.

Wildlife Habitat

Managing for wildlife requires providing nesting, brood, and escape cover; and year round food; most of which can be provided by plants naturally occurring in the environment when properly managed. When scoring the Wildlife Habitat scorecard, keep wildlife needs in mind to create compatible use production. Students should walk the whole field to evaluate all the elements. While walking the field, ask the questions, "If I were a quail or rabbit (wildlife) what is good, what is missing?" and "If I were livestock, what would define the field?" Fences may be permanent or temporary (hot wire).

Certain portions of the Wildlife Score Card will be answered by referring to the 50 X 50 foot plot as outlined above.

Soil Interpretation

Soil properties strongly influence both forage selection and field management. Soil surveys published by the Natural Resources Conservation Service are a basic tool to the grassland manager. They provide information about the properties of all the soils in a county.

The adaptation of plants to certain soils is also an important aspect of grassland management. Some plants thrive in deep, well drained soils but do poorly in shallow, poorly drained soils. Factors that limit plant adaptation may be soil fertility, poor soil drainage, soil depth, or droughtiness. A successful grassland manager determines the soil type and matches adapted forages to that environment.

Soil survey information will be provided at the judging site. The correct soil series must be determined by locating the judging site and soil mapping unit on an aerial photograph of the farm.

The soils slope will be determined using the site that is identified with flags as described above.

Plant Identification

You cannot successfully manage grasslands without a working knowledge of plant identification. You must be able to identify the plants you are managing and also the weedy invaders that might occur. A basic knowledge of the plants that are considered good food for wildlife is necessary to successfully increase numbers. It is also important to know the life cycle of the major plants found in grasslands and pastures. Perennial plants are managed differently than annual plants. Likewise, control of undesirable plants depends upon whether it is an annual, perennial, broadleaf, grass or grass-like plant.

GRASSLAND EVALUATION CONTEST RULES

The "GRASSLAND EVALUATION CONTEST GUIDE" will provide additional details as to how the GRASSLAND EVALUATION CONTEST is to be set up and conducted at the contest site. All contestants should familiarize themselves with this information along with these CONTEST RULES (reviewed annually).

RULES DURING COMPETITION:

1. A contest team will consist of a maximum of four (4) or a minimum of three (3) students who are currently enrolled at the high school level (FFA or 4H). If less than three members of a qualifying team competing at district are present, they may enter and compete as individuals at state contest. Only one scoring team per FFA chapter or 4H club (or group) will be allowed to compete, however, additional teams are encouraged to participate. The scoring team must be designated prior to the start of the contest.

2. Contestants will be supplied scantron, score cards, appropriate maps or aerial photos and any necessary information. All score cards, maps and aerial photos will be collected at each judging site. Instructors will provide scantrons for their students at the District Contests. Grassland Committee will provide scantrons for students at the State Contest.

3. Contestants will fill out their name, and team number on the scantron. If these items are left off the scantron, the individual will receive a zero (0).

4. Contestants will be allowed twenty-five (25) minutes to judge each of the four (4) segments of the contest with three (3) minutes to move between judging sites. Total contest time is approximately two (2) hours.

5. Contestants may use non-programmable hand-held calculators. Each participant will furnish their own pencils, calculator and clip board.

6. Contestants will NOT be allowed to:
   A. Talk to anyone during the contest or use other printed materials for reference.
   B. Touch plants used for the plant identification.
   C. Leave the contest site during the contest. There will be NO exceptions.
   D. Step into or touch plants within the 50 X 50 ft. plots.
   E. Have cell phones, smart watches or any other electronic devise on contest site.

7. Only contestants and officials will be allowed within the contest area during the contest.

8. Judge's decisions will be final concerning any questions involving the contest.

(Continued)

SCORING RULES AND ADDITIONAL GUIDELINES:

9. The winning team will be determined by adding together the highest three (3) team member's scores.

10. In case of a tie score, the Plant I.D. score will be used to determine the winner. Should this score also result in a tie, the Grassland Condition Score will be used followed by a "coin-flip" in the event of another tie.

11. Each of the six (6) District Contests may send four (4) FFA and four (4) 4-H top scoring teams to the State Contest.

12. Each team (both FFA and 4-H) must compete within their Vocational Education District boundary.

13. The highest scoring three-member FFA &/or 4H team(s) at the State Contest will become the State Champion Team(s)

14. The five highest scoring teams (FFA &/or 4H) will be eligible to represent Missouri at the Mid-America Grassland Evaluation Contest. Should any team be unable to attend, the instructor is asked to provide notice at least sixty (60) days prior to the Mid-America Contest.

15. Members of the 4-H and FFA first place teams in the State Grassland Evaluation Contest will not be eligible to participate in the next year's contest.

16. Questions to committee members will no longer be accepted after District Contests are over.

SCORE CARD CLARIFICATION NOTES:

17. Plant Identification: This part of the contest involves two answers (common name and life cycle) for each of the twenty-five plants. Both answers must be correct for the question to be considered as correct. If the plant falls in both life cycle categories, either one or both can be marked to be considered correct.

18. Grassland Condition: Question no. 3, "Matching Livestock & Forage". The answer to this question must be within a ten pounds (10 lbs) of the final correct answer determined by the judges at the contest site. Question no. 7, "Limestone Rate" answer must be rounded to the nearest tenth.

19. Soils: Contestants will determine "soil slope" from designated stakes located at or near the "soils" site. Elevations will not be given.

DISTRICT & STATE RULES REVISED: August, 2013

GRASSLAND EVALUATION CONTEST RULES

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RULES DURING COMPETITION:

1. A contest team will consist of a maximum of four (4) or a minimum of three (3) students who are either currently enrolled at the high school level (FFA or 4H). If less than three members of a qualifying team competing are present they may enter and compete as individuals at Mid America contest.

2. Contestants will be supplied scantron, score cards, appropriate maps or aerial photos, and any necessary information. All score cards, maps and aerial photos will be collected at each judging site.

3. Contestants will fill out their name and team number (provided at registration) on the scantron. If these items are left off the scantron, the individual will receive a zero (0).

4. A maximum of five (5) 4-H and five (5) FFA teams may enter from each state.

5. Contestants will be allowed twenty-five (25) minutes to judge each of the four (4) segments of the contest with three (3) minutes to move between judging sites. Total contest time is approximately two (2) hours.

6. Contestants may use non-programmable hand-held calculators. Each participant will furnish their own pencils, calculator and clipboard.

7. Contestants will NOT be allowed to:
   A. Talk to anyone during the contest or use other printed materials for reference.
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   E. Have cell phones, smart watches or any other electronic devise on contest site.

8. Only contestants and officials will be allowed within the contest area during the contest.

9. Judge's decisions will be final concerning any questions involving the contest.

(Continued)

SCORING RULES AND ADDITIONAL GUIDELINES:

10. The winning team will be determined by adding together the highest three (3) team member's scores. If less than three (3) members of a team are present, they may enter and compete as individuals.

11. In case of a tie score, the Plant I.D. score will be used to determine the winner. Should this score also result in a tie, the Grassland Condition Score will be used followed by a "coin-flip" in the event of another tie.

12. Members of the 4-H and FFA first place teams in a Mid-America Grassland Evaluation Contest will NOT be eligible to participate in the next year's contest.

SCORE CARD CLARIFICATION NOTES:

13. Plant Identification: This part of the contest involves two answers (common name and life cycle) for each of the twenty-five plants. Both answers must be correct for the question to be considered as correct. If the plant falls in both life cycle categories, either one or both can be marked to be considered correct.

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AWARDS

16. Team members compete for both team and individual awards.

17. Contest awards (trophies, plaques, &/or medallions) will be presented according to the following categories (in case of ties, see no. 11 under Scoring Rules):

    A. TEAMS:
        1. Five highest scoring FFA teams.
        2. Five highest scoring 4-H teams.
        3. Over-all Champion Team (highest scoring three-member team) - one award only.

    B. INDIVIDUALS:
        1. Five highest scoring FFA individuals.
        2. Five highest scoring 4-H individuals.
        3. Highest Over-all scoring individual -- one award only.

GRASSLAND CONDITION

Profitable grassland management for livestock pasture depends upon the manager's ability to match forage growth and livestock nutritional needs. Every livestock producer must first be a "grass farmer" since ruminant livestock depend directly on the quality and quantity of forage available. Shortages of forage quality or quantity at critical periods of the animal's productive cycle mean loss of production. Livestock production can never reach an economically optimum level on improperly managed pasture. This unit will discuss principles that can be used to match forage growth with animal nutritional needs to develop pasture programs.

Using Forages To Fill Grazing Season

Understanding forage growth is a key to any successful pasture program. No single forage provides adequate year-round grazing, but complimentary combinations of several forages including both cool-season and warm-season forages can provide good quality season-long grazing and some winter grazing as well (Figure 1). Forage selection for a pasture program is sometimes difficult due to the wide variety of forages available. The following section discusses the appraisal of existing conditions in a pasture.

Determining legume percentage

Determining the actual percentage of legume present in a pasture by visual estimates can be difficult for the untrained eye. A good rule to use for visually determining the percent of yield from the legume component in a pasture is to estimate the percentage of canopy cover as legume when the pasture canopy is six to eight inches tall and then divide by two to get the approximate season-long dry matter contribution from the legume. For example, if the canopy of white clover in a pasture is estimated to be approximately 30% then the percent legume as dry matter in that pasture would be about 15%. Obviously, a high percentage of canopy cover from the legume is necessary to provide all the advantages attributed to grass-legume mixtures.

Appraisal of Existing Conditions

1. What is the pasture type?

A. Fescue (>90% fescue)
B. Mixed cool-season grasses (<10% legumes)
C. Cool-season grass dominant (10 to 25% legume or other grasses)
D. Cool-season Grass / legume (26 to 60% legume)
E. Legume dominant (>75% legume)
F. Warm-season grass dominant (<40% other species)

Fescue (>90% fescue) Tall fescue is the major cool season grass planted in Missouri. Fescue pastures have tall fescue as the dominant forage species (>90%) with only scattered plants of other forages present. Active growth periods of tall fescue occur in spring and fall. Fescue pastures need nitrogen fertilization to produce good forage yields. Soil test fertilizer recommendations for cool-season grass pasture should be followed to achieve desired yield levels. Besides providing forage in spring and fall, tall fescue is often managed for winter pasture. Fall growth of the tall fescue is allowed to accumulate and grazing is deferred until winter. This practice is called stockpiling and works well in fall because the accumulated growth tends to

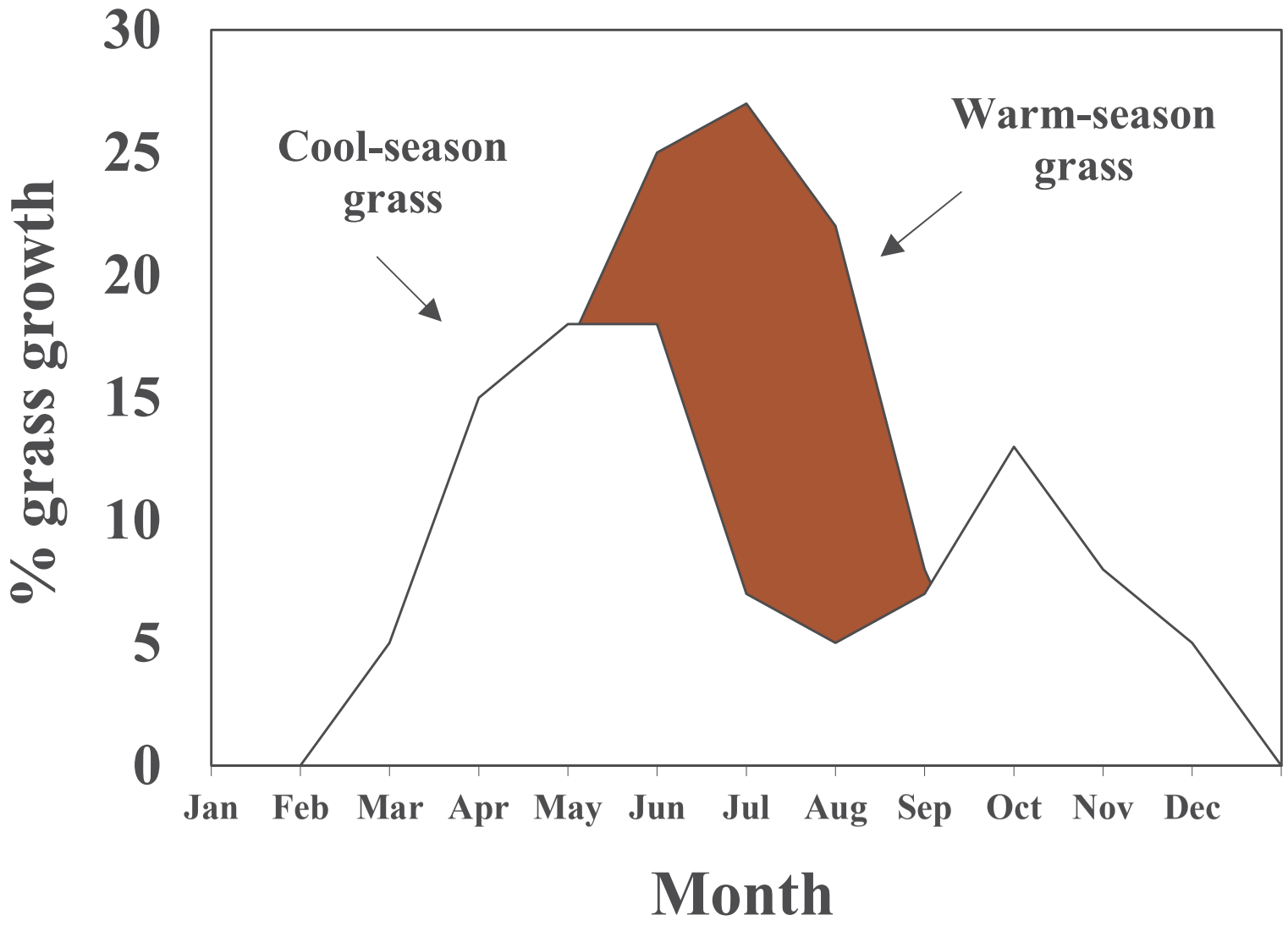


Figure 1. Complimentary growth patterns of cool and warm-season

remain high in nutritive quality and does not become mature as it does in spring. Tall fescue foliage tolerates freezing weather better than most other cool season grasses so it is preferred for fall stockpiled pasture.

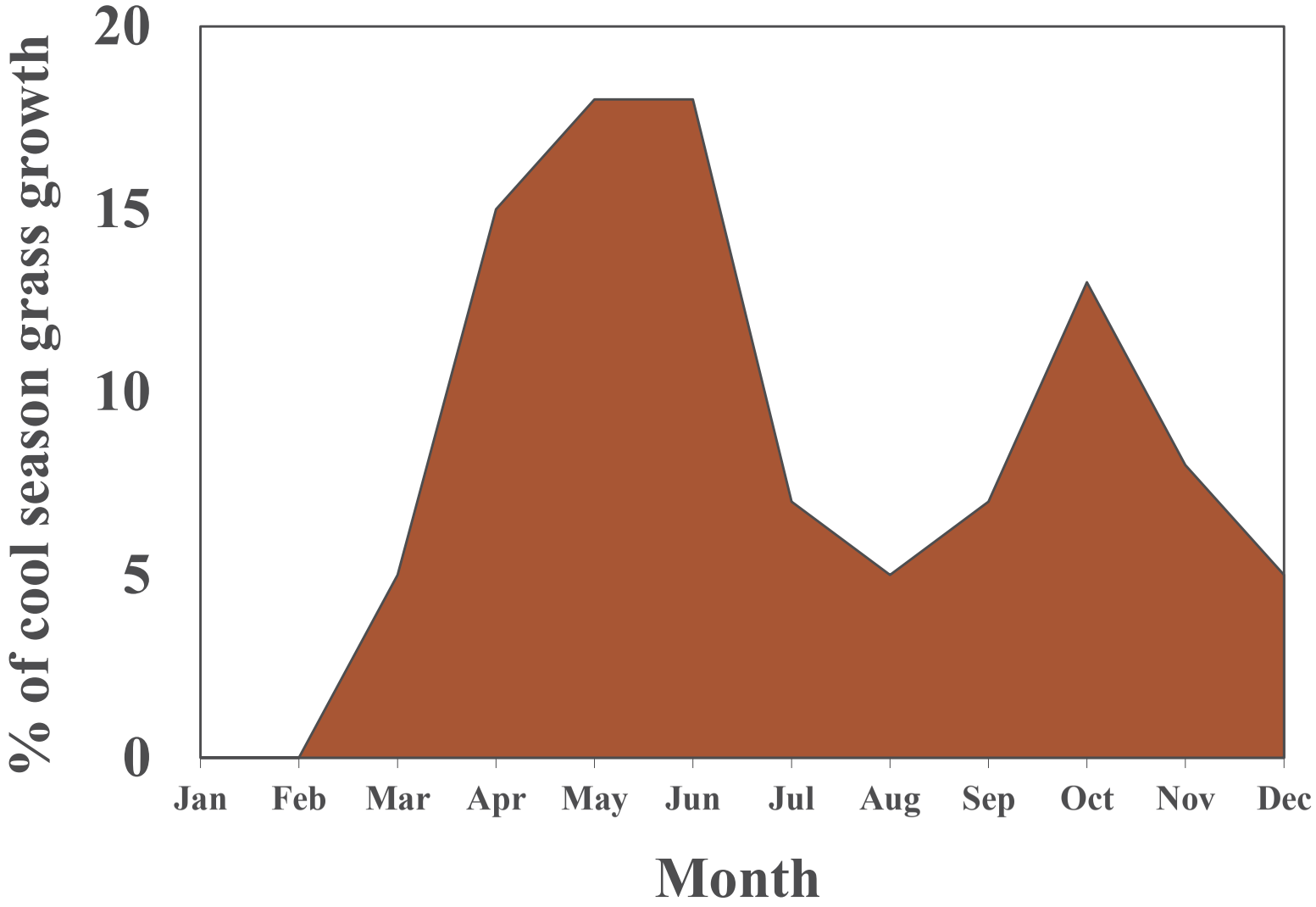
Many tall fescue pastures are infected with the fescue endophyte, which causes fescue toxicosis in grazing animals. Fescue toxicosis is caused by a toxin produced by an endophytic fungus that grows inside the fescue plant. Animals grazing fescue pastures that are infected with the endophytic fungus can show symptoms of lameness, heat stress, lower weight gains, low milk production, and low conception rates all of which reduce farm profitability. The fescue endophyte problem on a farm can often be offset by planting new pastures of endophyte free fescue varieties or by incorporating legumes into existing infected pastures. Fescue pastures usually have low value for wildlife due to the density of the foliage at ground level.

Mixed cool-season grasses (<10% legumes) Mixed cool-season grass pastures consist of a mix of cool season grass forages that may or may not include tall fescue. This category can also include pure stands of other cool-season grasses besides tall fescue. Perennial cool season grasses adapted to Missouri include Kentucky bluegrass, orchardgrass, perennial ryegrass, redtop, reed canarygrass, smooth bromegrass, tall fescue, and timothy. These grasses are commonly grown in pure stands, in mixtures with other cool season grasses, or in combination with legumes. Mixed cool-season pastures should receive nitrogen fertilization and the low percentage of legume (10%) is considered nutritionally non-significant. Soil test fertilizer recommendations for cool-season grass pasture should be followed to achieve desired yield levels. Cool season grasses are not often seeded in mixtures with warm season grasses in the same field because this combination requires very careful management to maintain the mixture.

Cool season grasses grow best during spring and fall, but are usually dormant or unproductive during hot summer months (Figure 2). From one-half to two-thirds of the annual growth of cool season grasses occurs in the spring and up to one-third of the annual growth occurs during the fall. Forage quality is very high when new growth begins in spring and declines with increasing growth as the plants become mature and produce seed. Fall regrowth of cool season grasses also has very good forage quality, however forage quality does not decline during the fall growth phase as in spring because plants remain vegetative during this time of year. Cold weather, snow, or ice can cause forage quality to decline during winter.

Cool-season grass dominant (10 to 25% legume or other grasses) Cool-season grass dominant pastures generally needs no nitrogen fertilizer in spring, but may respond well to nitrogen fertilizer in fall. These pastures can include fescue and/or a mix of cool season or warm season grasses along with a moderate percentage of legumes (10 to 25%). Legume percentages in this range will improve the nutritional value of a pasture and will help offset the effects of the fescue endophyte on cattle, but are not high enough to eliminate the need for nitrogen fertilization under high animal stocking rates. Soil test fertilizer recommendations for cool-season grass should be followed to achieve desired yield levels. However, if the goal of the landowner is to increase the percentage of legume in the pasture, then soil test fertilizer recommendations for clover-grass pasture should be followed to encourage legume growth. The legume component also helps extend the active spring growth period of the pasture into early summer. Other grasses including warm season grasses or weedy grass may be present at levels less than 25% of the pasture mix.

Figure 2. Seasonal growth of cool-season grasses.



Cool-season Grass / legume (26 to 60% legume) Legumes are commonly grown in combination with cool season grasses to improve nutritional quality of the pasture. Legumes are highly palatable and nutritious to livestock. Legumes generally have higher nutritive quality at any given growth stage than grasses. Legumes also help improve forage quality of a pasture when the companion grasses in a mixture become more mature than desired. Forage quality of grass/legume mixtures is excellent and livestock grazing this mixture should have few symptoms from fescue endophyte. Grass/legume pastures show little or no response to nitrogen fertilization because the nitrogen supplied by the legume through nitrogen fixation is high enough to support the growth of both the grass and legume. Legumes need higher soil fertility levels than grasses. Soil test fertilizer recommendations for clover-grass pasture should be followed to maintain production in this mixture. Grass/legume pastures also have more value to wildlife than fescue, mixed cool-season, or cool-season dominant pastures.

Legume dominant (>75% legume) Fields with this high percentage of legume (>75%) are more typical of hay fields than of grazed pastures, but legume dominant fields used for pasture will have the same benefits as listed for grass-legume pastures. Legumes can be used for pasture in spring, summer or fall, but require careful management to maintain adequate stands. Legumes also help offset the effects of fescue toxicosis when mixed in fields of endophyte infected tall fescue. Soil test fertilizer recommendations for clover-grass pasture should be followed to maintain production in this mixture.

Legumes adapted to Missouri include alfalfa, annual lespedeza (Kobe or Korean), birdsfoot trefoil, red clover, and white or ladino clover. Red and white clover grow in spring, early summer, and fall. Alfalfa and birdsfoot trefoil grow from spring through summer and fall. Annual lespedeza grows in summer and dies at frost. All of these are perennial plants except for annual lespedeza and red clover.

Warm-season grass dominant (<40% other species) Warm season grasses grow best during the summer months but grow very little in spring or fall (Fig.1). Warm season grasses provide good quality, actively growing forage during the hot summer when cool-season grasses and many legumes are dormant or unproductive. Warm season grasses should be used when forage availability is low in summer or when very high summer forage production is needed. A combination of warm season and cool season grass pastures will provide a constant forage supply over the growing season. Keep in mind that warm and cool season grasses should be planted in separate pastures for easier management.

Native warm season grasses adapted to Missouri include big bluestem, indiangrass, little bluestem, and switchgrass. These grasses are usually grown in pure stands or in mixtures with other warm season grasses. They are usually not grown in combination with most introduced legumes or cool season grasses because the native warm season grasses are not as aggressive as many legumes or cool season grasses especially in fertilized pastures. The native grasses should not be grazed shorter than eight inches to maintain vigor and regrowth of the plants. Introduced or non-native warm season grasses include bermudagrass (south Missouri only) and caucasian bluestem. Caucasian bluestem and bermudagrass are normally only grown in pure stands because they are more aggressive forage plants, they are lower growing than the native grasses, and they must be grazed at much shorter heights than the native grasses in order to maintain forage quality. All of the plants listed above are perennials.

The native warm-season grasses respond to moderate fertilizer applications and are much more desirable for wildlife cover than introduced warm-season grasses or most cool-season grasses. Introduced warm-season grasses such as bermudagrass and caucasian bluestem respond to high rates of nitrogen fertilizer, but have little value as wildlife cover. Fertilizer recommendations for warm-season grass pasture should be followed for all warm-season grass

pastures except for bermudagrass which has a specific recommendation listed for hay or pasture. Annual grasses, forbs, legumes, and cool-season grasses often become established in a warm-season grass pasture through seed dispersal or improper grazing or feeding management. These invading species should be maintained at less than 40% of the sward so the benefits of the warm-season grass can be realized.

Warm season grasses should be grazed when they are in the vegetative stage of growth. Fiber levels increase rapidly as the plants mature, reducing forage quality and making warm season grasses undesirable for stockpiling for later grazing. These grasses usually have a very rapid growth rate and very high production potential. Close attention is required to prevent them from becoming too mature for good forage quality.

2. What is the average growth stage of the dominant forage type?

A. Vegetative – leafy growth, few stems, few to no seed heads
B. Boot or bud – stem elongated, top of stem swollen
C. Heading or bloom – seed heads or flowers emerged-green color extends into seed head or seedpod
D. Mature – seed hard, ready to harvest, yellowing below seed head into stem
E. Dormant –cool season grasses-Dec. 16 – March 1; warm season grasses-Nov. 1 – May 1

The growth stage of the forage is very important in pasture management. As the forage matures the nutritional value and acceptability to grazing animals decline rapidly. Forages should be grazed before they reach maturity since nutritive quality is highest when the forage is vegetative and growing. This stage also corresponds with low plant fiber and high digestibility. Fiber levels increase as the plants mature decreasing digestibility of the forage. Plants go through specific developmental stages as they mature. For grasses these stages are vegetative, boot, heading or bloom and mature seed. Most cool season grasses produce seed only in the spring. Regrowth of cool-season grasses in summer and fall after the seed stems have been removed by grazing or hay harvest is vegetative and leafy with few to no seed heads. Warm season grasses can produce seed more than once per year. Legumes go through similar stages of development as the grasses. These stages for legumes are vegetative, bud, bloom, mature seed. Unlike most grasses, legumes except for annual lespedeza, can flower and produce seed several times during the growing season.

3. What best describes the condition of the pasture sward?

A. Spot grazed
B. Evenly grazed

Spot-grazed: Spot-grazing is actually a form of over-grazing in which spots or patches of a pasture are grazed too frequently. Spot-grazing occurs during periods of active forage growth when livestock graze spots in a pasture while allowing other areas of the field to become mature and unpalatable. The regrowth of the grazed forage in spots is often more palatable than the forage left ungrazed so the grazing animals frequently re-graze new growth of these spots. Spot-grazed fields have uneven forage heights and the forage in the grazed spots may become weak and thin if cattle remain in the field too long. Spot-grazing often occurs when livestock density or number in a pasture is too low for the current forage conditions. Frequent pasture rotation will improve the condition of spot grazed pastures.

Evenly grazed: Evenly grazed pastures, as the description implies, have a generally uniform grazing height, thick stands, good forage vigor, and respond well to good management. These pastures often have a good mix of grasses and/or legumes present. Some spot-grazed areas may be present, but make up less than 20% of the field.

4. Is weed or brush control needed other than by grazing or soil fertility management?

A. Yes
B. No

Weed and brush control is sometimes necessary to control certain invading species. Many weedy plants can be controlled by good grazing management and proper use of fertilizer. Forage plants growing in pastures that have good soil fertility and are not overgrazed are more competitive and prevent many weeds from becoming established. Other means of control, including mechanical or chemical control, becomes necessary when woody plants and other undesirable species make up 30% or more of the canopy in a pasture. Mechanical, chemical or spot treatment of thorny species maybe necessary at levels of 10% canopy.

5. What soil pH_s range is recommended for this sward?

A. 4.5-5.0
B. 5.1-5.5
C. 5.6-6.0
D. 6.1-6.5
E. 6.6-7.0
F. 7.1-7.5

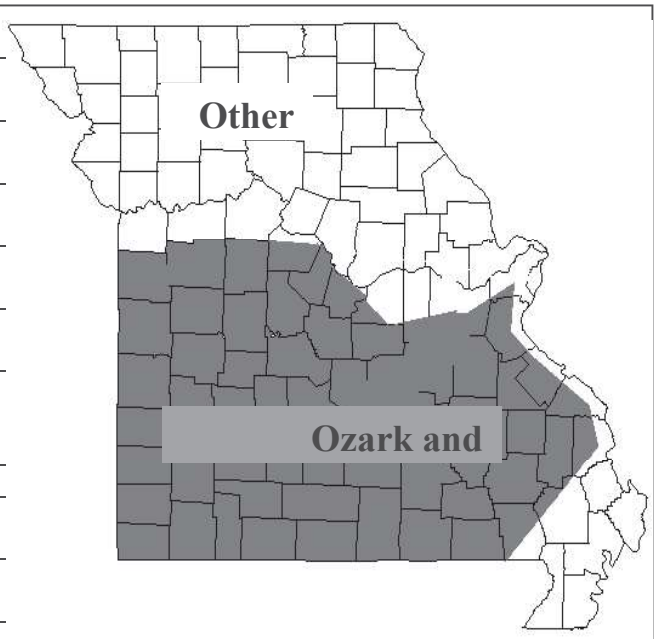
Most legumes need a higher soil pH_s than most grasses. Recommended soil pH_s levels for forages in Missouri range from 5.6 to 6.5, but certain crops require a higher soil pH_s within this range than others. The University of Missouri also recommends different pH_s ranges in different parts of the state for the same crop or forage. Specific pH_s ranges for forages grown in Missouri can be found in the table below which is from University Extension Guidesheet no. 9112, "Interpreting Missouri Soil Test Reports".

Soil pH_s is a measure of the acidity or alkalinity of the soil. The subscripted "s" in the pH_s term simply denotes the type of laboratory test used to measure the acidity of the soil sample- in this case a salt testing solution. Values for pH (no subscript), however, is determined in the lab by a water-based test instead of a salt solution. The University of Missouri soil testing laboratory uses the salt testing solution and reports soil acidity levels as pH_s . A value given for pH_s is about 0.5 units more acidic than the same value given simply as pH. For example, a pH_s value of 5.5 would be similar to a pH value of 6.0.

Most Missouri soils are acidic, however heavy applications of limestone can increase the soil pH_s to basic or alkaline levels. A pH of 7.0 is neutral - meaning it is neither acidic or basic. Low soil pH_s can have a dramatic impact on forage growth and persistence. The acidity of a soil increases by a factor of 10 for each integer below a pH of 7.0. For example, a pH of 6.0 is 10 times more acidic than 7.0, a pH of 5.0 is 100 times more acidic than 7.0, and a pH of 4.0 is 1000 times more acidic than 7.0.

Desired soil salt pH (pHş) ranges for Missouri crops.

Crop	Soil Region	
	Ozark and borders	Other
Alfalfa and alfalfa—grass establishment	6.6—7.0	6.1—6.5
Birdsfoot trefoil and birdsfoot trefoil—grass establishment	6.1—6.5	5.6—6.0
Clover and clover—grass establishment and production	6.1—6.5	5.6—6.0
Cool-Season grass establishment and production	5.6—6.0	5.6—6.0
Lespedeza and lespedeza—grass establishment	6.1—6.5	5.6—6.0
Overseeding legumes	6.1—6.5	5.6—6.0
Warm-season grass establishment and production	5.6—6.0	5.6—6.0
Sudan grass and sudan/sorghum crosses	5.6—6.0	5.6—6.0
All row crops	6.1—6.5	6.1—6.5



6. What fertilizer option is recommended for this pasture?

Fertilizer recommendations for a specific forage crop are shown in the "Nutrient Requirements" section of the University of Missouri soil test report. Up to four different forage crops may be shown under the "Cropping Options" heading. Two types of fertilizer recommendations are given for each forage crop - establishment recommendations and production recommendations. Establishment recommendations should be used when a new forage is being planted. Production recommendations should be used for pasture production of the existing forage. Each crop listed is assigned a "yield goal" or desired yield level. Establishment fertilizer recommendations have a yield goal of zero since no yield is expected at establishment time. Yield goals for pasture are shown as CD/A, which stands for "cow days per acre". One CD/A is 30 pounds of forage dry matter which is the average amount of forage needed for a 1000 lb. cow with a three to four month old calf. Recommendations for pounds of nitrogen (N), phosphate (P_2O_5), and potash (K_2O) needed to reach those yield goals are given for each crop.

NOTE: Each crop option will be identified on the left side by a three-digit number in the cropping options section. The student must choose the correct crop option from one of the reports used in the contest and write the corresponding identification number on the scorecard.

7. What limestone rate is recommended for this pasture in tons per acre?

Limestone recommendations are shown in the "Limestone Suggestions" section of the soil test report. The recommendation is reported as pounds of Effective Neutralizing Material (ENM) needed per acre to raise the soil pH_s to a desirable range for a particular crop. The limestone rate, in tons per acre, recommended for that field is calculated by dividing the ENM recommendation from the soil test report by the ENM guarantee of the limestone dealer. For example, if the ENM recommendation from the soil test report is 1600 lbs. and the limestone dealer guarantees 400 lbs. per ton of agricultural limestone, the amount of limestone that should be spread per acre is 4 tons (1600/400 = 4 tons limestone per acre). The answer must be rounded to the nearest tenth.

NOTE: The ENM value must be selected from the soil test report that corresponds to the desired crop.

University Extension
University of Missouri - Columbia

Date: 5/1/97
Serial No. 9999
Lab No. G99000

University Extension

Soil Test Recommendations

For: MO Grassland Contest Example

Field ID: Hilltop Sample No. 1
Acres: 20
Limed: Unknown Not irrigated

SOIL TEST INFORMATION Delta Lab Portageville		Ratings Verylow Low Medium High Veryhigh Excess
PHs	5.5	**********
Phosphorus	18 Lbs/a P	**********
Potassium	210 Lbs/a K	**********
Calcium	1035 Lbs/a Ca	**********
Magnesium	350 Lbs/a Mg	**********

0. matter 2.2 % N. Acidity 1.5 meq/100g C.E.C. 5.8 meq/100q

NUTRIENT REQUIREMENTS (Lbs/a)						LIMESTONE suggestions
Cropping options	Yield	N	P205	K20	Zn	S	
006 OVERSEEDING LEGUMES		0	55	0			ENM
003 CLOVER, CLOV-GRASS EST		20	55	0			440
017 CLOVER, CL-GRASS PAST 150 CD/A		0	35	20			EMG 0

Some herbicide labels list restrictions based on soil pH in water. Your sample has an estimated pH in water of 6.0. Use this value as a guide to the label. If you wish to have soil pH in water analyzed, contact your dealer or local extension specialist listed below.

To determine limestone needed in tons/acre, divide your ENM requirement by the guarantee of your limestone dealer.

For OVERSEEDING LEGUMES apply 440 lbs. ENM

For CLOVER/CLOVER-GRASS EST apply 440 lbs. ENM

Soils testing high in P or K should be retested annually to determine when maintenance fertilizer should be applied.

Do not use nitrogen on spring seedings of legumes after May 1st, because of potential weed competition.

Note: Quarry guaranteed analysis = 500

Area Specialist: _____

FARMER COPY

Matching livestock and forage

1. When does this livestock herd have the highest forage quality requirement?

A. Spring
B. Summer
C. Fall
D. Winter
E. Requirement high year round

Livestock nutritional requirements change throughout the year as the animals go through different stages of production. Forage quality must be higher for growing animals than for mature animals. Growing animals, such as steers or heifers, need a constant supply of high quality feed through the season to maintain growth. Shortages in quality will sharply reduce gain and profit. As an animal matures its nutritional needs change. The forage quality and quantity needed by mature animals also changes with production stage through the year.

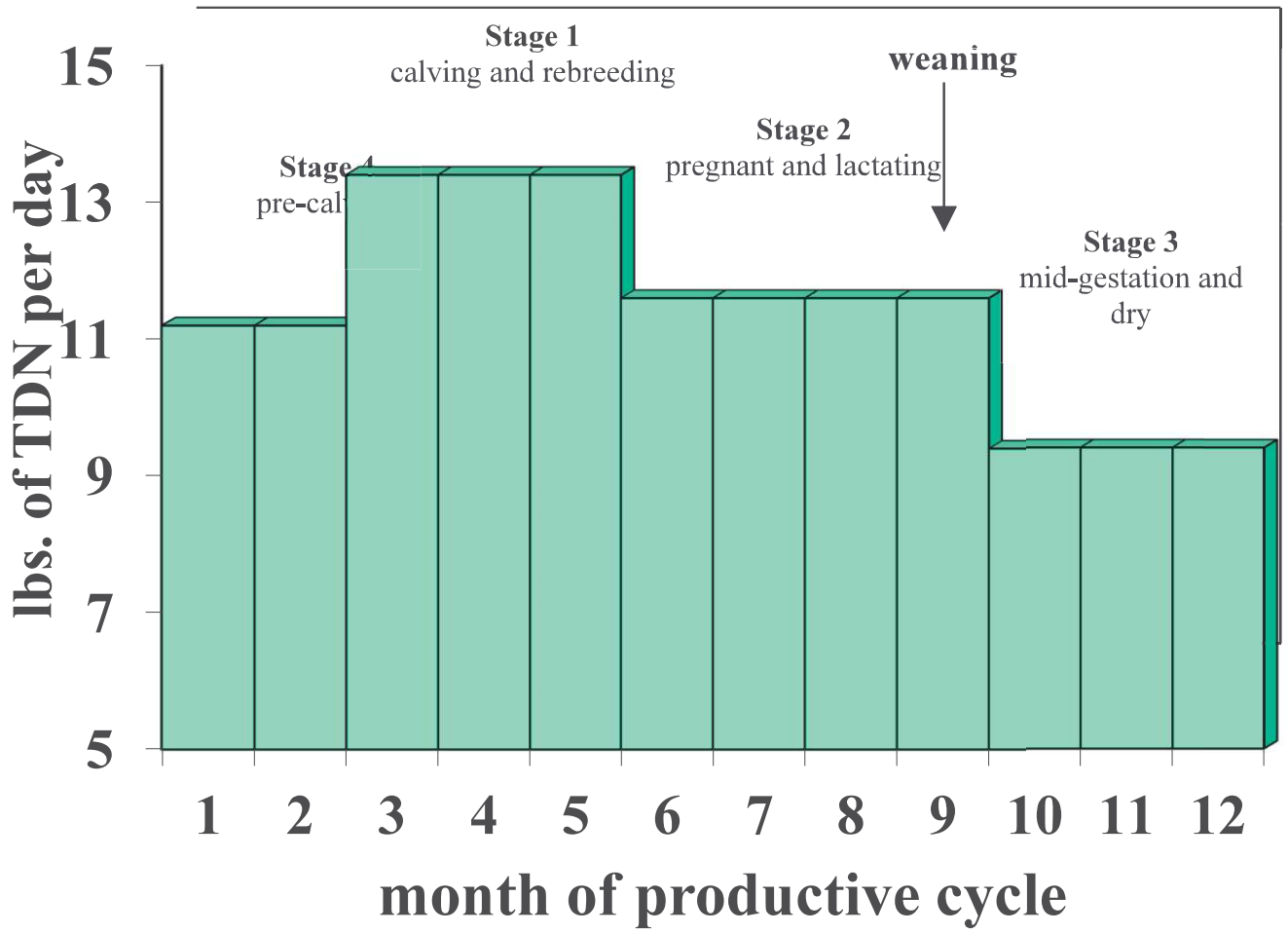
A mature beef cow goes through four stages of production each year (Figure 3). Nutritional needs will be different for each of these stages. Stage One is post-calving and lasts 90 days. Since the cow has just had a calf, her nutritional needs are now the highest of the entire year. She is lactating at her highest level, she is undergoing uterine involution, and she must cycle and re-breed within 90 days of calving to stay on a 12-month calving schedule in the herd. Lack of nutrition during this period results in lower milk production and failure to re-breed on time. A cow must re-breed in time to have a calf every 365 days. Failure to do this results in an unprofitable operation due to added costs of maintaining open, unbred cows.

In Stage Two the cow is pregnant and lactating. This stage usually lasts 115 days. Nutritional needs will be dropping slightly during this period. The cow is in the early stages of pregnancy while still nursing her calf. She should be gaining some weight now.

Stage Three is mid-gestation and lasts about 100 days. The cow has just weaned her calf and she is dry. Her nutritional needs are at the lowest point of the entire year since she only has to maintain herself and the developing fetus. She can get by on much lower quality pasture now than in Stage One.

Stage Four is pre-calving. This stage lasts about 60 days and is the second most important period nutritionally during the year. Seventy to 80 percent of fetal development is occurring. The cow is gaining weight and preparing for lactation. Inadequate nutrition during stage four will often cause weak calves and poor re-breeding success during stage one. Cows need to be in good body condition now. She needs good quality pasture or hay to make sure both herself and calf will be strong and healthy. First or second calf heifers need higher quality forage than mature cows during all four of these stages since their bodies are still growing plus they are producing a calf. This makes it very important to feed these animals separately from the mature animals to ensure proper development. Mature bulls also need good quality feed during the breeding season but can get by on lower quality forages other times of the year.

A cow herd has its highest forage quality requirement during stage one, which is during calving and rebreeding. This stage usually occurs in spring and fall in Missouri. Herds that have not set calving season or those that calve year-round need high forage quality year-round to support the cows calving at any given time. Year-round calving is not recommended. Calving seasons of 90 days or less are recommended to optimize forage production, breeding, and marketing.



Source: 1984 NRC requirements for beef cattle

Figure 3. Seasonal total digestible nutrient (TDN) requirement for a spring-calving 1,100 lb. Beef cow with average milk production

2. Does the given system's growth cycle match the seasonal peak nutritional needs of this livestock herd under present management?

A. Yes
B. No

Now that you know some basic concepts of forage production and changes in livestock nutritional needs you still face the challenge of matching these production schedules together. A good manager relies on his ability to combine the production of forage and livestock along with the environment into an economically and biologically sound program.

Spring time is the period when forage is abundant and the weather is favorable for calf survival and rapid growth. Most pastures in Missouri are made up of cool season forage species. A spring calving program matches the cool-season grass seasonal growth pattern rather well. The cow's greatest nutritional needs are between calving and re-breeding. The growth and quality of a cool season grass is also high at this time (Figure 2). Forage production and quality drop off in summer along with a slight drop in nutritional requirement by the cow. Adding a warm season grass or other summer forage to a cool season grass program fills the summer forage deficit and maintains livestock production until the cool season grass begins growing again in fall.

Summer calving is not recommended in Missouri. The reason for this is not entirely related to forage production since warm season forages are available and of high enough quality to maintain adequate nutrition. The primary reason not to have a summer calving season is due to weather. In summer, high temperatures and humidity reduce breeding activity and conception rates. Research has shown much lower conception rates in cattle breeding during hot weather because of higher embryonic mortality. The number of calves weaned per cow exposed to the bull has much greater impact on profitability than any other single factor. If a calf is never conceived it cannot be weaned.

Fall calving works well in Missouri since the combination of forage quality and cooler temperatures are again favorable for high conception rates in cows. Cool season grasses produce about one third of yearly production in fall. The quality of this fall growth is very good. Cows calving in September will have adequate nutrition on properly managed fall pastures. Re-breeding will take place after the cows have been flushed with high quality fall pasture. Warm season pastures (warm season grass, annual lespedeza, alfalfa) can improve a fall calving program by increasing the nutrition level of the cows during STAGE 4, which occurs during July and August for a fall calving herd. This improves milk production, calf vigor, and re-breeding success. Warm season pastures also work well if fall born calves are kept till they are yearlings before they are sold. The calves are weaned in spring and put on high quality spring pasture. In early summer the calves are rotated to warm season pastures to maintain good weight gains until they are sold later that summer or in fall.

Winter calving is not recommended in Missouri. The reason for this is due to adverse weather conditions for calving and not matching forage production with peak nutritional demands. Management of forage resources through the wintertime may be the most cost-effective practice a producer can use. Stock piling forages particularly tall fescue, grazing crop residues, and planting winter annual forages can drastically reduce a producer's winter-feed cost when compared to hay and/or supplements. Research has shown that with proper management and utilization the quality of stockpiled tall fescue and winter annual forages can meet the needs of most beef animals including lactating cows.

NOTE: Transparencies of Figures 2 and 3 can be overlain to illustrate how to match livestock nutritional needs with seasonal growth of cool-season grasses.

3. How many pounds of forage dry matter does this herd need to consume per day during each of these seasons?

	lbs. D.M. needed
Spring	_____
Summer	_____
Fall	_____
Winter	_____

Calculating Forage Dry Matter Intake Requirements

Although cattle need certain forage quality at specific stages of production, they also need adequate quantity. Estimating the total forage need is not difficult, but will require some calculation. The pasture stocking rate and hay supply can both be estimated in advance if animal needs and forage production is known.

Forage requirements vary not only with the animal's stage of production, but also by body size. Large animals need more feed to maintain themselves than do smaller animals. The following table gives guidelines for estimating forage Dry Matter Intake (DMI) by certain classes of animals. These figures are given as a percent of body weight (BW) to account for the difference in forage requirement due to body size. **NOTE: Notice that the percentage of forage DMI changes for each stage of production as already discussed in question 1. of this section.**

Approximate Daily Forage DMI Requirements For Different Classes of Cattle

Animal	Daily Forage DMI Requirement (% of BW)
Dry beef cow	2 %
Lactating beef cow (avg. milk prod.)	2.5 %
Lactating beef cow (Superior milk prod.)	3 %
Bull (during breeding season)	2.5 %
Bull (not during breeding season)	2 %
Growing steers and heifers	3 %

The following example illustrates how to calculate forage DMI requirements.

Example: Calculate the daily forage dry matter needs of this herd during the spring grazing period:

Spring-calving beef herd
30 cows - lactating (avg. prod.) (avg. weight =1,100 lbs.)
1 bull - 2,000 lbs.
10 heifers - avg. weight = 750 lbs.

Solution: 30 lactating cows X 1100 lbs. = 33,000 lbs.
1 breeding bull X 2000 lbs. = 2,000 lbs.
10 heifers X 750 lbs. = 7,500 lbs.

The cows are lactating so their requirement is 2.5 % of their body weight per day. During the breeding season the bull still needs 2.5 % of BW also. The growing heifers need 3 % BW per day.

33,000 X 0.025 = 825
2,000 X 0.025 = 50
7,500 X 0.03 = 225
1,100 lbs. forage dry matter needed per day

Example: Calculate the daily forage dry matter requirement for the same herd if the cows are dry in STAGE 3.

Solution: The herd needs less forage because the cows are dry and their nutrient and dry matter requirements are lower. The heifers are still growing so they still need 3 % of their BW per day. The cows and bull can be calculated at 2 %.

30 dry cows (1100 lbs. avg. wt.) = 33,000 lbs.
1 bull (2,000 lbs.) = 2,000 lbs.
10 heifers (750 lb. avg. wt.) = 7,500 lbs.

33,000 X .02 = 660 lbs. per day for cows
2,000 X .02 = 40 lbs. per day for bull
7,500 X .03 = 225 lbs. per day for heifers
925 lbs. dry matter needed per day for this herd.

4. Is forage availability adequate for this herd in each of these seasons?

Spring (100 days)
_____Adequate
_____Not adequate

Summer (100 days)
_____Adequate
_____Not adequate

Fall (100 days)
_____Adequate
_____Not adequate

Winter (65 days)
_____Adequate
_____Not adequate

Calculating Forage Dry Matter Requirements For A Specific Season

To calculate the forage DMI requirements for a specific period use the following calculation:

(lbs. dry matter needed per day) X (number of days in season)

Example: What is the forage DMI requirement for this same herd during the spring (100 days). This is a spring calving herd.

Solution: Since the herd is spring calving, the cows will be in STAGE ONE. They are lactating and preparing to re-breed. Their requirements will be 2.5% of BW per day. The bull will be working during this time so his need is 2.5 % of BW per day. The heifers will be bred this spring so their need is 3 % of BW per day.

The total daily forage DMI need is 1,100 lbs.

1100 lbs./day X 100 days = 110,000 lbs. forage DMI needed for spring season.

Calculating actual forage availability required for different grazing management systems

To determine if forage availability is adequate for the herd, you must also consider the harvest efficiency of the grazing system. No harvest system is 100% efficient, especially grazing animals. In a pasture system animal utilization of the forage is between 30 and 65 percent of what is actually grown. In continuous grazing systems cattle are allowed to continually graze a pasture with no restrictions on rotation. Much of what is produced is wasted. Only 30 to 35

percent of the total forage produced is actually eaten by the livestock. The other 65 to 70 percent is trampled, soiled by mud, manure, and urine, or used as bedding areas.

As grazing management restricts the grazing habits of the animals, forage utilization increases. When management-intensive grazing (MIG) is used, forage utilization can be as high as 65 percent of the forage produced. This level of utilization can only be achieved with a multiple paddock system with frequent pasture rotations of 3 days or less.

The following example gives a guideline for calculating the actual amount of forage dry matter production needed in a pasture to carry the same herd during the spring season.

Example: (Same herd as used previously) Calculate the actual amount of forage DM needed for this herd for the spring grazing period for continuous and management-intensive grazing systems.

Solution: The daily dry matter intake was calculated to be 1,100 lbs. and the total spring season DMI was 110,000 lbs. Forage utilization in the continuous grazing pasture management system is only about 35 percent. This means that forage dry matter availability needs to be almost three times the amount the herd will actually eat per day.

$$\frac{\text{110,000 lbs. DMI}}{0.35} = \text{314,285 lbs. forage DM needed for that season}$$

In an intensive grazing management system, forage utilization is about 65 percent so actual forage DM needed is only about 1.5 times as much as what is actually eaten.

$$\frac{\text{110,000 lbs. DMI}}{0.65} = \text{169,230 lbs. of forage DM needed for that season}$$

It becomes quite clear that by using good grazing management a producer can harvest almost twice as much forage with little extra cost except for fencing materials. The added utilization of forage and extra livestock gain per acre can often pay that cost very quickly.

Pasture Improvement

The answers to questions 3, 4, and 5 in this Pasture Improvement section are based on the choice for question 2.

1. What changes should be made in livestock management?

A. Continue present management
B. Reduce livestock numbers
C. Change calving season to different time of year
D. Shorten calving season to a period of <90 days.
E. Provide higher quality pasture
F. Switch to a management-intensive rotational grazing system

Continue present management: Use this option when the livestock management practices matches with the landowners goals and forage management.

Reduce livestock numbers: Use this option when the livestock numbers exceed the carrying capacity of the farm even when calculated for a different grazing management system. Calculating the forage requirement using the percentage utilization for management-intensive

grazing may allow the farmer to keep the herd at it's current size if livestock numbers are too high for a continuous grazing system.

NOTE: The goals stated by the landowner may also dictate reducing livestock numbers regardless of the carrying capacity of the farm, but this will be specifically stated for the contest.

Change calving season to a different time of year: Spring or fall calving are recommended for Missouri conditions. Summer calving should be avoided due to the potential of low cow conception rates caused by hot weather.

Shorten calving season to a period of <90 days: Use this option when the calving season is spread out over more than one season for that single herd or when year-round calving is being practiced.

Provide higher quality pasture This option should be chosen when the farm scenario states that the farmer has problems with low weight gains, low conception rates and/or low weaning weights or when fescue endophyte is a problem.

Switch to a management-intensive rotational grazing system Switching to a management-intensive rotational grazing system may improve forage availability if the carrying capacity of the farm is exceeded under continuous grazing management. Management-intensive grazing can also reduce problems with spot-grazing in pastures. This option should be chosen when there is a shortage of forage in more than one season.

2. What type of additional forage is needed to improve this forage program?

A. Cool-season grasses
B. Warm-season grasses
C. Legumes
D. No additional forages needed - use existing pastures

Additional forages should be chosen based upon information given in the farm scenario and the forage availability calculations. The options listed above can be used as shown in the following situations, however information given in the farm scenario will be specific enough so that only one will be the best answer. **Examples:** Cool-season grasses can be used when forage production is not adequate in spring and fall forage, but is adequate for summer. Warm-season grasses can be added to the system when summer forage production is not adequate. Adding legumes can be selected when the scenario identifies a forage quality problem, fescue endophyte problem or to improve summer forage production. If the scenario already has legumes included in pastures then selecting warm season grasses would be appropriate to fill shortages in summer forage production. If the system is functioning well, choose answer D. No additional forages needed - use existing pasture.

3. How should this additional forage be planted?

A. Plant on a clean, firm seedbed
B. No-till plant in a killed sod
C. Overseed or interseed in a closely grazed sod
D. No additional forages needed - use existing pasture

Plant on a clean, firm seedbed: Planting a stand of forages is best done on a clean-tilled, firm seedbed when conditions allow. This allows better weed control, fertilizer and lime incorporation, and better seed to soil contact. This option should be chosen when field renovation is desired and lime and fertilizer need to be incorporated into the soil.

No-till plant in a killed sod: No-till planting into a killed sod is should be chosen when soil erosion could be a hazard if the field is plowed or if the field is too rocky to be plowed. No-till planting allows the seed to be planted by a no-till drill directly into a sod that has been killed by herbicides. This option should be chosen for fields to be renovated having over 5% slope.

Overseed or interseed into a closely grazed sod: This option should be chosen when adding legumes to a grass pasture to improve forage quality. Overseeding is done during the winter months so that freezing and thawing of the soil will cover the legume seed. Legumes can also be interseeded with a no-till drill into the existing live sod.

No additional forages needed - use existing pasture: Choose this option for fields with adequate stands of desired forage and which require no additional forage species.

4. What fertilizer option is recommended for this forage?

Fertilizer recommendations should be selected from the soil test that corresponds with the crop chosen in question 2. If you chose to establish a new forage in question 2 you must also choose a fertilizer recommendation for establishment of that forage. If you choose to continue with the present forage, use a recommendation for pasture production of that forage.

5. What limestone rate is recommended for this forage in tons per acre?

Limestone recommendations should be selected from the soil test that corresponds with the crop chosen in question 2. The amount of limestone needed in tons per acre should be calculated using the same method as in question 7 of the “Appraisal of existing conditions” section.

GRASSLAND CONDITION

STUDENT I.D. NO._____ STUDENT NAME_____ SCORE:_____ Points: 100

==========

APPRAISAL OF EXISTING CONDITIONS
(5 points each)

_____1. What is the pasture type?
- A. Fescue (>90% fescue)
- B. Mixed cool-season grasses (<10% legumes)
- C. Cool-season grass dominant (10 to 25% legume or other grasses)
- D. Cool-season Grass / legume (26 to 60% legume)
- E. Legume dominant (>75% legume)
- F. Warm-season grass dominant (<40% other species)

_____2. What is the average growth stage of the dominant forage type?
- A. Vegetative
- B. Boot or bud
- C. Heading or bloom
- D. Mature
- E. Dormant

_____3. What best describes the condition of the pasture sward?

A. Spot grazed B. Evenly grazed

_____4. Is weed or brush control needed other than by grazing or soil fertility management?
- A. Yes
- B. No

_____5. What soil pH_s range is recommended for this sward?
- A. 4.5 - 5.0
- B. 5.1 - 5.5
- C. 5-6 - 6.0
- D. 6.1 - 6.5
- E. 6.6 - 7.0
- F. 7.1 - 7.5

_____6. What fertilizer option is recommended for this pasture?

_____7. What limestone rate is recommended for this pasture in tons per acre?

MATCHING LIVESTOCK AND FORAGE
(4 points for each answer space)

_____1. When does this livestock herd have the highest forage quality requirement?
- A. Spring
- B. Summer
- C. Fall
- D. Winter
- E. Requirement high year round

_____2. Does the given system's growth cycle match the seasonal peak nutritional needs of this livestock herd under present management?
- A. Yes
- B. No

3. How many pounds of forage dry matter does this herd need to consume per day in:

_____ lbs. in spring (4 pts.)
_____ lbs. in summer (4 pts.)
_____ lbs. in fall (4 pts.)
_____ lbs. in winter (4 pts.)

4. Is forage availability adequate for this herd in:

Spring - 100 days (4 pts.)
_____Adequate
_____Not adequate

Summer - 100 days (4 pts.)
_____Adequate
_____Not adequate

Fall - 100 days (4 pts.)
_____Adequate
_____Not adequate

Winter - 65 days (4 pts.)
_____Adequate
_____Not adequate

SEE REVERSE SIDE

PASTURE IMPROVEMENT

(Answers to questions 3, 4, and 5 for this section are based on the choice for question Number 2) (5 points each)

_____1. What change should be made in livestock management?
- A. Continue present management
- B. Reduce livestock numbers
- C. Change calving season to a different time of year
- D. Shorten calving season a period of <90 days
- E. Provide higher quality pasture
- F. Switch to a management-intensive rotational grazing system

_____2. What type of additional forage is needed to improve this forage program?
- A. Cool season grass
- B. Warm season grass
- C. Legumes
- D. No additional forages needed - use existing pasture

_____3. How should this forage be planted?
- A. Plant on clean, firm seedbed
- B. No-till plant in a killed sod
- C. Overseed or interseed in a closely grazed sod
- D. No additional forages needed - use existing pasture

_____4. What fertilizer option is recommended for this forage?

_____5. What limestone rate is recommended for this forage in tons per acre?

Revised: April, 2003

Grassland Evaluation Contest Sample Scenario

Pasture Scenario:

The farmer has a 120 acre cow/calf operation. He has a fall calving cow herd. He would like to wean his calves the beginning of spring and graze them out through the spring and sell at the beginning of summer. He has been using continuous grazing, but would consider using management intensive grazing if it will help him meet his goals. He needs to harvest and store 25 tons of hay from spring season to feed in the winter in addition to stockpiled tall fescue. Harvesting and feeding losses have been calculated for the hay.

Current Situation:

* 30 cows weighing 1100 pounds with superior milking ability
* 1 bull weighing 2000 pounds
* Fall calving herd
* 90% calf crop
* Continuous grazing
* He wants to wean all calves at the beginning of spring and graze them out through the spring, sell at the beginning of summer. All calves will be sold at this time.
* Average weaning weight in the spring is 450 pounds.
* He plans to graze them for 100 days and sell them at 600 pounds.
* Their average daily gain would be 1.5 pounds.
* Calculate the average weight for the 100 days period for figuring forage consumption by season.
* Use only whole numbers for calculating.

Forage Production:

Pasture	Acres	Spring	Summer	Fall	Winter
Fescue/legume	60	231,000	100,800	117,600	
Orchard/alfalfa	40	169,600	92,800	57,600	
Fescue	20	59,900	5,800		65,000
Minus hay harvested		- 76,923			
TOTALS	120	383,577	199,400	175,200	65,000

Hay available to feed: 50,000 lbs.

GRASSLAND CONDITION

STUDENT I.D. NO. "Sample" STUDENT NAME "Exercise Scenario" SCORE:_____ Points: 100

==========

APPRAISAL OF EXISTING CONDITIONS
(5 points each)

_____1. What is the pasture type?
- A. Fescue (>90% fescue)
- B. Mixed cool-season grasses (<10% legumes)
- C. Cool-season grass dominant (10 to 25% legume or other grasses)
- D. Cool-season Grass / legume (26 to 60% legume)
- E. Legume dominant (>75% legume)
- F. Warm-season grass dominant (<40% other species)

_____2. What is the average growth stage of the dominant forage type?
- A. Vegetative
- B. Boot or bud
- C. Heading or bloom
- D. Mature
- E. Dormant

_____3. What best describes the condition of the pasture sward?

- A. Spot grazed
- B. Evenly grazed

_____4. Is weed or brush control needed other than by grazing or soil fertility management?
- A. Yes
- B. No

_____5. What soil pH_s range is recommended for this sward?
- A. 4.5 - 5.0
- B. 5.1 - 5.5
- C. 5-6 - 6.0
- D. 6.1 - 6.5
- E. 6.6 - 7.0
- F. 7.1 - 7.5

_____ 6. What fertilizer option is recommended for this pasture?

_____7. What limestone rate is recommended for this pasture in tons per acre?

SEE REVERSE SIDE

MATCHING LIVESTOCK AND FORAGE
(4 points for each answer space)

__E___1. When does this livestock herd have the highest forage quality requirement?
- A. Spring
- B. Summer
- C. Fall
- D. Winter
- E. Requirement high year round

__A___2. Does the system's growth cycle match the seasonal peak nutritional needs of this livestock herd under present management?
- A. Yes
- B. No

3. How many pounds of forage dry matter does this herd need to consume per day in:

__1125__ lbs. in spring (4 pts.)
__700__ lbs. in summer (4 pts.)
__1040__ lbs. in fall (4 pts.)
__1030__ lbs. in winter (4 pts.)

4. Is forage availability adequate for this herd in:

Spring - 100 days (4 pts.)
__X__Adequate
_____Not adequate

Summer - 100 days (4 pts.)
_____Adequate
__X__Not adequate

Fall - 100 days (4 pts.)
_____Adequate
__X__Not adequate

Winter - 65 days (4 pts.)
__X__Adequate
_____Not adequate

PASTURE IMPROVEMENT
(Answers to questions 3, 4, and 5 for this section are based on the choice for question Number 2) (5 points each)

__F__ 1. What change should be made in livestock management?
A. Continue present management
B. Reduce livestock numbers
C. Change calving season to a different time of year
D. Shorten calving season a period of <90 days
E. Provide higher quality pasture
F. Switch to a management-intensive rotational grazing system

__D__ 2. What type of additional forage is needed to improve this forage program?
A. Cool season grass
B. Warm season grass
C. Legumes
D. No additional forages needed – use existing pasture

__D__ 3. How should this forage be planted?
A. Plant on clean, firm seedbed
B. No-till plant in a killed sod
C. Overseed or interseed in a closely grazed sod
D. No additional forages needed – use existing pasture

_____ 4. What fertilizer option is recommended for this forage?

_____ 5. What limestone rate is recommended for this forage in tons per acre?

Revised: April, 2003

Matching Livestock and Forage

1. When does this livestock herd have the highest forage quality requirement? The answer is “E year round. This is a fall calving herd with calves weaned and backgrounded through spring. The highest forage quality requirement occurs between calving and rebreeding for the cows and in the spring for the calves.

2. Does this pasture's growth cycle match the seasonal peak nutritional needs of this livestock herd under present management? The answer is “A - Yes”. This pasture contains a mix of fescue, orchardgrass, legume mixtures and alfalfa. This provides actively growing plants throughout the growing season.

3. How many pounds of forage dry matter does this herd need to consume per day in: (see calculations next page)

4. Is forage availability adequate for this herd in: Forage availability is adequate in spring and winter with continuous grazing. See calculations next page.

Pasture improvement

1. What changes should be made in livestock management? The answer is “F – switch to a management intensive rotational grazing system. By switching to MiG forage supplies meet animal demand in all seasons.

2. What type of additional forage is needed to improve this forage program? The answer is “D - No additional forages needed - use existing pasture”. Since forage was short in summer, fall and winter any shift in forage species would create a larger deficit in the other seasons. Management intensive grazing will correct the situation in all seasons.

3. How should this forage be planted? The answer is “D - No additional forages needed - use existing pasture” since no additional forages are needed.

4. What fertilizer rate is recommended for this forage? The answer is the same as for Question 6 existing conditions.

5. What limestone rate is recommended for this forage in tons per acre? The answer is the same as for Question 7 in the Appraisal of Existing Conditions.

Pasture Scenario Calculations:

Animal Liveweight
30 cows @ 1100 lbs. = 33000 lbs.
1 bull @ 2000 lbs. = 2000 lbs.
27 calves @ 525 lbs. = 14175 lbs. (Spring)

Calf Number:
30 X .90 = 27

Calf Avg. Weight:
450 + .5 (150) = 525

Forage Consumption:

Spring
Cows (dry) = 33,000 x .02 = 660
Bull = 2,000 x .02 = 40
Calves = 14,175 x .03 = 425
1125

Fall
Cows (lact) = 33,000 x .03 = 990
Bull (brdg) = 2,000 x .025 = 50
1040

Summer
Cows (dry) = 33,000 x .02 = 660
Bull = 2,000 x .02 = 40
700

Winter
Cows (lact) = 33,000 x .03 = 990
Bull = 2,000 x .02 = 40
1030

Total forage required based on % utilization (.35 cont. .65 mig)

Spring

1125/.35 = 3214 x 100 = 321,400
1125/.65 = 1731 x 100 = 173,100

Summer

700/.35 = 2000 x 100 = 200,000
700/.65 = 1077 x 100 = 107,700

Fall

1040/.35 = 2971 x 100 = 297,100
1040/.65 = 1600 x 100 = 160,000

Winter

1030 daily needs x 65 = 66,950 herd requirements for the season

65,000 standing x .35 (cont. grazing) = 22,750 + 50,000 hay = 72,750
65,000 standing x .65 (MiG) = 42,250 + 50,000 hay = 92,250

WILDLIFE HABITAT

Native grasslands historically covered much of the United States. At present, Missouri has some thirteen million acres of grassland ranging in use from agricultural production to wildlife habitat. Of the thirteen million, less than ½ of 1% remains as native grasslands. However, many grassland wildlife species have adapted to well-managed nonnative grasslands. These grassland dependent species are in decline nationwide due to decrease in diversity and quality management. Wildlife habitat requirements are compatible with attentive livestock grazing or haying.

Grasslands provide food and cover for many species of wildlife. Open prairie species nest and raise broods in expansive grassland and only use a very small amount of shrubs for summer thermal cover. As such, prairie chickens, upland sandpiper, and meadowlark each attain their primary life cycle needs from grassland that is adequately managed. Species like the eastern cottontail rabbit, northern bobwhite quail, and eastern wild turkey use diverse grasslands along with other adjacent cover types to satisfy life cycle requirements. They prefer grassland for nesting and brooding, intermixed with dense shrubby cover, woodlands, and crop or fallow fields. Interspersion of multiple, different cover types are most beneficial.

The most important function of grassland for wildlife is to provide cover for nesting and brooding. Nesting cover must offer specific characteristics to support wildlife. The density and amount of vertical structure provided by grasses and forbs at the time of nest initiation often determines the value of the grassland for nesting. Vertical structure is usually determined by grazing or other management. Proper grazing management normally improves nesting and brooding habitat compared to idle grasslands, whereas grasslands that are improperly grazed may be practically useless for most wildlife activity. In the absence of careful planning, rotational grazing methods can even be detrimental to grassland wildlife nesting.

Grasslands are also an important source of wildlife food. The species of wildlife desired or already present in grassland will determine the plant varieties which are needed. For quail and other songbirds that require seeds in their diet, large amounts of seed-producing annual plants will increase the value of grassland. In contrast, rabbits consume the vegetative parts of grasses, legumes, and many other broad-leaved plants. If these plants are removed by continuous, severe grazing or haying, the carrying capacity of the grassland will be reduced. Generally, the higher the plant diversity, the more value the field will have for species like quail and rabbits.

THREE TYPES OF GRASSLAND

1. **Cool-season grasslands** or pastures are dominated by grasses that grow best during the cool spring and fall. These grasses begin their growth early in the spring when the soil temperature reaches 40°F. Their growth slows during the warmest part of the summer when the soil temperature nears 80°F, and resume growth again as

the soil cools in the fall. Cool-season grasses are popular with farmers because they are easy to establish and maintain, respond to heavy fertilization, and some persist under poor conditions or management. Fescue, Kentucky bluegrass, and smooth bromegrass, are all sod-forming cool-season grasses. Timothy and orchardgrass are similar cool-season grasses that grow in more open stands and provide better wildlife cover. Native cool season grasses can include Virginia and Canada wild ryes, and western wheatgrass. Fescue is the most commonly used grass for pasture and hay in much of the Midwest. It is an exotic grass species and is usually infected with an endophyte fungus that has been found to cause health problems in livestock. Unless managed specifically for wildlife, it normally has very little value for wildlife nesting, brooding, or roosting.

Most cool-season grasses need to be grazed or otherwise managed to thin the stand and attract wildlife. Prescribed fire can be used to reduce the vigor of the stand and remove litter. Cool-season grasses may be grazed to 2-4" in height, though most wildlife prefer taller vegetation. Grazing below this height will result in lower production, increased soil erosion, and minimal wildlife use. In fact, quail and rabbits prefer vegetation from 6-18" over much of the area, mixed with ample bare ground. Optimizing such specific habitat conditions can be challenging for livestock producers with robust cool-season grasses. These grasses are normally at their peak quality during the peak nesting period for many grassland birds. Coincidentally, cool-season grasses are usually either grazed by livestock or cut for hay when species like bobwhite quail are trying to accomplish nesting activities.

2. **Native Warm-season grasslands** or pastures are dominated by grasses that once comprised the natural grasslands and prairies settled by early-American pioneers. In Missouri, most of the current native warm-season grasslands have been established through planting with improved cultivars. Native warm-season grasses grow best when the weather is hot and the soil temperature is high. They begin growing when the soil nears 60°F and continue to grow during the warmest months of the year until the soil temperature reaches nearly 90°F. Although native warm-season grasses have a shorter growing season, their unique process of photosynthesis allows for more efficient use of sunlight, water, and soil nutrients than cool-season grasses. Big bluestem, indiangrass, side-oats grama, little bluestem, eastern gamagrass, and switchgrass are all native warm-season grasses that can be successfully used in a grazing system. By nature, native warm-season grasses are bunchgrasses and grow with considerable space between plants. They do not form continuous sod like most cool-season grasses. Bare ground between grass clumps allows room for animal movement as well as growing space for beneficial food and cover plants. A diversity of seed-producing broadleaf plants which attract many kinds of insects vastly improves grassland for wildlife. These conditions are ideal for young quail and songbirds, whose primary diet consists of insects for the first 2-3 weeks after leaving

the nest. Native warm-season grasses should be grazed no shorter than 8" in height, and not until May or June. When grazed at this time with the proper stocking rate, most ground-nesting wildlife will have already initiated nesting or completed incubation, and nest trampling or abandonment would be less likely. After nest initiation, grazing usually doesn't interfere with incubation unless too much cover is removed or stock density is high enough to cause nest trampling (>1 animal/ac). Always allow sufficient time for warm-season grasses to regrow, ensuring at least 8-10" of growth by first frost. This important rest period and minimal leaf area rebuilds root reserves for overwintering and initiating spring growth. Residual cover will be excellent for winter roosting and nesting the next spring. Unlike cool-season grasses and alfalfa, haying of native warm-season grasses usually occurs after the June peak of the hatch, sparing the nest and incubating hen.

3. **Native grasslands or prairies** are also dominated by a mixture of warm-season grasses and forbs. When early-American settlers moved through, Missouri's native prairies covered nearly one third of the state. Currently, very few tracts of natural grassland or native prairie remain which have not been plowed or otherwise tilled. These remnant native prairies are usually small tracts of diverse grassland that may contain hundreds of grass and broadleaved plant species. They are found primarily in the west central and southwest portions of Missouri. This diversity of plant species can make them very attractive to many species of wildlife.
   Native prairie remnants along with planted native warm-season grasses provide excellent summer pasture. Grazing should begin about May 15 or whenever the vegetation reaches 8-10" in height. Under normal conditions, native and planted prairies should not be grazed after August 15, and no lower than 8" in height to allow for re-growth before winter dormancy in late fall.
   Along with planted native warm-season grasses, remnant native prairie also provides quality hay. For best production in Missouri, July is the recommended haying period. Haying earlier or later can have a negative effect on either yield or quality of the hay (haying in June or after late August). The timing of hay cutting within the recommended dates will also dictate the types of plants that will persist within a prairie. Late June to early July will promote grasses over time, while late July-early August will stimulate forbs. Varying the hay cutting dates within the suggested time frame will help maintain greater diversity and grassland health. Landowners and managers of prairie remnants should be cautious in applying fertilizer or lime unless the prairie is in excellent condition. Applying fertilizer (especially nitrogen) may favor undesirable, competitive, or weedy plants. Prairies that have been hayed for decades may need phosphorus and potash added, but fertilizer can shift the balance of diversity in the prairie toward those relatively few plants that thrive on enhanced fertility conditions at the expense of many desirable species. Similarly, native prairies already contain several beneficial legumes and should never be over seeded with introduced legumes to increase production. Prescribed burns should be conducted on a prairie every few years to maintain healthy grasses and forbs. February to mid-March burns encourage the growth of

more broadleaves and forbs, while late March to mid-April burns encourage grasses. However, prescribed burns can be conducted year around, depending on management goals and slope conditions. Fall burns will help reduce invasion of woody species and will stimulate forbs. Late winter burns will also stimulate forbs. As with haying, it is important to vary prescribed burn timing to maintain diversity and overall health of the prairie. CAUTION: Use fire with great care. Experienced personnel are available to assist in the planning of prescribed burns.

FACTORS AFFECTING THE VALUE OF GRASSLAND FOR WILDLIFE

Different species of wildlife are attracted to grasslands for specific purposes. As an example, some birds may seek nesting sites while others may use them primarily for over-night roosting. The following four factors usually determine wildlife utilization of grassland:

1. **GROWTH HABIT OF THE GRASSLAND**:

Each species of grass has its own growth characteristics. The structure**,** or growth form and arrangement of grassland plants, is important to wildlife. Some grasses have low growing leaves and grow in dense stands that produce a sod (Bermuda grass and Tall Fescue). Sod-forming grasses have a very high stem density at ground level and quickly populate bare ground. This fact makes them less attractive to ground nesting birds, because mobility is impaired and young chicks are not able to move through the thick grass. Although some cool-season grasses form sod, not all sod-forming grasses are difficult for wildlife to move through if managed properly, e.g. Smooth Brome and Redtop. Most warm-season grasses and a few cool-season grasses like Timothy form clumps and are called bunchgrasses. Generally, bunchgrasses provide attractive habitat because small animals are able to move between grass clumps without restraint. Broadleaf plants and legumes are able to grow in the open space and provide beneficial food and cover. Alternatively, some bunchgrasses like Caucasian Bluestem are too dense at ground level and restrict growth of important forbs, creating a monoculture of poor wildlife cover. Ground-nesting wildlife, e.g. quail, rabbits, and prairie chickens, need vertical cover for nesting. Adequate cover can be provided by either cool or warm season grasses, though there are differences between these which must be incorporated into management. Because nesting generally commences early in the spring before warm-season grasses begin new growth, overhead cover at this time could only be provided by new cool-season grass growth or the previous year's warm-season grass residue. For nesting that occurs later in the spring or early summer, new warm-season grass growth can provide tall enough vertical cover for nesting. Therefore, when properly managed both cool and warm season grasses can provide a good nesting environment early in the nesting season, though warm-season grass may be better in late summer.

Similar vertical cover is also important for brood cover, but must include ample bare ground and many seed-producing, insect-attracting forbs. Brood cover must be predominantly erect and easy to move through for very young wildlife, while providing overhead protection from avian predators. Quality brood cover may also benefit young wildlife by reducing the impact of harsh rain showers and moderating humidity and

temperature extremes. Studies show that during mid-June, ground-level temperatures will be 21° F cooler and the humidity will be 29% higher in a native warm-season grass field than a corn field. During the peak quail hatch around June 15, cooler temperatures and higher humidity creates an ideal environment for the production of young quail. In addition, the tall, stiff, upright stems, and elevated leaves of most native warm-season grasses and forbs can effectively reduce wind speed and the wind chill effect on warm-blooded animals during winter.

2. **COMPOSITION OF THE GRASSLAND**:

Various species of grass are the main component of grassland, but legumes and other broadleaf plants increase productivity for both wildlife and livestock. As previously discussed, many animals depend on important broadleaf plants that attract insects and to produce seeds. Prairie forbs have unique and diverse flowering mechanisms which attract butterflies and other pollinating insects to ensure the production of seed and persistence of the prairie. Thus, two of the most important factors that determine the value of grassland for wildlife are the growth form and arrangement of the grasses, and the diversity found within.

3. **SIZE OF THE GRASSLAND OR PASTURE UNIT**:

Livestock are strong and mobile, moving to find available forage within any size fenced pasture. Wildlife is not confined by fences, but is constrained by their ability as a species to safely travel for food and cover. Rabbits and quail in particular require habitat components near (within 250') one another for safe movement.

Many species of wildlife, including rabbits and bobwhite quail, concentrate fundamental activities near the "edge" of grassland fields. Edge is defined as a location where two different cover types meet. These transitional zones contain a mixture of plant species and structure found in each of the distinct cover types, which is attractive to wildlife. For many small animals and birds, an edge provides multiple cover types used to satisfy life cycle requirements in close proximity. As a result of this increased convenience, predation is less likely and survival rates increase. For certain grassland wildlife, the transition area between grasslands and woodlands, old fields, or crop fields is critical. Rabbits require grassland vegetation for food in addition to brushy escape cover to survive pressure from predators. While quail could utilize the interior of large, open, properly managed grasslands, they too are most often found near the edge. A well managed edge can provide colonies of protective shrubby cover along with a rich variety of seed-producing, insect-attracting plants - everything they need, with greater security. For the livestock or hay producer, grassland management practices are usually directed toward maximizing production of forage and destroying valuable wildlife cover. Periodic prescribed burning of grassland to increase production will eliminate live shrubs and downed brushy cover unless specifically protected from fire. When managing for rabbits and quail, it is important to realize that they may fully utilize a properly managed 20 acre grassland, but may never use the interior of larger, poorly managed fields which lack adequate, well-distributed protective cover. Research suggests that in a grazing situation, greater nest success will result from paddock sizes of 10-20 acres. Patch burn grazing creates usable large fields due to the mosaic of

structure and cover created with the technique. Remember however, that large, open grassland with little or no woody cover is important when managing for "open-land" prairie species like prairie chickens, Upland Sandpiper, and Meadowlark. Well managed grasslands of at least 250 acres should be available for these open prairie species.

4. **MANAGEMENT OF THE GRASSLAND**:

When managing grassland for wildlife our primary goal is to set back plant succession. Management practices which create bare ground will stimulate a diverse array of new plant growth from seeds in the soil seed bank. By promoting these so-called "early successional species", the grassland will flourish with a variety of vegetation and habitat conditions that favor wildlife food and cover. Plant species and structure diversity can be enhanced with prescribed fire, herbicide treatment, or mechanical disturbance (e.g., disking, grazing, seeding, or mowing). Similar and beneficial results can be achieved using each of these practices, depending on the timing and current stage of growth in the grassland. Likewise, performing these practices at the wrong time can degrade grassland and reduce its value for wildlife. In grassland used for agricultural production, timing and method of harvest are likely the most critical factors affecting their value for wildlife. Grasslands are usually either hayed or grazed by livestock for a designated period of time.

When grassland is cut for hay, the effect is immediate and unexpected by wildlife. Food and cover vegetation is removed within a very short amount of time, forcing wildlife to move to adjacent areas or be exposed to predators. The negative impact of haying on wildlife can be reduced by leaving a 30' wide uncut perimeter around the field, in addition to strips across the center of larger fields. These uncut areas provide usable, residual cover which can be harvested at a later date.

In contrast to haying, grazing normally removes food and cover vegetation over a longer period of time. Based upon the management of the grazing system, livestock may graze from as little as one day to continuously. The rate of vegetation removal will be determined by two primary factors: 1) Stocking Rate and 2) Grazing Period.

Livestock grazing is generally managed using a continuous or rotational system. Continuous grazing allows livestock in one grazing unit to graze for a long period of time, selectively choosing the plants they eat. Oftentimes, continuous grazing results in the near elimination of certain choice plants (decreaser plants) and allows the introduction or spread of plants that are not as palatable to livestock (increaser plants or invader plants). Severe, continuous grazing reduces forage production and eliminates wildlife cover and food. Depending on the stock density in a continuous grazing system, cattle trampling can also destroy wildlife nests. Years of relentless, continuous grazing can transform productive grassland into undesirable, inadequate plants. Grassland that is continuously, rigorously grazed will produce less forage each year. Conversely, light to moderate seasonal grazing can produce very good nesting and brood cover. Grasslands which are lightly to moderately grazed will contain a mosaic of patches which range from heavily to lightly grazed. This diversity of vegetative structure and plant species is attractive to wildlife. However, even light and moderate grazing for

extremely long periods of time can result in loss of desirable forage plants which are continually re-grazed by livestock. Due to the “spotty” nature of continuous light to moderate grazing, nearby patches of these same desirable plant species may be passed over and allowed to mature, making them unpalatable and undesirable by the livestock for future grazing. Two management techniques that can help solve this problem are rotation grazing and prescribed burning. Rotation grazing may be as simple as switching livestock between two grazing units or pastures, but often works best with more than two grazing units. So-called “Management intensive Grazing” (MiG) can result in higher production for the grazing herd through lower stock density and higher pounds per day gain per head. Rotational systems require more management on the part of the operator due to the active movement of livestock through smaller grazing units (paddocks), on a schedule ranging from twice daily to once per week. It is important to note that the proper term for this type of grazing system is “Management intensive Grazing”, because it is the management and not necessarily the grazing that is intensified. Grazing units are “rested” when they are left idle or allowed a break between grazing periods. Resting a paddock increases the vigor of choice plants, affording them a chance to rebuild vital tissues, replenish energy reserves, and perhaps reproduce. This gradually restores or increases the quality of plants within the grazing unit. More plant diversity and vigor in the grazing system will result in increased livestock production and appeal to wildlife. It is important to realize that optimal rest periods are normally longer for native grasses (35-60 days) than for cool-season grasses and legumes.

Grazing height affects cool and warm season grasslands differently. Cool-season grasses primarily store energy reserves for rebuilding tissues in underground root systems. Warm-season grasses store a significant portion of their reserves in the lower stem in addition to the roots and have significantly greater root mass. These physiological differences allow cool-season grasses to be grazed to shorter heights without weakening plants. Therefore, the species composition of grassland must be considered when evaluating the height of vegetation and subsequent grazing pressure. Regardless of species, the height of vegetation during and after grazing a paddock is crucial for grassland wildlife. Ahead of grazing when forage grows undisturbed, quail may utilize the field for nesting but may soon be forced to abandon nests or move broods if plant height is uniformly grazed below 8”. Moving broods or attempting to re-nest later in the season, possibly in less desirable cover, will increase predation and diminish nesting success. Quail nests can also be destroyed by livestock trampling when stocking rates are too high. Heavily or severely grazed pastures oftentimes look like a short carpet of green grass. Grasses will be weakened in continuously, severely grazed pasture and will eventually allow weeds, woody vegetation, or nuisance species to increase. Any benefits of heavily grazed pastures to wildlife will depend on remaining species composition and structure. If a cool-season or native warm-season grass pasture has a history of heavy grazing, all grazing should be deferred for a growing season to improve the vigor and species composition of the stand. After a period of rest, the stand can be grazed but should be monitored closely to avoid removal of too much

forage. Moderate grazing is defined as leaving 3-8” on cool-season or 8-12” on native warm-season pastures through the winter, on at least 75% of the grazing unit. Moderate grazing usually creates the most desirable wildlife habitat conditions. Under-grazing frequently results in overly tall forage throughout the unit during most of the year. For some species of wildlife, this can be just as detrimental as heavy grazing pressure. Very dense grassy vegetation, especially cool-season grasses like fescue, can restrict the movement of young quail from the nest. As with heavily grazed areas, wildlife benefits of lightly grazed grassland units are determined by the current species composition, structure, and density of the stand. The value of an individual grazing paddock to wildlife depends on 1) the amount of residual vegetation left after grazing, 2) stock density, 3) the duration of rest (especially after grazing at high stock density), and 4) the size of the paddock. Bobwhite quail will not use very short cover or small paddocks if stock density is greater than one animal per acre, as is common with rotational grazing. Nest trampling will likely occur at high stock densities and sufficient residue must remain for nest initiation. Ideally, the paddock resting period must also allow enough time for nest building, egg laying, and incubation before livestock return. At minimum this would require 35 days, nearly matching the optimum rest period for native warm-season grasses (42 to 49 days). Most rotational grazing systems will provide succulent forage for livestock, simultaneously allowing some areas to grow undisturbed. Areas that are ungrazed and resting, or areas that are a mosaic of light to moderately grazed can provide wildlife habitat if the vegetative structure and length of rest is adequate. Prairie remnants and planted native warm-season grasses may be used for rotation grazing and also work well in a grazing system called patch-burn grazing. Patch-burn grazing involves the rotation of burned patches within perimeter-fenced grasslands to distribute grazing pressure from year to year. Each winter or spring one-fourth to one-third of the entire grazing area is burned, consequently focusing grazing pressure on the lush, new growth of the burned patch. Livestock tend to prefer tender, new growth and graze it much shorter and more often than unburned portions. Each year a new patch is burned and the previously burned patch will be grazed significantly less, allowing it to rest until burned again. Livestock have access to all parts of the pasture but only graze the burned portions very short, leaving taller residual vegetation in the lightly grazed, unburned portions. Patch-burn grazing provides excellent nesting and brood cover. If fire cannot be used to create burned patches, producers can simulate patch-burn grazing with mowing or fencing. Focus heavy livestock grazing in designated areas and lighter grazing on the remainder by mowing patches or fencing in early spring. The disadvantage to these alternative methods is that litter is not effectively removed and buildup can contribute to high nest predation in addition to difficult brood movement. Mob grazing (ultra-high stock densities) can help control litter accumulation but nests in paddocks managed with this high stock density technique will likely be trampled (although birds nesting and brooding in paddocks rested during the nesting season may be quite successful).

5. WILDLIFE COVER IN GRASSLAND:

Pastures and hay fields that are isolated from other habitat components are of little value to rabbits and quail. They readily use woody cover for protection, idle grassy areas with bare ground for nesting, and crop residues or weedy patches for feeding and raising broods. These cover types must be intermixed within the grassland or located nearby. Quail and rabbits rely on a variety of cover types to meet seasonal life cycle requirements. In areas where wildlife habitat is optimized, grassland only provides a portion of what is needed during the year. Low growing shrubby cover and woodlands provide thermal protection in the summer and, if dense enough, predator and weather protection in winter. Crop fields oftentimes provide summer brooding habitat and high-energy waste grain after harvest in the fall and winter. Fallow weedy areas and food plots are foraged for seeds throughout severe winter months and into spring where insects emerge or new growth is available. When left idle they may also be used for nesting, along with protected odd or idle grassy areas that are managed appropriately. Grassland which differs significantly from the field being evaluated will also lend to the diversity of habitat components that allow quail and rabbits to thrive. To be considered, the differences must be easily apparent and offer alternate cover for nesting, feeding, brooding, roosting, loafing, predator protection, etc. Beneficial variations between grassland may include growth habit, structure, species composition, and management (cool vs. warm season grasses, monoculture vs. many species, monotypic cover height vs. varied vertical structure, heavily grazed grass "carpet" vs. burned or disked idle grassland, etc.). Additional cover types should be available that are protected from grazing. Properly managed grasslands can provide a variety of cover for wildlife activities including nesting, roosting, brooding, and winter protection. Herbaceous cover or soft cover is the vegetative growth consisting of grasses and non-woody broad-leaved plants. The majority of short cover in grassland is herbaceous. Herbaceous cover is used primarily for nesting, brooding, feeding, and sometimes roosting or loafing. Shrubby cover or brush refers to low growing woody cover provided mainly by shrubs. Shrubs are low-growing woody plants, usually with multiple stems that arise from a common base. Most shrubs reach only 3-12' at maturity and branch structure is close to the ground. When they grow close together to form a thicket (high stem density), they provide excellent protective cover for quail and other small animals. Quality shrubby cover has a barren or sparsely vegetated understory, without sod or thick grasses that could inhibit movement by small animals. Brushy areas produce mast and browse for many animals, and the dense branches provide nesting for many songbirds. Escape cover is a term used to describe an area where small birds and animals can escape predators such as foxes, coyotes and hawks. It may consist of live or cut brush, dense shrubs, brambles, or other well-branched woody structure with bare ground underneath. Quality escape cover should be dense enough to serve as a barrier that is extremely difficult for a predator to move through and can consist of hinged or severed brush, dense shrubs, brambles, or other well-branched woody structure with a bare or sparsely vegetated understory. Although not always necessary, to ensure escape cover integrity is maintained, it is suggested that escape cover be

excluded from livestock because grazing can reduce woody cover density and diversity of vegetation which limits its usefulness to wildlife.
Patches of escape cover need to be large enough for animals to use and feel secure from predators. Ideally, they would be distributed so that the entire grassland could be used by wildlife for nesting, brooding, or feeding without excessive vulnerability. For quail and rabbits, a patch of escape cover should be at least 1500 ft_2 (30'x50') and provided within or adjacent to each 10 acres of grassland. To be considered adequate, escape cover must have high stem or branch density with intertwined branches that yield nearly continuous cover. In grassland lacking suitable dense woody cover, artificial escape cover can be created using cut brush. This downed woody structure is best arranged by placing several large trees closely side by side so that their branch tips intertwine and form continuous cover. Alternating the trunk direction of well-branched, sturdy tree species like Shingle Oak, Pin Oak, or Hedge works best and last longer than softer species. Select optimal locations for downed woody structures and eliminate ground cover before placing material. An idle area is a patch of cover which is protected from grazing and otherwise unused for agricultural production. An idle area can be a combination of one or more cover types. These small areas can provide part of the life cycle requirements for grassland wildlife. To be useful, idle areas need to be:

- at least 30' wide
- ¼ acre in size
- found within or immediately adjacent to the grassland field (e.g., fenced pond, odd corner, etc.)

Idle areas should be periodically managed to produce a diverse plant community. Idle areas left unmanaged will soon be dominated by one or a few plant species (often sod-forming grasses), greatly limiting their use by wildlife. Prescribed burning, disking, and herbicides can be used to improve stagnant idle areas. Suitable idle areas which are along a significant portion of the field perimeter can be considered part of a field border. A field border refers to a strip of vegetation around the perimeter of a paddock or field that differs from the vegetation within. Field borders are generally some type of useable wildlife cover and should be at least 30' wide. They may be created by protecting existing cover from haying or grazing, establishing new cover, or otherwise shifting management in those areas. Wildlife can use the resulting changes in vegetation to fulfill life cycle requirements when the field itself is unsuitable. Field borders are especially beneficial when adjacent fields are grazed or hayed, leaving very little wildlife cover over large landscapes. To satisfy minimal wildlife needs in fields less than 20 acres, 25-50% of the field perimeter should be bordered. Larger fields need 75-100% of the perimeter in field borders to be attractive and valuable to wildlife.

NORTHERN BOBWHITE QUAIL: BASIC MANAGEMENT

Bobwhite quail are best managed on a twenty to forty acre basis. The area is small enough to work with and large enough for a covey of quail. The most obvious quail management is to protect what is there now - shrubby and woody cover around edges, in draws and other idle areas which usually occur on a farm.

FOOD MANAGEMENT: Food must be available and adjacent to escape cover. Birds should be able to walk through quality cover to their feeding grounds. Food must be abundant, high quality, and available so that it can be utilized.

The bobwhite quail diet will vary throughout its population range. In grain producing areas, soybeans are used most frequently followed by corn, weed seeds, and milo. In other areas quail will rely heavily on weed seed and cereal grain crop residues when available. Fall tillage of crop stubble will eliminate an important food source that can improve winter survival. No-till cropping systems are beneficial, providing more numerous seeds, insects, and cover. A quail management plan should always incorporate the following important sources of food: 1) grain crop residue or annual grain food plots and 2) native weed seeds, grasses, and shrub/tree fruits.

IMPORTANT QUAIL FOOD PLANTS INCLUDE: Acorns, grain crop residues, alfalfa, annual lespedezas, bedstraws, beggar ticks, blackberry, bidens, cinquefoil, clovers, croton, dandelion, foxtails, Illinois bundle flower, lambsquarter, partridge pea, pig weed, poison ivy, pokeweed, ragweeds, sedges, sensitive briar, smartweeds, sunflowers.

COVER MANAGEMENT: Cover can often be improved simply by restricting livestock access with fencing to allow natural plant growth. Maintain patches of dense brushy cover around all fields, and in travel lanes or scattered across fields larger than 20 acres.

Escape cover can be provided by thickets of dense shrubs (dogwoods, plum, or blackberries) and loosely constructed areas of brush at least 1500 ft^2 in size (30' x 50'). Escape cover located next to food production areas are best. Avoid tightly stacked brush or dozer piles which may be more attractive to foxes and raccoons and less usable by rabbits and quail. Consider an independent patch of shrubs/brush as suitable escape cover if it is at least 30' wide, 1500 ft^2 in area, and you or a hunting dog would not want to go through it.

Nesting cover is usually provided by unmowed or ungrazed to moderately grazed grassland, idle crop fields, or weedy field borders. Quail prefer sparse, clumpy grasslands with at least 25% bare ground for ease of movement, 6-18" high vertical structure, and residual dry litter (usually made from dried grass leaves and fine stems and placed at the base of a grass clump) to create a nest. Native warm-season grasses, Redtop, Timothy, and Orchardgrass are desirable grasses when managed for openness at ground level and correct vertical structure. 25-50% bare ground along with a diversity of forbs would create ideal nesting habitat. Nesting areas may be maintained by grazing, burning, or disking every few years. Diverse grasslands consisting of several grass and forbs species and 25-50% bare ground are ideal. Under optimum

management, adequate nesting cover should be provided by at least 50% of the grazing unit or an equivalent amount should be immediately adjacent.

Roosting cover provides concealment from above and thermal protection from heat and sun. Quail roost in vegetation that is rather open or clumpy, away from dense or tangled escape cover. Fields of annual forbs like ragweed and croton, or grasses like Big and Little Bluestem or Broomsedge are good roosting areas.

Bare ground is a critical component of quail habitat because it facilitates movement and foraging. Quail are ground-dwelling birds and prefer to walk rather than fly. They are also sight feeders, picking up seeds and insects off the ground and low vegetation. Heavy sods and accumulated litter inhibit movement and foraging by quail. The importance of bare ground cannot be overemphasized. It is necessary for ease of movement, dusting, and feeding. For greatest appeal to quail there should be no less than 25% bare ground in the field or grazing unit.

SUMMARY: Bobwhite quail are primarily seed eaters except for the first few weeks after hatching. They do eat insects when they are abundant and easy prey, but seeds remain the staple food for most of the year. Escape cover is critical and must be located next to feeding areas. To be effective, cover must be managed to produce the necessary structure. Livestock grazing can be a very effective tool for managing quail habitat when used properly, but improperly used, it can make large areas unusable.

BOBWHITE QUAIL LIFE CYCLE

APRIL:	Covey breakup occurs. Whistling and pairing begins
MAY:	Nesting gets underway. Early attempts are often unsuccessful due to hay cutting, predators, etc.
JUNE:	Hatching peak is around June 15th. Heavy rainfall and floods at this time can have a detrimental impact on quail populations.
JULY:	The second hatching peak is usually in mid to late July, due to second attempts at nesting. Heavy rains or drought can play a role in hatch success.
AUGUST:	Late hatches occur, particularly if there were excessive rains in June or July. Annually 10-20% of the population measured in the fall are usually late hatch birds.
SEPT:	Birds from July hatches become mature enough to enter the fall shuffle.
OCTOBER:	The quail begin to become habitat selective. They often leave poor (marginal) habitat to find better conditions.
NOV:	Winter coveys formed. Exception: If the percentage of late hatched birds (Aug-Sept) is high, then weak covey units are formed and hunting is poor.
DEC:	A generally fair month for quail, unless ice and snow is deep.
JANUARY:	Peak fat reserves are reached about mid-month. Severe weather becomes a factor. Quail will select and concentrate in the best habitat where food sources are rapidly depleted.
FEBRUARY:	Severe weather still a factor. Extended periods of ice or snow cover are most harmful. Population losses at this point for any reason are most harmful (poaching, predator, starvation, etc.).

MARCH: Food, cover, and fat reserves at lowest point of the year - adverse weather can still be a factor. Covey breakup begins at the end of the month

COVER SELECTION:

1. Spring and summer - Quail need grassy unmowed areas for nesting - usually last year's vegetation is used for nesting. They tend to select grassy or weedy areas as feeding sites. Important that plant density is sparse to allow movement through vegetation.

2. Fall and winter- Quail will move into woody areas. They tend to select dense brush as core cover. Usually won't venture farther than about 80' from good brushy cover to feed.

FOOD SELECTION:

1. Spring and summer – insects and green plant material. Berries and remaining seed residues also used.

2. **Fall and winter –** Weed seed and waste grain from crop residue very important

EASTERN COTTONTAIL RABBIT - BASIC MANAGEMENT

The average Missouri farm has ample room for rabbit management. Under good conditions, the home range of a cottontail is often less than five acres.

Rabbits need well-distributed escape cover, an ample year-round food supply, and a safe place for nesting and development of young. Although rabbits drink during hot, dry spells, they can also obtain water from the succulent plants they eat.

FOOD MANAGEMENT: Bluegrass is sought for food nearly year-round, although not heavily during the summer. Preferred summer foods include white clover, annual lespedezas, and crabgrass. Newly sprouted wheat and waste grain from corn and milo are important during fall and winter. Annual cheat grass and other winter annuals are important food during early spring. High quality foods must be next to good cover for rabbits.

IMPORTANT RABBIT FOOD PLANTS INCLUDE: Waste grain crop residues, asters, Kentucky Bluegrass, cheatgrass, cinquefoil, clovers, crabgrass, dandelion, fall panic grass, fleabanes, horse nettle, knotweed, annual lespedezas, nodding foxtail, plantains, poison ivy, ragweeds, sedges, smartweeds, wild strawberry, sumacs, tall thistle, tick trefoils, and timothy.

COVER MANAGEMENT: Dense, well distributed protective cover is the most critical element in good rabbit habitat. Live shrub thickets or downed brushy structure located in the right place bring the quickest response of all management practices. Rabbits often take over a downed woody structure the night after construction.

Some trees like Pin or Shingle Oak will remain alive for several years when hinge-cut at the stump. This can be done by cutting mostly through the trunk and felling the top over, still attached to the stump. The live twigs and limbs of hinge-cut trees can provide

both food and cover for several years. When creating artificial brush structures, place them close to existing natural woody cover such as briars, fencerows, or woodland edges.

Fencing woodlots, gullies, and pond areas to exclude livestock can improve existing cover and allow grass and shrubs to thrive. By protecting fencerows or field borders from grazing and felling the larger trees, resulting shrubby growth will be low and dense.

Allow sprouts, briars, and brush to grow on odd or idle areas of at least ¼ acre to provide excellent nesting, loafing, and roosting sites for wildlife.

SUMMARY: A rabbit management plan including as many of the following items as possible will be most successful: 1) Dense shrub thickets, briar patches, downed woody structure and woodlands protected from grazing 2) Cereal grain crops (oats, wheat, rye, barley), 3) Annual grain crops (corn, milo, soybeans), 4) Green browse (light to moderately grazed native warm-season and cool-season grasses with ample forbs and legumes), 5) Weedy areas (crabgrass, foxtail, ragweed).

WILDLIFE MANAGEMENT PRACTICES

Competency/Objective: Appraise a fenced plot of grassland or pasture for its ability to meet the basic needs of wildlife.

Study questions:

1. Why consider the needs of wildlife in the management of grasslands?

2. What is the species composition of this grassland?
   What are the dominant grasses?
   What legumes are present?
   What grassland composition is best for rabbit and quail that might use the area?

3. Compared to bobwhite quail, what major grassland characteristics does the prairie chicken require?

4. What other types of wildlife utilize grasslands?

5. How can forage composition affect wildlife use?
   What percent of the ground is shaded by legumes?
   What range of legume canopy cover is ideal for rabbits and quail?

6. How does the structure and availability of cover affect wildlife?

7. How does the size of the grassland affect wildlife use?

8. How does the timing and intensity of a forage harvest affect wildlife use?
   What is the grazing pressure within this pasture unit - Heavy, Moderate, or Light?

9. Define the term “management-intensive grazing system”.

10. What is the minimum grazing height for warm-season grasses?

11. Under a grazing system, can there be a “border” within the fenced area?
    A border refers to a minimum 30’ wide strip of usable vegetation on the perimeter of a field. If livestock graze from fence row to fence row, can there be a border?

12. Inspect escape cover within the fenced area of the pasture. Can you find an area where a rabbit being chased by a coyote can escape being caught?

13. Consider the shrubs and weedy plants that are 6-18” tall within the fenced pasture. These knee-high plants must provide enough aerial cover to allow a rabbit or quail to move undetected by hawks and owls, yet be open at ground level. What percent of this cover is ideal for rabbits and quail?

14. What is the distance from the center of the grazed field to the nearest crop field?
    Why is this important to quail and rabbits?

15. What percent of this pasture is within 250’ of protected escape cover?
    Why is this important to rabbits and quail?

References:

1. “Introduction to Grassland Management”, (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1996, Unit IV.

2. Wildlife Management for Missouri Landowners, Pitts, David E., MO Department of Conservation, Box 180, Jefferson City, MO 65101. (Booklet free upon request)

3. The Bobwhite Quail, Its Life and Management, Walter Rosene. The Sun Press, Hartwell, GA. 30643.

4. On The Edge, Dailey, Tom and Hutton, Tom, Mo. Dept of Conservation, Box 180, Jefferson City, Mo. 65101. (Booklet free upon request)

5. Missouri Bobwhite Quail Habitat Appraisal Guide, White, Bill, Pat Graham, and Robert A Pierce II, University of Missouri Extension Publication MP902

Wildlife Section Scorecard Questions

This series of questions will be used to create the 20 questions on the back of the wildlife scorecard. Correct answers on answer sheet.

1. Remnant native prairies are located primarily in this part of Missouri:
   A. West-central & southwest B. Northeast & east C. East-central & southeast

2. Several species of wildlife use grasslands for:
   A. All of these B. Foraging C. Roosting D. Dusting E. Nesting

3. The maximum density or the upper limit of survival possible of a species that particular range or area is capable of supporting during a definite period of the year is referred to as:
   A. Carrying capacity B. Diversity C. Habitat D. Limit

4. Warm-season grasses should be cut for hay during this period:
   A. May to mid June B. Late June through early August C. Late June to early July D. August only

5. The transition zone or area between two or more diverse communities or habitat types is referred to as an ecotone, but more commonly called:
   A. Border B. Niche C. Edge D. Zone

6. An organism or species that is not native to the region in which it is found.
   A. Exothermic B. Endangered C. Endemic D. Exotic

7. Cool season grasses do most of their growing during the spring and fall.
   A. True B. False

8. The following is not a grass:
   A. Foxtail B. Yellow nutgrass C. Purple top D. Downy chess

9. Remnant native prairies considered to be in poor condition should not be fertilized, limed or have seed added.
   A. Statement is True B. Statement is False

10. A low growing, woody plant with several permanent stems arising from a common base.
    A. Forb B. Shrub C. Herb D. Grass

11. The parameter or limit in an animal's habitat that outweighs all other in limiting productivity is called a:
A. Succession B. Niche C. Limiting Factor D. Dominant Factor

12. Quail and rabbits prefer grasses that grow in clumps, rather than those that form dense sods.
A. True B. False

13. Research has shown that rabbits and quail rarely move further than this distance between different habitat components.
A. One-half mile B. One mile C.Two miles D. One-eighth mile

14. The following is not a type of warm-season grass:
A. Fescue B. Switchgrass C. Big bluestem D. Indiangrass

15. In a native warm-season grass pasture or prairie, this type of grazing would be best for both livestock production and wildlife habitat:
A. Patch burn grazing
B. No grazing
C. Continuous severe grazing
D. Rotation grazing

16. Usually the most productive grazing practice for nesting wildlife is:
A. Heavy B. Rotational C. Light to moderate D. Mob grazing

17. In wildlife management, a strip of herbaceous or woody vegetation, usually low growing and more than 30 feet in width, established along the edges of fields, woodlands, or streams.
A. Degradation strip B. Interspersion area C. Indicator area D. Border

18. This plant is not a legume:
A. Partridge pea B. Sunflower C. Lead plant D. Lespedeza

19. A plant that completes its life cycle in two years.
A. Annual B. Seasonal C. Perennial D. Biennial

20. Which plant types are the dominant species in a grassland?
A. Grasses, shrubs and legumes
B. All plant species
C. Grasses and forbs
D. Woody plants, grasses, forbs, and legumes

21. Warm-season grasses should not be grazed closer to the ground than:
A. 2 (two) inches B. 20 (twenty) inches C. 8 (eight) inches D. ½ (one half) inch

22. The best compromise between peak quality and quantity for warm-season grass hay occurs in:
A. April B. May C. July D. September

23. Burning a native prairie periodically under proper conditions benefits wildlife by:
A. Making nests harder for predators to find
B. Improving conditions for animal mobility
C. Exposing bare areas for dusting
D. Removing excess plant litter
E. All of the above

24. Heavy grazing or excessive haying could cause undesirable plants to:
A. Increase B. Decrease C. Completely die out

25. Proper management of a grassland may include:
A. Haying B. Fertilizing C. Grazing D. Prescribed Fire E. All of these

26. Missouri has this many acres that are considered to be grasslands.
A. 5 million B. 25 thousand C. 13 million

27. The stages through which an ecosystem passes from less complex to more complex, ie, from bare ground to an oak hickory forest in MO is called:
A. Niche B. Limiting Factor C. Dominant Factor D. Succession

28. The soil temperature at which warm-season grasses grow most efficiently is between (degrees F):
A. 88 – 100^{o} F B. 40- 78^{o}F C. 55 – 90^{o}F

29. The place where the animal lives; where all its requirements for life are fulfilled is referred to as its:
A. Carrying Capacity B. Diversity C. Habitat D. Home

30. A cross section of an area used as a sample for recording, mapping, or studying vegetation.
A. Indigenous sample B. Spot Sample C. Sward D. Transect

31. Any plant that by its presence, frequency, or vigor indicates any particular property of the site.

A. Site specific plant B. Perennial C. Indicator plant D. Decreasers plant

32. The stages through which an organism passes during its existence.
A. Life cycle B. Edge Effect C. Succession D. None of these

33. A plant that is capable of removing nitrogen from the air and adding it to the soil by way of its root system is called a:
A. Sedge B. Legume C. Rush D. Grass

34. This plant is not a grass.
A. Green Foxtail B. Birdsfoot trefoil C. Downy chess D. Sand Bur

35. Wildlife prefer grasses which:
A. Form a dense sod with a high stem density at ground level
B. Grow in less dense stands with upright leaves
C. Have berries

36. Cool season grasses grow best during this time of year:
A. Spring/fall B. Spring/summer C. Summer D. Summer/fall

37. A species (animal or plant) that is a part of the original fauna or flora of an area.
A. Organism B. Predator C. Exotic species D. Native species

38. In a pasture rotation system, warm-season grasses are used to supplement cool-season grasses during the:
A. Summer B. Winter C. Fall D. Spring

39. Which plant type(s) will live for at least two (2) years?
A. Perennial and annual B. Biennial and Perennial C. Biennial and annual
D. Perennial only

40. Relatively small, often isolated native grasslands that occur on hilltops and south facing slopes, where thin, dry soils and dry harsh desert like summer conditions harbor unique natural communities of plants and animals.
A. Glade B. Sward C. Savanna D. Desert Tundra

41. The land area that drains toward a natural surface water system.
A. Diversion terrace B. Water course C. Watershed

42. Cool-season grasses do not use soil nutrients as efficiently as native warm-season grasses and require somewhat high fertility and soil pH.
A. False B. True

43. Cutting hay on native prairies during September will:
    A. Reduce the need for fertilizer
    B. Weaken the native grasses
    C. Improve wildlife habitat
    D. Increase hay production next year
    E. None of the above

44. Burning a warm-season grass pasture or hayfield should be:
    A. Done in October every three years.
    B. Prevented if at all possible.
    C. Done at specific times to benefit wildlife and increase forage production.
    D. Done in August every year.

45. Rabbits and quail use field edges where other habitat types are available rather than the center of large fields.
    A. False B. True

46. In this group are the mid to tall grasses, and forbs that are most liked by grazing animals and repeated grazing may even destroy them.
    A. Increasers B. Biennial C. Decreasers D. Invaders

47. Which of the following functions are provided by well managed grasslands?
    A. Nesting cover B. Dusting cover C. Thermal cover
    D. Vertical structure E. All of the above

48. What percentage of native grassland remains in Missouri?
    A. 5% B. 10% C.1/2% D. 1%

49. Grassland wildlife prefer the following:
    A. Native prairie (warm season grasses and forbs)
    B. Non-native warm season grasses C. Endophyte infected fescue
    D. Well managed mixed cool season grasses and legumes E. A and D

50. All rotation grazing is poor for wildlife.
    A. True B. False

51. Which of the following is not a purpose for prescribed burning?
    A. Woody plant control
    B. To focus grazing intensity
    C. Increase forage
    D. Improve wildlife habitat
    E. None of the above

52. Which of the following is a fungus that infects fescue and makes it more unsuitable for livestock and wildlife?
A. Neophyte B. Mildew C. Endoplasm D. Endophyte

53. Herbaceous cover that is burned in fall or spring will not be suitable for nesting Cover until:
A. Bare ground is completely eliminated
B. The vegetation reaches vertical height adequate to conceal the nesting hen.
C. The next growing season.

54. Which of the following has the best growth and structure characteristics for brood habitat:
A. A mixed stand of annual forbs
B. Closely grazed Caucasian Bluestem
C. A recently disturbed field with ragweed and crotons
D. An unburned stand of native grasses
E. A and C

55. Which of the following is not a component of quality brood cover?
A. Proximity to escape cover
B. Continuous ground cover
C. Bare ground
D. Open structure of forbs

56. Which of the following is not a component of suitable escape cover?
A. Heavy logs on the ground B. A thicket of brambles
C. Thick, dense matted fescue D. Downed tree tops

57. Native prairie may consist of warm season and cool season grasses, sedges, forbs, and some shrubby species.
A. True B. False

58. Quail prefer to nest at least 500' from an edge.
A. True B. False

59. Livestock and wildlife can be compatible.
A. True B. False

60. Herbaceous cover is used for:
A. Food B. Nesting/ brood cover C. Roosting/ loafing D. All of the above

61. Fields with crop residues that have been tilled under in the fall provide:
A. More food for wildlife B. Very little or no benefit to wildlife C. Adequate cover benefits for wildlife

62. Dense sods make poor wildlife habitat. A grass that does not form a dense sod is:
A. Caucasian bluestem B. Little bluestem C. Fescue
D. Bermuda grass

63. The minimum recommended escape patch for quail and rabbits is:
A. 150 sq ft B. 15,000 sq ft C.1500 sq ft D. ¼ acre

Answer Sheet for Wildlife Section Questions

1	A	17	D	33	B	49	E
2	A	18	B	34	B	50	B
3	A	19	D	35	B	51	E
4	B	20	C	36	A	52	D
5	C	21	C	37	D	53	B
6	D	22	C	38	A	54	E
7	A	23	E	39	B	55	B
8	B	24	A	40	A	56	C
9	A	25	E	41	C	57	A
10	B	26	C	42	B	58	B
11	C	27	D	43	B	59	A
12	A	28	C	44	C	60	D
13	D	29	C	45	B	61	B
14	A	30	D	46	C	62	B
15	A	31	C	47	E	63	C
16	C	32	A	48	C		

WILDLIFE HABITAT

STUDENT ID:_____ STUDENT NAME:_____ SCORE: _____

Points Possible: 100

Appraisal of Existing Conditions

(Questions 1-8: 5 points each)

The ***bold*** point values beside each multiple choice answer will be used in the Quality of Habitat Scoring Section.

Look at the 50' x 50' enclosure to answer the first four questions:

_____ **1. The ground cover is mostly: (50' X 50')**
A. Thick and continuous ***(0 pts)*** **B.** Open and patchy ***(5 pts)***

_____ **2. Wildlife friendly forbs are present in greater than 50%:(50' X50')**
A. True ***(5 pts)*** **B.** False ***(0 pts)***

_____ **3. Bare ground is present in greater than 25%: (50' X50')**
A. True ***(5 pts)*** **B.** False ***(0 pts)***

_____ **4. The majority (>50%) of the vegetation (excluding seed stalks) is: (50' X50')**
A. Less than 6" ***(1 pts)*** **B.** 6" - 18" ***(3 pts)*** **C.** More than 18" ***(2 pts)***

_____ **5. Distance from center of field to the nearest diverse idle area**
A. Greater than 500' ***(0 pts)*** **B.** 250 - 500' ***(2 pts)*** **C.** Less than 250' ***(4 pts)***

_____ **6. Percent of the field covered by unprotected escape cover:**
A. Less than 1% (0 pts) B. 1 - 10% (1pts) C. 11 - 25% (2 pts)

_____ **7. Field size - the percent of the field within 250' of protected escape cover:**
A. 25% or less ***(1 pts)*** **C.** 51 - 75% ***(3 pts)***
B. 26 - 50 % ***(2 pts)*** **D.** Greater than 75% ***(4 pts)***

_____ **8. Distance from center of the field to edge of nearest crop field:**
A. 500' or more to crop field ***(1pts)***
B. 250 - 500' to crop field ***(2 pts)***
C. Less than 250' to crop field ***(3 pts)***

Quality of Habitat

(20 points total)

1. Based on the tally from answers to the multiple choice in the previous section rate the quality of habitat provided by the entire field for quail and rabbits. Use point values in bold and parentheses beside the multiple choice answers for questions 1-8 on the Appraisal of Existing Conditions section to determine the total point value. Place an X next to the correct answer. (10 points possible)

____ Poor (4-14 pts)
____ Fair (15-23 pts)
____ Good (24-32 pts)

2. Identify the factors limiting the field's carrying capacity for quail and rabbits. In the left hand column below, circle the letter of each limiting factor which has been discovered during the field evaluation. In the right hand column, circle the number of each management practice that can be implemented to improve the limiting factors indicated. (1 point for each item - total of 10 points possible)

Limiting Habitat Factors	Management Practices
A. Ground cover thick and/or continuous	1. Establish and/or fence escape cover
B. Inadequate nesting cover	2. Lightly disc strips on the contour
C. Inadequate brood cover	3. Use prescribed fire
D. Insufficient escape cover	4. Adjust stocking rate
E. Insufficient plant diversity	5. Overseed with wildlife friendly forbs

Scorecard revised 08/2018

Wildlife Habitat Score Card

Objective: Evaluate grassland for its value to cottontail rabbits and bobwhite quail.
A grassland manager who is interested in livestock production and wildlife must be able to recognize the requirements of both. It is important to remember that wild animals are not confined by fences. Although necessary feeding, nesting, or roosting cover may be provided within the grassland unit, suitable escape cover like downed woody structure and shrubby thickets may be located adjacent.

The following scorecard lists factors to be considered when evaluating a specific tract of grassland, pasture, or hay field. The objective of this exercise is to improve habitat for rabbits and quail by identifying and addressing specific limiting factors. The grassland unit should be evaluated based on current conditions within the perimeter fence; however, certain questions require the examination of surrounding areas. An aerial photograph of the unit would be helpful with identifying habitat components in adjacent fields. A brief explanation follows each appraisal category.

Appraisal of Existing Conditions

Look at the 50' x 50' enclosure to answer the first four questions:

1. The ground cover is mostly: ***(50'X50')***

A. Thick and continuous ***(0 pts)*** **B. Open and patchy** ***(5 pts)***

A thick and continuous structure of vegetation has little to no wildlife value because it lacks sufficient bare ground which inhibits animal movement and leaves little room for desirable, seed-producing plants to thrive. All grasses can become too thick for quail and rabbits to effectively utilize as a habitat, but fescue, bermuda, brome and Caucasian bluestem tend to reach this point of uninhabitability quicker than native warm-season grasses.

Native warm-season grasses grow in such a way as to allow movement at ground level between the grasses. Most of the native warm season grasses, some of the native cool seasons such as the wild ryes and june grass; and introduced cool seasons such as orchardgrass and timothy grow in this open, patchy manner rather than a continuous sod. An open mixture of warm-season grasses along with sedges, native perennial forbs including legumes, and seed-producing annual plants provide the diversity required by ground-nesting wildlife and many songbirds. A variety of insects are attracted to the forbs where they are fed upon by young birds and other wildlife. In addition, high quality native warm-season dominant grasslands provide a cool, moist summer environment and warm, dry winter protection.

2. Wildlife friendly forbs are present in greater than 50%:(50x50') (i.e., at least 625 sq. ft.)

A. True ***(5 pts)*** **B. False** ***(0 pts)***

It is important to know what general species of plants are present and what impact they have on the overall structure and diversity of the grassland.

Broadleaf plants, including legumes, improve grasslands for both wildlife and livestock. Lush, vegetative parts of most legumes and some forbs are sought and eaten by wildlife as well as livestock. Insect-attracting characteristics and robust seed production of these plants also benefit numerous bird and animal species that rely on them for food. With adequate structure and bare ground, grazing units with 5-50% of the canopy coverage in broadleaf, herbaceous

plants normally provide ideal rabbit and quail feeding or brooding habitat. Grazing units expressing less than 5% canopy coverage of forbs usually confirm poor diversity and food availability. Exceeding 50% yields little additional benefit at the expense of grasses or bare ground and depending on species present, may inhibit livestock grazing. In fact, exceptionally high coverage or a monoculture certain legumes may also reveal low diversity of the grassland due to severe grazing, competition with other beneficial forbs, or overly dense growth with impenetrable conditions. Desirable legumes and forbs include alfalfa, clovers, tick trefoils (Desmodium species), annual lespedezas, partridge pea, lead plant, bush clovers, indigos, sunflower, croton, and many others.

Legume dominated pastures can be excellent for turkey poults, quail chicks, and many songbirds if they can easily move through vegetation. However, some legumes are more aggressive than others and may grow thick and tangled under favorable conditions. This impenetrable cover can inhibit movement by small wildlife in search of insects and succulent vegetation. The key is to manage legume dominated fields for adequate open space and bare ground. Alfalfa, annual lespedezas, native legumes, and white and alsike clovers are preferred. Deer, rabbits, groundhogs, and other smaller rodents are typically attracted to legume pastures as a source of food and cover.

It is important to note that this question does not necessarily refer to canopy coverage of the forb species. Important wildlife forbs may occupy the vegetation canopy, but they also sometimes grow under the canopy of taller grasses. For this question, students should be looking for ***presence*** of seven or more wildlife friendly forbs, not merely canopy coverage.

3. Bare ground is present in greater than 25%: ***(50'X50')***

A. True ***(5 pts)*** **B. False** ***(0 pts)***

Bare ground is a critical component of quail habitat because it facilitates movement and foraging. Quail are ground-dwelling birds and prefer to walk rather than fly. They are also sight feeders, picking up seeds and insects off the ground and low vegetation. Heavy sods and accumulated litter inhibit movement and foraging by quail. The importance of bare ground cannot be overemphasized. It is necessary for ease of movement, dusting, and feeding. For greatest appeal to quail there should be no less than 25% bare ground in the field or grazing unit.

Note: prior to 2013, percent bare ground referred to bare ground observable when looking down from above. This method under-represented the amount of bare ground present in most native warm season grass stands. From this point forward, students should assess the bare ground percentage at the soil interface.

Students may need to look at similar vegetation conditions adjacent to the 50X50 to determine the presence of bare ground *within* the 50x50 (e.g., transects around the 50x50 adjacent to the contest square)

4. The majority (>50%) of the vegetation (excluding seed stalks) is: ***(50'X50')***

A. Less than 6" ***(1 pts)*** **B. 6" - 18"** ***(3 pts)*** **C. Greater than 18"** ***(2 pts)***

Consider all herbaceous and woody vegetation that is from 6-18" tall (about ankle to knee high). This vegetation is different from that in question two because regardless of plant species,

any type of overhead canopy can provide protection from aerial predators. High quality, desirable cover will be sparse enough at ground level for easy movement though the vegetation by young quail and rabbits. The optimal range for 6-18" canopy coverage is 26-75%; beyond that range is less attractive. If canopy coverage at 6-18" exceeds 76%, vegetation will likely be too thick and inhibit movement of quail, rabbits, and turkeys. Likewise, fields with canopy coverage below 25% do not provide sufficient overhead cover and may increase predation, or may be avoided by species of wildlife that lack a sense of security.

5. Distance from center of field to the nearest diverse idle area: (i.e. protected from grazing, with bunch grasses (little or no sod cover), fallow crop, or weedy cover)

A. Greater than 500' ***(0 pts)*** **B. 250 – 500'** ***(2 pts)*** **C. Less than 250'** ***(4 pts)***

Idle areas that are relatively close to the center of the field are important to rabbits and quail. If managed properly they can provide excellent nesting and roosting sites, and often support seed-producing plants that quail need. Because the peak quail hatching period (around June 15) coincides with optimal grazing, these protected areas provide nesting sites which would otherwise be disturbed by livestock. When appraising grassland for wildlife, consider whether there are unproductive areas that could be protected and managed. When managing for rabbits or quail, it is best if protected nesting sites are present within 250 feet from the center of the field being assessed.

Oftentimes, idle areas will require some type of management to be useful to wildlife (prescribed burning, light disking). Without periodic disturbance of the soil and/or vegetation, they will proceed through higher stages of plant succession and become less beneficial to many wildlife species.

6. Percent of field covered by unprotected escape cover:

A. **Less than 1%.** ***(0 pts)*** The field is devoid of adequate escape cover

B. **1% - 10%** ***(1 pts)*** This is a low to moderate amount of escape cover, valuable to wildlife if it has not been trampled by livestock. Look into the thicket to determine if predators could pass through easily, or if a rabbit could escape a predator upon entering.

C. **11-25%** ***(3 pts)*** This amount of escape cover provides adequate refuge for quail, rabbits, and other wildlife to avoid predation and reduce harmful effects of summer heat, cold winter winds and precipitation (e.g. heavy rains and snows).

   Woody escape cover (includes briars, thickets, blackberry patches, brush, or other woody cover of adequate size, density, and condition) is very important to the survival of rabbits and quail. Suitable woody cover would be dense enough that a man would have
   great difficulty walking through it, and a coyote or fox would not be able to catch a rabbit taking refuge in it. An adequate patch of woody or escape cover is at least 1500 sq ft in size. For this question, cover within the field does not have to be protected from grazing.

7. Field size - the percent of the field within 250' of protected escape cover:

A. Less than 25% *(1 pt)*
B. 26 to 50% *(2 pts)*
C. 51 – 75% *(3 pts)*
D. Greater than 75% *(4 pts)*

Large, open fields are less valuable to grassland edge species (quail and rabbits) than small fields. As described previously, quail prefer the field edges where more than one cover type is available in close proximity. Research shows that quail rarely move further than one-eighth mile (660') between necessary habitat components.
Cottontail rabbits require a variety of cover types that are even closer together (<250'). Hence, the interior of large, contiguous grassland would be utilized very little, if any, by these wildlife species. Quality concealment cover must be open at ground level, without sod, and allow easy movement by small animals and birds. Dense shrubs, downed brush or other escape cover which affords security from predators or protection from the elements is appropriate. The portion of a pasture or hay field within 250' of adequate woody cover generally represents the area that will be utilized by the quail and rabbits during average seasonal conditions.

8. Distance from center of field to edge of nearest crop field:

A. 500' or more to crop field *(1 pts)*
B. 250-500' to crop field *(2 pts)*
C. Less than 250' crop field *(3pts)*

Rabbits and quail thrive when a variety of cover types and feeding areas are close together. Rabbits prefer to move less than 250' for essential habitat components, while quail will move up to 660' if necessary. Crop fields that are more than 500 feet from the center of the grassland unit are beyond optimal range, and of limited value to rabbits and quail. A crop field or significant food plot (>1 acre) with no fall tillage, located within 250 feet from the center of the pasture is most advantageous for wildlife.

Crop fields can be an important part of bobwhite quail habitat, and offer other wildlife benefits. During the growing season, annual grain crops present desirable overhead cover, cooler temperatures, bare ground for ease of movement and dusting, and attract insects for growing chicks. Weedy areas which are skipped or survive herbicide applications contain high seed-producing annual plants that provide important quail food. Especially common in no-till cropping systems, crop residue and waste grain left on the soil surface after harvest can be an important winter food source for a range of wildlife. Standing crop stubble offers at least some security for quail, rabbits, and other small game that feed in these areas. Fields with crop residues that have been tilled under in the fall provide substantially less, or perhaps no benefit to wildlife until a new crop is planted and growing in the spring. In the absence of crop fields, annual grain food plots of at least an acre can be substituted where needed.
Research also shows that a high number of bobwhite quail nests are located between 50'-150' from a change in cover type. Cover types with ample bare ground (crop fields, fallow ground, and disked areas) which are located next to properly managed grassland significantly increase the chance for quail to successfully hatch and raise a brood. Food plots, fire breaks, herbicide treatment, or burned areas within or adjacent to the field could serve the same purpose. Under

grazing conditions, these practices could be implemented and protected in field borders without excessive impact to the livestock production system.

Quality of Habitat

(10 points each)

1. Based on the tally from answers to the multiple choice in the previous section rate the quality of habitat provided by the entire field for quail and rabbits. Use point values in bold and parentheses beside the multiple choice answers for questions 1-8 on the Appraisal of Existing Conditions section to determine the total point value. Place an X next to the correct answer. (10 points possible)

____ Poor (4-14 pts)
____ Fair (15-23 pts)
____ Good (24-32 pts)

Biologists use Wildlife Habitat Appraisal Guides (WHAGs) to assess habitat conditions for the species they manage. Under this system, various habitat conditions are assigned a score representing the value of that component. A cumulative score is then computed which represents the existing habitat condition. By referring back to those scores that were low, habitat managers are able to identify those conditions that are limiting population growth (limiting factors). The cumulative point value from the Appraisal of Existing Conditions section of the scorecard represents a simplified, but effective WHAG tool. This point value therefore dictates the score for the Quality of Habitat section, providing an assessment of the field's habitat for quail and rabbits.

The actual score a field receives can be used to help improve habitat for the species being managed. For example, a field scoring on the high end of the Fair category may need only a minor management modification to improve to a Good rating, while one with a score on the low end of that category would need multiple improvements. Therefore a graduated system allows managers to identify where habitat modifications should occur.

2. Identify the factors limiting the field's carrying capacity for quail and rabbits. In the left hand column below, circle the letter of each limiting factor which has been discovered during the field evaluation. In the right hand column, circle the number of each management practice that can be implemented to improve the limiting factors indicated. (1 point for each item - total of 10 points possible)

Limiting Habitat Factors	Management Practices
A. Ground cover thick and/or continuous	1. Establish protected escape cover
B. Inadequate nesting cover	2. Lightly disc strips on the contour
C. Inadequate brood cover	3. Use prescribed fire
D. Too far to protected escape cover	4. Adjust stocking rate
E. Insufficient plant diversity	5. Overseed with wildlife friendly forbs

A. Thick, continuous ground cover makes it difficult for quail and rabbits to move around and forage or carry out daily activities. An adequate amount of bare ground would delay the vegetation from becoming too thick and dense for wildlife use. Disking, burning, or applying herbicide can create greater structure and species diversity while increasing bare ground. (This is a direct reference to question # 1 under "Appraisal of Existing Conditions" Section)

B. Inadequate Nesting Cover can be vegetation that is less than 6 inches or greater than 18 inches on 50% or more of the pasture. Improper vegetative heights do not provide adequate structure for protection of rabbits and quail during critical nesting seasons. Grazing at a lighter stocking rate in severely grazed pastures or a heavier stocking rate in under-grazed paddocks can improve nesting structure. When adjusting stock density, timing and duration must be considered for the most optimal quail and rabbit management. Adjust the stocking rate to achieve ideal vertical structure. (This is a direct reference to question #4 under "Appraisal of Existing Conditions" Section)

C. Inadequate brood cover may be caused by thick vegetation with little bare ground. Depending on the current condition of the pasture, disking, herbicide, or prescribed fire may be used to increase bare ground, remove excess litter and reduce the density of vegetation. (This is a direct reference to question #3 under "Appraisal of Existing Conditions" Section)

D. Distance to protected escape cover is critical for optimal quail and rabbit habitat. Fields with little or no adequate escape cover in close proximity will not be used. Although escape cover can be maintained/established without the use of a fence, protection from grazing can preserve or restore quality escape cover properties such as woody cover density and species diversity. New shrubby cover may be planted or created using cut brush. Larger grasslands require more patches of escape cover for successful quail and rabbit management. At least 1500 sq ft of escape cover should be available for every 10 acres of grassland. (This is a direct reference to question #7 only under "Appraisal of Existing Conditions" Section, select this as a limiting factor if A is the answer.)

E. Insufficient food plant diversity can limit quail and rabbit utilization of grassland. High food plant diversity allows grassland to support wildlife throughout the year, when seasonal changes affect the type and availability of forage plants. Low food plant diversity can be corrected by disking, burning, or over-seeding with wildlife friendly forbs. (This is a direct reference to question #2 under "Appraisal of Existing Conditions" Section)

SOIL EVALUATION

The soil evaluation portion of this Grassland Evaluation Contest was designed to teach the students how to use the Soil Survey report in making wise land-use decisions. All of the soils information needed to complete the Soils Scorecard is given in the detailed soil series description and tables in the Soil Survey report. County Soil Survey manuals are available upon request from the local Natural Resources Conservation Service. Soil Survey information can also be found on the Web Soil Survey. https://websoilsurvey.nrcs.usda.gov

The following is an example of how to use the Soil Survey report to complete the soil evaluation section of the Grassland Evaluation Contest.

General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

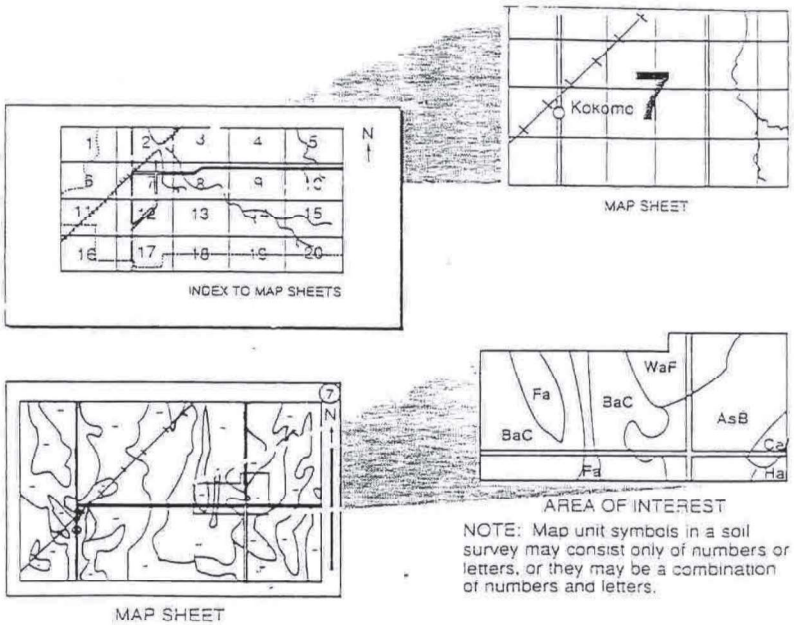
To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets,** which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



The **Summary of Tables** shows, which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

SOIL EVALUATION

1. **Surface texture**

Soil texture refers to the percentage by weight of sand, silt and clay in a soil. Depending on how much sand, silt, and clay are present, the soils are given names like sandy loam, clay loam, or silty clay loam.

Texture is an important soil property because it is closely related to many aspects of soil behavior. The ease of tilling and plant root development within the soil are both influenced by soil texture. Texture affects the amount of air and water a soil will hold and the rate of water movement through the soil.

Plant nutrient supplies are also related to soil texture. Tiny silt and clay particles provide more mineral nutrients to plants than large sand grains. Sandy soils require a high level of management to improve their productivity; they require more fertilizer and more frequent irrigation or rain than other soils.

This answer is found in the description of the surface horizon. Some soils may contain multiple A horizons. This question refers to the first or top horizons.

2. **Rock Fragments content of surface layer (The topmost A Horizon)**

The surface layer is taken into account with this question. Soil texture in relation to the content of rock fragments greatly affects the plant growth through limiting available water holding capacity. This also affects bearing capacity of the soil for heavy traffic areas and locations for water and feeding areas. The rock fragment content of the surface layer also dictates the seeding and harvesting methods and ease of tillage.

The rock fragments content in the horizons below the topmost horizon is taken into account with the available water holding capacity and therefore will not be included in this answer.

The rock fragment content of the surface layer is found in the description of the topmost A horizon. The amount is recorded as a modifier to the soil texture and also listed with the percentage of each kind of rock later in the description.

3. **Slope (between 50' stakes in field)**

Slope affects the use and management of the soil. It is directly related to the soil erosion hazard, and it influences a farmer's choice of crops and conservation practice. Slope refers to the steepness of the land surface. Slope is measured in percent calculated as the amount of vertical change in elevation over some fixed horizontal distance. In this case the slope is estimated between two stakes at or near the fifty by fifty foot plot.

4. **Depth of soil (or zone) limiting rooting depth.**

Restrictive layers are slowly permeable and water tends to build up above them. They also restrict roots from penetrating through them. Because these layers are so slowly permeable, water does tend to build up above them, creating perched water tables. Perched water tables are temporary and their presence is usually indicated by gray colors or mottling just above and in the upper part of the restrictive layer. These soils tend to be more susceptible to drought due to the lower available water holding capacity.

Limiting layers include fragipans or bedrock. Fragipans are denoted with an x in the horizon lettering (some examples include: Btx, Ex, etc…). Bedrock will be denoted as a Cr for soft or weathered bedrock or R for hard bedrock such as limestone, sandstone, or dolomite.

5. **Drainage class.**
   Drainage class refers to the frequency and duration of periods of saturation or particle saturation during soil formation. Drainage class affects the adaptation of forages to the soil. See chart on page 67.
   Answer found on soil interpretation sheet.

6. **Depth of topsoil layers (all the A Horizons)**
   The surface layers are usually denoted with an Ap or A. The depth of these horizons indicates the soil quality and productivity in the plant root zone. The deeper the topsoil the more productive the soil usually is.

7. **Permeability of most limiting layer or to 60 inches.**
   Permeability refers to water movement through the soil, specifically the rate at which a saturated soil transmits water.
   This figure should come from the permeability chart on the soil interpretation sheet. Each horizon has its permeability listed. The slowest permeability (In/Hr range) above bedrock (Cr or R horizons) should be used (the most limiting layer).

8. **Available water capacity to most limiting layer (fragipan or bedrock) or to 60 inches.**
   Available water capacity (AWC) is the potential of a soil to hold water in a form available to plants. Since the soil provides the only reservoir of water from which plants can draw, the size or volume of the reservoir is one of the most important properties of the soil. Soils that have a high AWC have a greater potential to be productive than soils with a low AWC.
   Figure the available water capacity from the chart on the soil interpretation sheet. Each layer has the range given. Average the range and multiply by the inches in the horizon. If the last horizon extends beyond 60 inches, only calculate to sixty inches. Add all horizon figures together to 60 inches or to the top of the root limiting layer to arrive at the answer. See page 66 for an example calculation.

9. **Land capability class**
   Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops and the way they respond to management.
   The numerals indicate progressively greater limitations and narrower choices for practical use.
   Answer is found on the soil interpretation sheet under Land Capability Classification.

10. **Major factors, if any, that keep area out of Class I**
    In class I there are no subclasses because the soils of this class have few limitations. Soil limitations are indicated by the letters e,w,s. “e” indicates erosion potential, “w” indicates wetness and/or flooding, and “s” indicates shallow, stony, or droughty soils.
    Answer is found on the soil interpretation sheet under Land Capability Classification.

FORAGE ADAPTATION

Determine which forages are adapted to the site according to the chart in the Study Guide page 66.

EXAMPLE PROBLEM: Soils Scorecard

The following is an example problem. The soil series description was taken from the Greene and Lawrence County Soil Surveys. The answers for the Scorecard have been marked on the following soil series description **[0-X]** with the appropriate number representing the questions on the Contest Soils Scorecard.

CLAIBORNE SERIES

The Claiborne Series consists of deep **[4-A]**, well drained **[5-E]**, moderately permeable soils **[7-D]** formed in local alluvium or residuum of cherty limestone. These soils are on foot slopes and high terraces along the major streams. Slopes range from 2 to 9 percent.

Claiborne soils are similar to Ashton soils and are commonly adjacent to those soils and to Hartville and Viraton soils. Ashton soils contain fewer coarse fragments in the solum than the Claiborne soils. Also, they are lower on the landscape. Hartville soils are somewhat poorly drained. Viraton soils have a fragipan.

Typical pedon of Claiborne silt loam **[1-C]**, 2 to 5 percent slopes.

Ap-- 0 to 6 inches **[6-B]**; dark brown (10YR 3/3) silt loam **[1-C]**; weak very fine granular structure; very friable; many fine roots; slightly acid; abrupt smooth boundary.

B1-- 6 to 14 inches; reddish brown (5YR 4/4) silty clay loam; weak fine subangular blocky structure; friable; many fine roots; few fine pores; medium acid; clear smooth boundary.

B21t-- 14 to 18 inches; yellowish red (5YR 4/6) silty clay loam; weak fine subangular blocky structure; friable; few fine roots; few very fine pores; many black stains (iron and manganese oxide); strongly acid; clear smooth boundary.

B22t-- 18 to 29 inches; red (2.5YR 4/6) and dark red (2.5YR 3/6) silty clay loam; weak medium subangular blocky structure; firm few fine roots; thin patchy clay films on faces of peds few very fine pores; many black stains (iron and manganese oxide); about 5 percent chert fragments; strongly acid; clear smooth boundary.

B23t-- 29 to 41 inches; mottled dark red (2.5YR 3/6) and yellowish red (5YR 5/6) silty clay loam; weak medium subangular blocky structure; firm; few fine roots; few very fine pores; very black stains (iron and manganese oxide); light gray (10YR 7/2) silt coatings on about 10 percent of the peds; about 5 percent fine chert fragments; strongly acid; clear smooth boundary.

B24t-- 41 to 60 inches; mottled dark red (2.5YR 3/6) and yellowish red (5YR 5/6) silty clay loam; moderate very fine subangular blocky structure; few fine roots; few fine pores; very black stains (iron and manganese oxide); light gray (10YR 7/2) silt coatings on about 10 percent of the peds; about 5 percent chert fragments; very strongly acid.

The solum ranges from 60 to 100 inches in thickness. Its content of angular chert fragments ranges, by volume, from 0 to 25 percent.

The A Horizon has hue of 10YR, value of 3, and chroma of 2 to 4. The B horizon has hue of 7.5YR, 5YR or 2.5YR, value of 3 to 5, and chroma of 4 to 8. It is dominantly silt loam to silty clay but ranges to clay in the lower part.

[3-B] Slope of field - For purposes of this contest, two flags or stakes will be set in the field near the 50 X 50 foot plot. The student will determine the slope using the appropriate calculations.

PH Site 4.9--Surface layer
PH range 4.5 -- 6.0

Soil Water Holding Capacity

SOIL DEPTH (IN.)	AVAILABLE WATER CAPACITY IN./IN. (Use Average)
0 - 17	0.17--0.21 **[8-D]**
17 - 46	0.17--0.20
46 -60	0.17--0.20

Capability Class

SLOPE	CLASS
2-- 5%	2E **[9-B & 10-C]**
5--12%	3E
12--20%	4E
20--45%	6E

Solution To Problem [8]

SOIL DEPTH (IN.)		AVAILABLE WATER CAPACITY IN./IN.		
17"	X	.19	=	3.2 inches
29"	X	.185	=	5.4 inches
14"	X	.185	=	2.6 inches
60"	TOTAL		11.2 inches	

The following “Forage Adaptation by Soil Drainage Class” table will be used to determine the suitability of this particular soil for each of the forages listed on the Scorecard.

FORAGE ADAPTATION BY SOIL DRAINAGE CLASS

	Very Poorly Drained	Poorly Drained	Some-what Poorly Drained	Mod. Well Drained	Well Drained	Some-what Excess Drained	Excess Drained
Alfalfa				X	X	X	
Annual Lespedeza				X	X	X	X
Birdsfoot Trefoil			X	X	X	X	
Red Clover			X	X	X	X	
White or Ladino Clover			X	X	X		
Brome-grass			X	X	X		
Big Bluestem			X	X	X	X	
Tall Fescue		X	X	X	X	X	X
Indian- grass			X	X	X	X	X
Orchard-grass				X	X	X	
Switch-grass		X	X	X	X	X	X
Timothy			X	X	X	X	
Caucasian Bluestem				X	X	X	X
Bermuda-grass			X	X	X	X	X
Little Bluestem				X	X	X	X
Kentucky Bluegrass			X	X	X	X	X
Reed Canary-grass	X	X	X	X	X	X	

SOIL INTERPRETATION

STUDENT I.D. NO._____ STUDENT NAME_____ SCORE:_____ Points: 100

==========

SOIL EVALUATION

(5 points each)

__1. Surface Texture
- A. Sand
- B. Sandy loam
- C. Loam or silt loam
- D. Clay loam or silty clay loam
- E. Clay or silty clay

___2. Chert and gravel content of surface layer
- A. <15% (no coarse fragment modifier such as sand, silt or clay
- B. 15 - <35% cherty or gravelly
- C. 35 - <60% very cherty or gravelly
- D. >/= to 60% extremely cherty or extremely gravelly

___3. Slope (between 50' stakes in field)
- A. 0 - <2% nearly level
- B. 2 - <5% gently sloping
- C. 5 - <9% sloping
- D. 9 - <14% strongly
- E. 14 - <25% steep
- F. >/= to 25% very steep

___4. Depth of soil (or zone) limiting rooting depth
- A. 40 - 60+ in. deep or very deep
- B. 20 - <40 in.
- C. 10 - <20 in. shallow
- D. 0 - <10 in. very shallow

___5. Drainage class
- A. Very poorly drained
- B. Poorly drained
- C. Somewhat poorly drained
- D. Moderately well drained
- E. Well drained
- F. Somewhat excessively drained
- G. Excessively drained

___6. Depth of surface layer (The A Horizons)
- A. <3 inches
- B. 3 - <7 inches
- C. 7 - 10 inches
- D. >10 inches

___7. Permeability of most limiting layer or to 60 inches

	Inches/Hour	Class
A.	<0.06	very slow
B.	0.06 - <0.2	slow
C.	0.20 - <0.6	moderately slow
D.	0.60- <2.0	moderate
E.	2.00 - <6.0	moderately rapid
F.	6.00 - <20.0	rapid
G.	>20.0	very rapid

___8. Available water capacity to most limiting layer or to 60 inches
- A. 0 - <3 very low
- B. 3 - <6 low
- C. 6 - <9 moderate
- D. 9 - <12 high
- E. >/= to 12 very high

___9. Land capability class
- A. Class I
- B. Class II
- C. Class III
- D. Class IV
- E. Class V
- F. Class VI
- G. Class VII
- H. Class VIII

___10. Major factors, if any, that keep area out of Class I
- A. s = stoniness, shallowness, droughtiness
- B. w = wetness, and/or flooding
- C. e = erosion
- D. None

FORAGE ADAPTATION

(5 points each)
(check one space per answer)

Forage	Adapted	Not Adapted
1. Caucasian Bluestem	_____	_____
2. Annual Lespedeza	_____	_____
3. Reed Canary Grass	_____	_____
4. White or Ladino Clover	_____	_____
5. Little Bluestem	_____	_____
6. Bromegrass	_____	_____
7. Alfalfa	_____	_____
8. Orchardgrass	_____	_____
9. Timothy	_____	_____
10. Big Bluestem	_____	_____

Revised: August, 2015

Practical Exercise and Scenario -- Soil Interpretation Score Card

I. Select soil series to be used in this exercise from the attached aerial photo and soil map. Ans. The site is located on a Snead Series, soil map unit 50006.

II. Answers for the Soil Interpretation Scorecard are:

1. D Surface Texture – Silty clay loam
2. A Chert and gravel content of surface layer (The A Horizons) - less than 15%
3. C Slope (Assume 6%) – 5-<9%
4. B Depth of Soil (or Zone) limiting root depth – 20-<40 in.
5. D Drainage class – Moderately well drained
6. D Depth of Surface layer (The A Horizons) - 12 inches
7. B Permeability of most limiting layer or to 60 inches - .06
8. B Available water capacity to most limiting layer or to 60 inches
9. D Land Capability Class - IV
10. C Major factors, if any, that keep area out of Class I - Erosion

III. Forage Adaptation

	Forage	Adapted	Not Adapted
1.	Caucasian Bluestem	X	
2.	Annual Lespedeza	X	
3.	Reed Canary Grass	X	
4.	White or Ladino Clover	X	
5.	Little Bluestem	X	
6.	Bromegrass	X	
7.	Alfalfa	X	
8.	Orchardgrass	X	
9.	Timothy	X	
10.	Big Bluestem	X	

SOIL INTERPRETATION

STUDENT I.D. NO. (Sample) STUDENT NAME (Practical Exercise) SCORE: (KEY) Points: 100

SOIL EVALUATION
(5 points each)

D 1. Surface Texture
- A. Sand
- B. Sandy loam
- C. Loam or silt loam
- D. Clay loam or silty clay loam
- E. Clay or silty clay

A 2. Chert and gravel content of surface layer
- A. <15% (no coarse fragment modifier such as sand, silt or clay
- B. 15 - <35% cherty or gravelly
- C. 35 - <60% very cherty or gravelly
- D. >/= to 60% extremely cherty or extremely gravelly

C 3. Slope (between 50' stakes in field)
- A. 0 - <2% nearly level
- B. 2 - <5% gently sloping
- C. 5 - <9% sloping
- D. 9 - <14% strongly
- E. 14 - <25% steep
- F. >/= to 25% very steep

B 4. Depth of soil (or zone) limiting rooting depth
- A. 40 - 60+ in. deep or very deep
- B. 20 - <40 in.
- C. 10 - <20 in. shallow
- D. 0 - <10 in. very shallow

D 5. Drainage class
- A. Very poorly drained
- B. Poorly drained
- C. Somewhat poorly drained
- D. Moderately well drained
- E. Well drained
- F. Somewhat excessively drained
- G. Excessively drained

D 6. Depth of surface layer (The A Horizons)
- A. <3 inches
- B. 3 - <7 inches
- C. 7 - 10 inches
- D. >10 inches

B 7. Permeability of most limiting layer or to 60 inches

	Inches/Hour	Class
A.	<0.06	very slow
B.	0.06 - <0.2	slow
C.	0.20 - <0.6	moderately slow
D.	0.60- <2.0	moderate
E.	2.00 - <6.0	moderately rapid
F.	6.00 - <20.0	rapid
G.	>20.0	very rapid

B 8. Available water capacity to most limiting layer or to 60 inches
- A. 0 - <3 very low
- B. 3 - <6 low
- C. 6 - <9 moderate
- D. 9 - <12 high
- E. >/= to 12 very high

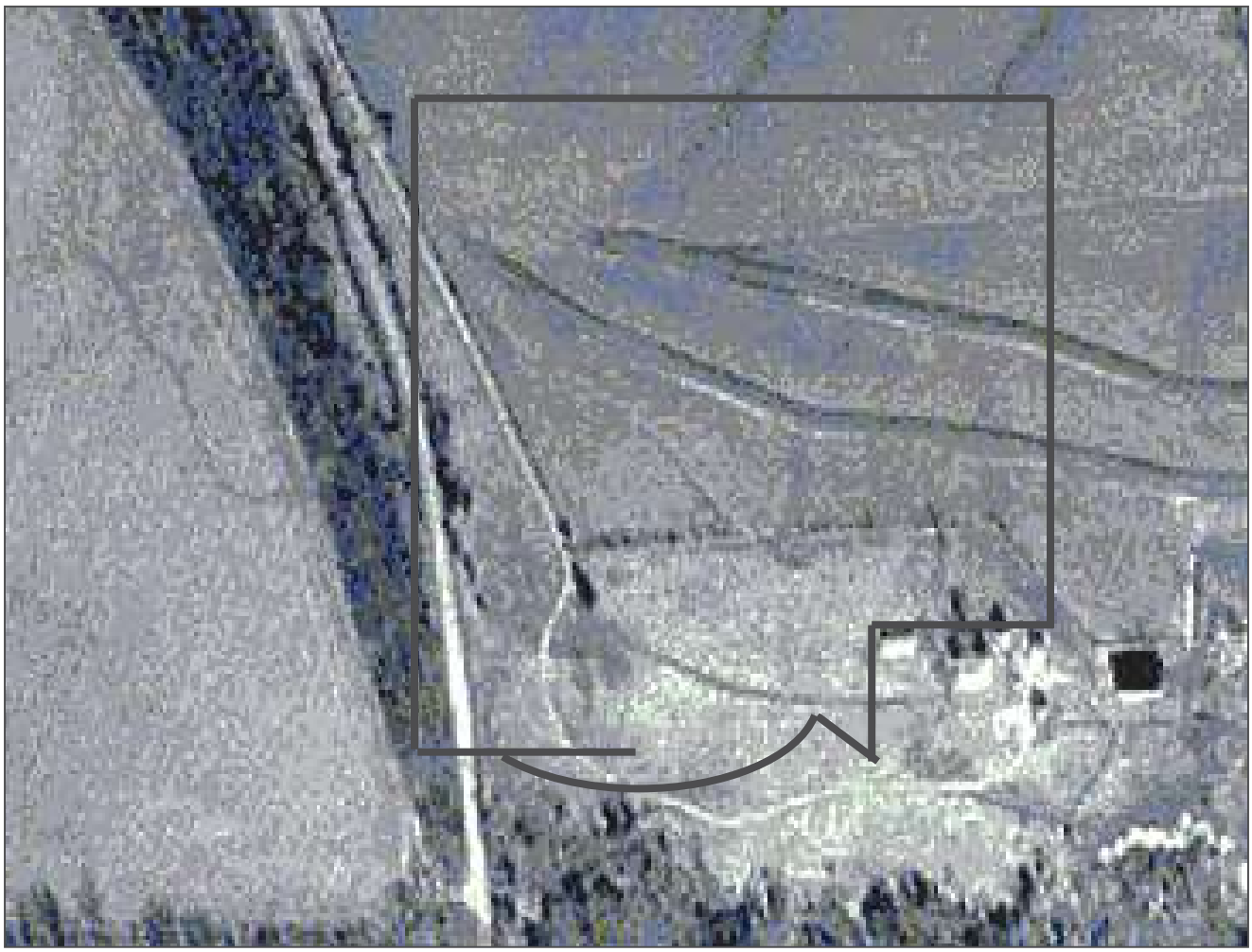
D 9. Land capability class
- A. Class I
- B. Class II
- C. Class III
- D. Class IV
- E. Class V
- F. Class VI
- G. Class VII
- H. Class VIII

C 10. Major factors, if any, that keep area out of Class I
- A. s= stoniness, shallowness, droughtiness
- B. w = wetness, and/or flooding
- C. e = erosion
- D. None

FORAGE ADAPTATION
(5 points each)
(check one space per answer)

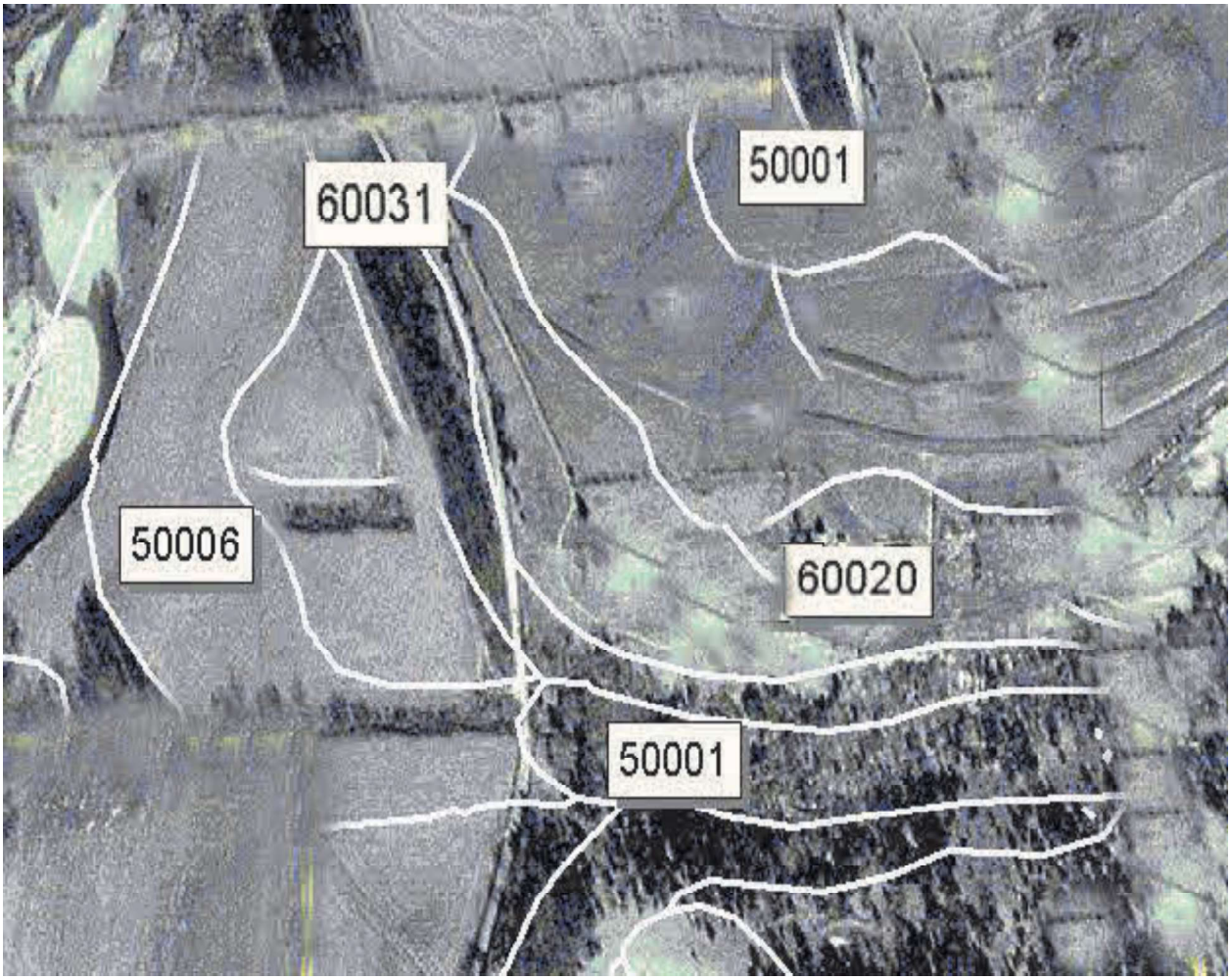
Forage	Adapted	Not Adapted
1. Caucasian Bluestem	X	
2. Annual Lespedeza	X	
3. Reed Canary Grass	X	
4. White or Ladino Clover	X	
5. Little Bluestem	X	
6. Bromegrass	X	
7. Alfalfa	X	
8. Orchardgrass	X	
9. Timothy	X	
10. Big Bluestem	X	

Revised: August, 2015



0 660 Feet

N
W E
S



0 660 Feet

N
W E
S

Armstrong Series **Soil Map Unit 50001**

Depth class: Very deep
Drainage class: Somewhat poorly
Landform: Uplands
Parent material: Loess or loamy sediments over glacial till
Slope range: 5 to 9 Percent
Land Capability Classification: 3E

Soil Depths (Inches)	Available Water Capacity (In/in range)	Permeability (In/hr range)
0-6	0.20-0.22	0.20-0.60
6-44	0.11-0.16	0.06-0.20
44-70	0.14-0.16	0.20-0.60

Taxonomic class: Fine, smectitic, mesic Aquertic Hapludalfs

Typical Pedon: Armstrong loam 5 to 9 percent slopes, eroded.

Ap=0 to 6 inches; very dark grayish brown (10YR 3/2) loam; grayish brown (10YR 5/2) dry; mixing of brown (10YR 4/3); weak fine granular structure; friable; slightly acid; abrupt smooth boundary.
BE=6 to 14 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine subangular blocky structure; friable; thin discontinuous light gray (10YR 6/1) dry silt coatings on faces of peds; strongly acid; clear smooth boundary.
2Bt1=14 to 18 inches; brown (7.5YR 4/4) clay loam; few fine distinct brown (5YR 4/4) and prominent yellowish red (5YR 4/6) mottles; moderate fine subangular blocky structure; firm few thin discontinuous clay films; thin continuous light gray (19YR 6/1) dry silt coatings on faces of peds; stone line at base of horizon; strongly acid; gradual smooth boundary.
2Bt2=18 to 26 inches; mottled brown (7.5YR 4/4) and dark grayish brown (10YR 4/2) clay; few fine prominent red (2.5YR 4/6) mottles; moderate fine moderate fine subangular blocky structure; very firm; thin continuous light gray (10YR 6/1) dry silt coatings on faces of peds; clay films on most peds; some pebbles; very strongly acid; gradual smooth boundary.
2Bt3=26 to 31 inches; mottled strong brown (7.5YR 5/6) and light brownish gray (10YR 6/2) clay; few fine prominent dark red (2.5YR 3/6) and common medium distinct yellowish red (5YR 4/6) mottles; moderate fine subangular blocky structure; very firm; thick discontinuous clay films; some pebbles; strongly acid; gradual smooth boundary.
2Bt4=31 to 44 inches; strong brown (7.5YR 5/6) clay loam; common fine prominent light brownish gray (10YR 6/2) yellowish red (5YR 4/6) mottles; moderate fine prismatic structure parting to weak medium subangular blocky; very firm; few thin discontinuous clay films on peds and in old root channels; black (N/20) organic material on vertical ped faces; common fine black concretions (oxides); strongly acid; gradual smooth boundary.
2BC=44 to 70 inches; yellowish brown (10YR 5/6) clay loam; common fine and medium prominent gray (10Y 6/1) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; dark brown clay flows in some channels; common fine black concretions (oxide); moderately acid.

Range in Characteristics: Solum thickness and depth to free carbonates commonly are more than 48 inches but range from about 42 to 80 inches. A stone line or pebble band is at the upper boundary of the subhorizon with highest clay content. Soil reaction ranges from moderately acid to very strongly acid in the most acid part, but ranges to slightly alkaline in the BC horizon where carbonates are present.

Drainage: Surface runoff is rapid. Drainage is somewhat poorly. A perched water table is at a depth of 1 to 3 feet during most winter and spring months.

Use and Vegetation: These soils are used mainly for hay and pasture but some corn and oats are grown. Native vegetation was mixed prairie grasses and deciduous trees.

Snead Series **Soil Map Unit 50006**

Depth class: Moderately deep
Drainage class: Moderately well
Landform: Uplands
Parent material: Residuum from calcareous, clayey, gray shale's thin interbedded limestone
Slope range: 5 to 14 Percent
Land Capability Classification: 4E

Soil Depths (Inches)	Available Water Capacity (In/in range)	Permeability (In/hr range)
0-7	0.21-0.24	0.20-0.60
7-31	0.12-0.14	0.06-0.20
31-80	-----	0.01-0.20

Taxonomic class: Fine, mixed, mesic Aquic Hapludolls

Typical Pedon: Snead silty clay loam 5 to 14 percent slopes, eroded.

Ap=0 to 5 inches; very dark gray (10YR 3/1) silty clay loam; gray (10YR 5/1) dry; strong medium granular structure; friable; many very fine roots; few clean sand grains; slightly acid; clear smooth boundary.
A=5 to 12 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; strong very fine subangular blocky structure; friable; common very fine grass roots; many fine pores; few fine sand grains; slightly acid; clear smooth boundary.
Bw=12 to 17 inches; mottled very dark gray (10YR 3/1), olive gray (5YR 5/2) and olive (5YR 5/4) clay; weak fine subangular blocky structure; firm; few very fine roots; 5 percent fragments of limestone or white concretions; slightly effervescence; moderately alkaline; clear smooth boundary.
BC=17 to 24 inches; mottled brown (7.5YR 4/4) and dark grayish brown (10YR 4/2) clay; few fine prominent red (2.5YR 4/6) mottles; moderate fine moderate fine subangular blocky structure; very firm; thin continuous light gray (10YR 6/1) dry silt coatings on faces of peds; clay films on most peds; some pebbles; very strongly acid; gradual smooth boundary.
C=24 to 25 inches; olive gray (5YR 5/2) silty clay; many medium faint dark gray (5Y 4/1) and many medium prominent olive brown (2.5Y 5/2) mottles; massive; firm; few very fine grass roots; 10 percent fragments of limestone; strong effervescence; moderately alkaline; abrupt smooth boundary.
Cr=25 to 66 inches; olive gray (5Y 5/2) soft shale.

Range in Characteristics: Thickness of the solum ranges from 15 to 40 inches and depth to a paralithic contact ranges from 20 to 40 inches. Depth to free carbonates ranges from 12 inches to the upper limit of the partly weathered shale.

Drainage: Moderately well drained. Surface runoff is medium to rapid.

Use and Vegetation: About equal parts are in row crops, such as corn and soybeans, and pasture. Native vegetation was tall prairie grasses.

Lenzburg Series **Soil Map Unit 60020**

Depth class: Very deep
Drainage class: Well
Landform: Uplands
Parent material: Materials that have been excavated during surface mining operations
Slope range: 2 to 9 Percent
Land Capability Classification: 3E

Soil Depths (Inches)	Available Water Capacity (In/in range)	Permeability (In/hr range)
0-3	0.15-0.19	0.60-2.00
3-60	0.11-0.17	0.20-0.60

Taxonomic class: Fine-loamy, mixed, active, calcareous, mesic Alfic Udarents

Typical Pedon: Lenzburg silty loam, 2 to 9 percent slopes

Ap=0 to 3 inches; mixed dark brown (10YR 4/3), light brownish gray (10YR 6/2), yellowish brown (10YR 5/6), and yellowish red (5YR 5/6) silt loam; pale brown (10YR 6/3) dry; weak fine granular structure; friable, slightly hard; about 15 percent rock fragments of till pebbles and channers and flags of limestone and siltstone; slightly effervescent; slightly alkaline; abrupt wavy boundary.

AC=3 to 6 inches; mixed yellowish brown (10YR 5/4), light brownish gray (10YR 6/2), and strong brown (7.5YR 5/6) silt loam; moderate medium platy structure; friable, hard and slightly hard; about 15 percent rock fragments of till pebbles and channers and flags of limestone and siltstone; strongly effervescent; slightly alkaline; abrupt wavy boundary.

C1=6 to 10 inches; brown (10YR 4/3) silty clay loam; strong thick horizontal layers; massive; firm, hard; about 15 percent rock fragments of till pebbles and channers and flags of limestone and siltstone; few light brownish gray (10YR 6/2) soil fragments; few distinct very dark gray (10YR 3/1) coatings on faces of soil fragments; strong effervescent; slightly alkaline; abrupt wavy boundary.

C2=10 to 33 inches; mixed brown (7.5YR 4/4) and pale brown (10YR 6/3) silty clay loam; massive; firm, hard; few vertical cleavage planes; few gray (10YR 5/1) soil fragments throughout, and few yellowish red (5YR 5/6) soil fragments in the lower part; about 18 percent rock fragments of till pebbles and channers and flags of limestone and siltstone; strong effervescent; slightly alkaline; clear smooth boundary.

C3=33 to 45 inches; mixed brown (10YR 4/4) and pale brown (10YR 6/3) silty clay loam; massive; firm, hard; few gray (10YR 6/1) and grayish brown (10YR 5/2) soil fragments; about 18 percent rock fragments of till pebbles and channers and flags of limestone and siltstone; strong effervescent; slightly alkaline; clear smooth boundary.

C4=45 to 60 inches; mixed brown (7.5YR 4/4) and gray (10YR 5/1) silty clay; very firm, very hard; and few yellowish red (5YR 5/8) soil fragments; about 10 percent rock fragments of limestone; strongly effervescence; slightly alkaline.

Range in Characteristics: The A horizon is silt loam, silty clay loam, clay loam, or loam; or gravelly, stony, or channery analogs. Typically it has weak or moderate, fine or medium structure. The C horizon is silty clay loam, silt loam, loam, silty clay, or clay loam; or the channery, gravelly, or cobbly analogs. Thin strata or small pockets of coarser or finer textured material are in some pedons.

Drainage: Runoff is slow to very rapid.

Use and Vegetation: Many areas that have a stony surface or steep slopes are seeded to grass-legume mixtures or fescue and are used for pasture. Other areas have a mixture of boradleaf trees, or pine plantation and are used for recreation or wildlife habitat. Some areas have been graded and used for meadow, small grain, or row crops. Corn, milo, soybeans, and wheat are the principal crops.

Winfield Series — Soil Map Unit 60031

Depth class: Very deep
Drainage class: Moderately Well
Landform: Ridgetops and Sideslopes
Parent material: Loess
Slope range: 9 to 14 Percent
Land Capability Classification: 3E

Soil Depths (Inches)	Available Water Capacity (In/in range)	Permeability (In/hr range)
0-6	0.20-0.24	0.60-2.00
6-10	0.18-0.22	0.60-2.00
10-40	0.18-0.20	0.60-2.00
40-60	0.20-0.22	0.60-2.00

Taxonomic class: Fine-silty, mixed, superactive, mesic Oxyaquic Hapludalfs

Typical Pedon: Winfield silt loam, 9 to 14 percent slopes.

Ap=0 to 6 inches; brown (10YR 4/3) silt loam; pale brown (10YR 6/3) dry; moderate fine granular structure; friable; common fine roots; few dark brown (10YR 3/3) stains; neutral; clear smooth boundary.
E=6 to 10 inches; brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; common fine roots; slightly acid; clear smooth boundary.
BE=10 to 14 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure; friable; many fine roots; slightly acid; clear smooth boundary.
Bt1=14 to 22 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine subangular blocky structure; firm; common fine roots; many faint brown clay films on faces of peds; strongly acid; gradual smooth boundary.
Bt2=23 to 30 inches; yellowish brown (10YR 5/6) silt clay loam; strong medium subangular blocky structure; firm; few fine roots; many faint brown clay films on faces of peds; some peds coated with gray silt; common fine very dark brown iron and manganese concretions; very strongly acid; gradual smooth boundary.
Btg1=30 to 40 inches; variegated light brownish gray (10YR 6/2), dark brown (7.5YR 4/4) and yellowish brown (10YR 5/6) silt clay loam; moderate medium prismatic structure parting to weak medium subangular blocky; firm; few fine roots; many faint clay films on peds; very thick light brownish gray clay coatings on flows on some vertical prism faces; many very dark brown iron and manganese concretions; very strongly acid; gradual smooth boundary.
Btg2=40 to 54 inches; gray (10Y 6/1) silty clay loam; moderate medium prismatic structure parting to weak medium subangular blocky; firm; few fine roots; many distinct clay films on vertical faces of prisms; few faint clay films on other faces of peds; many fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulation in ped interiors; many soft very dark brown iron and manganese accumulations; very strongly acid; diffuse wavy boundary.
Cg=54 to 60 inches; gray (10YR 6/1) silt loam; massive; friable; few fine roots; many fine prominent dark brown (7.5YR 4/4) masses of iron accumulation in ped interiors; common soft very dark brown iron and manganese accumulations; moderately acid.

Range in Characteristics: Sand content averages less than 10 percent throughout the series control section. Depth to the base of the argillic is 25 to 65 inches. The Ap horizon is silt loam or silty clay loam.

Drainage: Moderately well drained. Runoff is medium to very rapid. In undisturbed areas there is a perched water table that has an upper limit of 2.0 to 3.5 feet during November to April in most years.

Use and Vegetation: Most areas are cleared and used to grow soybeans, small grains, corn, hay, and pasture. Remaining areas are in hardwood forest. Native vegetation is deciduous hardwood (oak and hickory).

PLANT IDENTIFICATION

Missouri has over thirteen million acres of grasslands, which are agriculturally, economically and environmentally important to all its residents. These lands are used for either grazing or haying (or both) and the production of these acres will be dictated by how the plants respond under these conditions. Furthermore, every acre has some potential for improved wildlife habitat. The quality of wildlife habitat depends on two factors: 1) composition of the grassland and 2) how the grassland is managed.

Nearly every phase of grassland management is intimately associated with a knowledge of the plants, their requirements, life history, and forage value. Wildlife species as well as domestic livestock are generally a product of the plants they eat. Proper grazing capacity of grasslands, periods and degrees of use, and class of livestock to which a particular pasture is best suited are determined largely by the character and composition of the vegetation and the life habits and values of the plants themselves. Persons unfamiliar with plants or vegetative cover are usually unable to interpret signs of overgrazing in a pasture situation. In addition, since plants are the basic units of wildlife habitat (food and cover), it becomes increasingly important for a landowner to be able to identify the plants in order to overcome any limiting factors.

Livestock allowed to graze uncontrolled, will select those plants, which are most succulent and nutritious. This constant pressure may not allow time for regrowth and may result in certain plants being eliminated. Other plants, which are seldom grazed, may tend to increase in number or invade a pasture reducing its forage production (see Glossary: increasers, decreasers and invaders). In order for a landowner to make proper management decisions in response to these principles, he must first be able to identify the plants involved.

The following list of grasses, forbs, legumes and woody plants are only a few of the plants that might be encountered in a grassland situation. In order for a landowner to either control or encourage a certain plant, it is important that he know its life cycle, i.e., whether it is an annual, biennial or perennial (see Glossary).

The list includes only common names, however the student is encouraged to collect the individual plants and to further identify them as to their proper scientific name. Scientific names remain the same throughout the world, whereas the common names may vary even in a local area. Many books are available which can be used to key these plants to a scientific name (see Suggested References).

PLANT IDENTIFICATION LIST

STUDENT I.D. NO._____ STUDENT NAME_____ SCORE_____ POINTS: 100

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(Write the number of the plant in the space before its name and under its proper life cycle designation NOTE: Ann = Annual, Bie/Per = Biennial or Perennial)

(Ann) (Bie/Per) **GRASSES & GRASS-LIKE**

1. ____ ____ Barley, Little
2. ____ ____ Barnyard Grass
3. ____ ____ Bermuda Grass
4. ____ ____ Bluegrass(Kentucky)
5. ____ ____ Bluestem, Big
6. ____ ____ Bluestem(Old World)
7. ____ ____ Bluestem, Little
8. ____ ____ Bromegrass, Smooth
9. ____ ____ Broomsedge(Broomstraw)
10. ____ ____ Crabgrass
11. ____ ____ Downy Chess(Downy Brome, Cheat Grass)
12. ____ ____ Eastern Gamagrass
13. ____ ____ Fall Panicum
14. ____ ____ Fescue(Tall)
15. ____ ____ Foxtail(Giant, Green & Yellow)
16. ____ ____ Indiangrass
17. ____ ____ Johnsongrass
18. ____ ____ Nimblewill
19. ____ ____ Orchardgrass
20. ____ ____ Purple Top
21. ____ ____ Reed Canary Grass
22. ____ ____ Ryegrass
23. ____ ____ Sedges
24. ____ ____ Switchgrass
25. ____ ____ Timothy

(Ann) (Bie/Per) **WOODY PLANTS**

26. ____ ____ Blackberry/Dewberry
27. ____ ____ Black Cherry
28. ____ ____ Coralberry(Buckbrush)
29. ____ ____ Dogwood
30. ____ ____ Elm
31. ____ ____ Grape
32. ____ ____ Greenbriar
33. ____ ____ Gooseberry
34. ____ ____ Hickory
35. ____ ____ Honeysuckle(Bush or Japanese)
36. ____ ____ Locust(Black or Honey)
37. ____ ____ Oak, Black or White
38. ____ ____ Osage Orange
39. ____ ____ Persimmon
40. ____ ____ Poison Ivy
41. ____ ____ Red Cedar(Juniper)
42. ____ ____ Rose(Multiflora or Wild)
43. ____ ____ Sassafras
44. ____ ____ Sumac
45. ____ ____ Walnut
46. ____ ____ Wild Plum

(Ann) (Bie/Per) **FORBS**

47. ____ ____ Bull Nettle(Horse)
48. ____ ____ Chicory, Common
49. ____ ____ Cinquefoil
50. ____ ____ Cocklebur, Common
51. ____ ____ Croton
52. ____ ____ Curly Dock
53. ____ ____ Daisy Fleabane
54. ____ ____ Dandelion
55. ____ ____ Field Bindweed
56. ____ ____ Goldenrod(Prairie)
57. ____ ____ Hemp Dogbane
58. ____ ____ Horseweed
59. ____ ____ Ironweed
60. ____ ____ Lambsquarter
61. ____ ____ Milkweed, Common
62. ____ ____ Mullein
63. ____ ____ Nodding Spurge
64. ____ ____ Oxeye Daisy
65. ____ ____ Perilla Mint
66. ____ ____ Pigweed
67. ____ ____ Plantain
68. ____ ____ Poison Hemlock
69. ____ ____ Pokeweed
70. ____ ____ Queen Anne's Lace
71. ____ ____ Ragweed(Common, Giant, Lanceleaf)
72. ____ ____ Red Sorrel
73. ____ ____ Smartweed
74. ____ ____ Spotted Knapweed
75. ____ ____ Thistle(Tall, Musk, Bull)
76. ____ ____ Three-Seeded Mercury
77. ____ ____ Wild Indigo (Blue, Cream,White)
78. ____ ____ Yarrow, Common
79. ____ ____ Yellow Wood Sorrel

(Ann) (Bie/Per) **LEGUMES**

80. ____ ____ Alfalfa
81. ____ ____ Birdsfoot Trefoil
82. ____ ____ Cats Claw Sensitive Briar
83. ____ ____ Clover, White
84. ____ ____ Clover, Red
85. ____ ____ Clover, Sweet
86. ____ ____ Clover(Little Hop)
87. ____ ____ Goat's Rue
88. ____ ____ Illinois Bundleflower
89. ____ ____ Lespedeza(Korean, Common)
90. ____ ____ Lespedeza, Sericea
91. ____ ____ Partridge Pea
92. ____ ____ Tick Trefoil(Beggar Tick)
93. ____ ____ Vetch(Common, Hairy)

GRASSLAND EVALUATION CONTEST

PLANT IDENTIFICATION LIST

STUDENT I.D. NO._____ STUDENT NAME_____ SCORE_____ POINTS: 100

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(Write the number of the plant in the space before its name and under its proper life cycle designation; NOTE: Ann = Annual, Bie/Per = Biennial or Perennial)

(Ann) (Bie/Per) **GRASSES & GRASS-LIKE**

1. X ____ Barley, Little
2. X ____ Barnyard Grass
3. ____ X Bermuda Grass
4. ____ X Bluegrass(Kentucky)
5. ____ X Bluestem, Big
6. ____ X Bluestem(Old World)
7. ____ X Bluestem, Little
8. ____ X Bromegrass, Smooth
9. ____ X Broomsedge(Broomstraw)
10. X ____ Crabgrass
11. X ____ Downy Chess(Downy Brome, Cheat Grass)
12. ____ X Eastern Gamagrass
13. X ____ Fall Panicum
14. ____ X Fescue(Tall)
15. X ____ Foxtail(Giant, Green & Yellow)
16. ____ X Indiangrass
17. ____ X Johnsongrass
18. ____ X Nimblewill
19. ____ X Orchardgrass
20. ____ X Purple Top
21. ____ X Reed Canary Grass
22. X X Ryegrass
23. X X Sedges
24. ____ X Switchgrass
25. ____ X Timothy

(Ann) (Bie/Per) **WOODY PLANTS**

26. ____ X Blackberry/Dewberry
27. ____ X Black Cherry
28. ____ X Coralberry(Buckbrush)
29. ____ X Dogwood
30. ____ X Elm
31. ____ X Grape
32. ____ X Greenbriar
33. ____ X Gooseberry
34. ____ X Hickory
35. ____ X Honeysuckle(Bush or Japanese)
36. ____ X Locust(Black or Honey)
37. ____ X Oak, Black or White
38. ____ X Osage Orange
39. ____ X Persimmon
40. ____ X Poison Ivy
41. ____ X Red Cedar(Juniper)
42. ____ X Rose(Multiflora or Wild)
43. ____ X Sassafras
44. ____ X Sumac
45. ____ X Walnut
46. ____ X Wild Plum

(Ann) (Bie/Per) **FORBS**

47. ____ X Bull Nettle(Horse)
48. ____ X Chicory, Common
49. ____ X Cinquefoil
50. X ____ Cocklebur, Common
51. X ____ Croton
52. ____ X Curly Dock
53. X ____ Daisy Fleabane
54. ____ X Dandelion
55. ____ X Field Bindweed
56. ____ X Goldenrod(Prairie)
57. ____ X Hemp Dogbane
58. X ____ Horseweed
59. ____ X Ironweed
60. X ____ Lambsquarter
61. ____ X Milkweed, Common
62. ____ X Mullein
63. X ____ Nodding Spurge
64. ____ X Oxeye daisy
65. X ____ Perilla Mint
66. X ____ Pigweed
67. X X Plantain
68. ____ X Poison Hemlock
69. ____ X Pokeweed
70. ____ X Queen Anne's Lace
71. X ____ Ragweed(Common, Giant, Lanceleaf)
72. ____ X Red Sorrel
73. X X Smartweed
74. ____ X Spotted Knapweed
75. ____ X Thistle(Tall, Musk, Bull)
76. X ____ Three-Seeded Mercury
77. ____ X Wild Indigo (Blue, Cream,White)
78. ____ X Yarrow, Common
79. ____ X Yellow Wood Sorrel

(Ann) (Bie/Per) **LEGUMES*

80. ____ X Alfalfa
81. ____ X Birdsfoot Trefoil
82. ____ X Cats Claw Sensitive Briar
83. ____ X Clover, White
84. ____ X Clover, Red
85. ____ X Clover, Sweet
86. X ____ Clover(Little Hop)
87. ____ X Goat's Rue
88. ____ X Illinois Bundleflower
89. X ____ Lespedeza(Korean, Common)
90. ____ X Lespedeza, Sericea
91. X ____ Partridge Pea
92. ____ X Tick Trefoil(Beggar Tick)
93. X ____ Vetch(Common, Hairy)

A GLOSSARY OF SELECTED TERMS FOR CONSERVATION AND RESOURCE USE.

A

Acid Soil: Soil with a pH value less than 7.0; for most practical purposes, a soild with a pH value less than 6.6. The term is usually applied to the surface layer or to the root zone unless specified otherwise.

Agricultural land: All land devoted to crop of livestock production; e.g., farmstead, drainage and irrigation ditches, ponds, cropland, and grazing land on farms.

Animal unit: A measurement of livestock numbers based on the equivalent of a mature cow (approximately 1,000 pounds live weight); roughly, one cow, 1.4 yearling cattle, one horse, one mule, five sheep, five swine, or six goats. Abbr. A.U.

Annual food plot: A small area of land planted to a mixture of annual plants which produce an abundance of small seeds as supplemental food for wild animals; the crop is not harvested, but is left standing in the field.

Annual Plant: A plant that completes its life cycle and dies in one year or less.

Association: A climax plant community identified by the combination of dominant species present.

Available forage: Forage that is accessible for animal consumption. The standing dry matter yield of forage in a paddock or grazing unit. May be measure from desired grazing height.

Available water: The portion of water in a soil that can be absorbed by plant roots.

B

Backgrounding: Practice of raising a beef animal from weaning until placement in the feedlot. Backgrounding may either take place on pasture of with stored feed.

Biennial plant: A plant that requires two years to complete its life cycle.

Biomass: The amount of living matter in a given unit of the environment.

Border, Field (**wildlife management**): a strip of herbaceous or woody vegetation, usually low-growing and at least thirty feet wide, established along the edges of fields, woodlands, or streams. Ideally, there would be cover elements of shrub and/ or escape, and the herbaceous cover should be open at ground level with at least 25% bare ground present and overhead (6-18”) cover.

Brood Habitat (Brooding Habitat): Cover used by young birds to forage for insects and other invertebrates. Characterized by abundant annual plants (especially broadleaves) with a leafy canopy, relatively open, scattered stems in the understory, and abundant bare ground for ease of movement. Species diversity tends to be high. These same annual plants also produce abundant seeds for fall and winter food. In the eastern United States, this cover type occurs for one to two years following a disturbance (disking, burning, etc.)

Browse (n): Refers to the nutritious buds or tips of branches of shrubs, vines, saplings, and forbs that are selected for food by "browsing" wildlife such as deer.

Brush pile: a small stack of cut branches, shrubs, and other woody vegetation, and open at ground level which serves as protective cover for small wild animals.

Bunchgrass: Grass with growth forms that are clumped or tufted, rather than single-stemmed, sod-forming.

C

Canopy: Amount of ground shaded by plant foliage, whether herbaceous or woody.

Carrying capacity: The maximum population that a given ecosystem can support indefinitely.

Community: An aggregation of organisms within a specified area

Conservation: 1.The wise use of natural resource. (The criteria for "wise use" can be the original concept of conservation by Pinchot: "greatest good for the greatest number in the long run.") 2. "A state of harmony between man and the land." …Aldo Leopold.

Consumable forage: The average annual dry matter forage requirements for an animal unit X the number of available animal units.

Continuous grazing: Livestock have access to unit year round. Unit has no allocated periods of rest.

Cool season plant: A plant that makes it major growth during the cool portion of the year. For example, cool-season grasses grow when the soil temperature is just above 32 degrees (F) and nearly stops growth when the soil temperature is above 78 degrees (F).

Cover: Vegetation or other material used by wild animals for nesting, rearing of young, resting, escape from predators, or protection from adverse weather conditions.

Covey: A small flock or number of birds together, often functioning somewhat as a unit; the term is chiefly applied to partridges (including quail).

D

Deciduous plant: A plant that sheds all its leaves every year at a certain season (usually autumn).

Decreaser plant species: The plant species of original vegetation that will generally decrease in relative amount with continued overuse; commonly termed decreasers.

Deferred grazing: The discontinuance of livestock grazing on an area for a specified period of time during the growing season to promote plant reproduction, establishment of new plants or restoration of vigor in old plants.

Degradation: 1.To wear down by erosion, especially through stream action. 2. To be contaminated by salts, chemicals, or other pollutants before being returned to the environment after being used by man.

Density: In biology, the number of organisms per area unit at a given time.

Diversity: The variety of species within a given association of organisms. Areas of high diversity are characterized by a great variety of species; usually relatively few individual s represent any one species. Areas with low diversity are characterized by few species; relatively large numbers of individuals represent each species. Diversity enhances ecosystem stability.

Dominant (ecology): A species which by its activity, behavior, or number has considerable influence or control upon the conditions of existence of associated species; a species which "controls" its habitat and food web.

Downed Tree Structure: Woody cover created by placing several large, well branched trees side by side so tops intertwine. The area needs to be free of sod forming grasses and open at ground level beneath the branches.

Dry matter forage: Vegetative material suitable for forage that has been dried to remove all moisture.

E

Ecology: The study of interrelationships of organisms to one another and to their environment.

Ecosytem: A contraction for 'ecological system;" the interacting system of a biological community and its non-living environment.

Edge or ecotone (wildlife): The transitional zone where one cover type ends and another begins. The junction zone may have considerable linear extent, but is narrower than the adjoining community areas themselves.

Endangered species (native): A species of native fish, wildlife or plant threatened with extinction because its habitat is threatened with destruction, drastic modification, or severe curtailment; or because of over-exploitation, disease, predation, or other factors. Its survival requires assistance.

Endemic species: An organism or species that is restricted to a relatively small geographic area or to an unusual or rare type of habitat.

Energy (or food) pyramid: The passage of energy as food from one trophic level to another. Since about 80 to 90 percent of the energy in each transfer is lost as waste heat, the resulting shape of the energy levels is that of a pyramid.

Escape Cover: Cover that affords prey species protection from mammalian and avian predators. For quail, adequate escape cover is considered to be a patch of thick shrubby cover (e.g., plum, dogwood, blackberry) 1500 sq. ft. or more in size. It must have many intertwined branches and an open, sod-free understory. Also suitable are densely-branched downed trees (without a sod

understory). Bulldozed piles typically are too tightly packed and full of dirt that attracts predators searching for den sites.

Exotic: An organism or species that is not native to the region in which it is found.

F

Field border: Minimum 30' border created by fencing or immediately adjacent and protected to the field in question. It must have cover elements of shrub and/ or escape, and the herbaceous cover must be open at ground level with at least 25% bare ground present and overhead (6-18") cover.

Food web (food cycle): All of the interconnecting food chains in a community.

Forage inventory: A compilation of the carrying capacity in animal units and animal unit months for all management units with a farm being evaluated. The carrying capacity of each management unit is the sum of carrying capacities of the pasture units it contains. The carrying capacity of each management unit is determined by dividing land area by the stocking rate (AC/AU).

Forage Production: The total amount of dry matter produced per unit of area on an annual basis.

Forb: An herbaceous plant which is not a grass, sedge or rush. A broadleaf flowering plant.

Forest: A plant association predominantly of trees and other woody vegetation. Community dominated by trees forming a closed canopy with a multilayered and dense understory of shade-tolerant subcanopy trees, shrubs, vines, ferns and herbs.

G

Glade: Open, rocky barren areas dominated by drought-adapted forbs, warm-season grasses and specialized fauna. They are relatively small, often isolated native grasslands that occur on hilltops and south facing slopes, where thin, dry soils and dry harsh desert like summer conditions harbor unique natural communities of plants and animals.

Grass: A member of the botanical family Graminieae, characterized by bladelike, narrow leaves arranged on the culm or stem (jointed) in two ranks, flowers in spikelets, and seedlike fruit, e.g. wheat, oats, sorghum, fescue, big bluestem, etc.

Grassland: Land on which the existing plant cover is dominated by grasses and other herbaceous (non-woody) plants (forbs).

Grazing: The eating of any kind of standing vegetation, except browse, by domestic livestock or wild animals.

Grazing capacity: The maximum stocking rate possible without inducing damage to vegetation or related resources.

Grazing land: Land used regularly for grazing. The term is not confined to land suitable only for grazing. Cropland and pasture used in connection with a system of farm crop rotation are usually not included.

Grazing cell: A parcel of land subdivided into paddocks and grazed rotationally.

Grazing period: The length of time that livestock are present on a particular paddock during a particular grazing cycle.

Grazing season: The portion of the year that livestock graze, or are permitted to graze, on a given range or pasture. It is sometimes called a grazing period.

Grazing system: A specialization of grazing management, which defines systematically recurring periods of grazing and deferment for two or more management units.

Grazing unit: An area of rangeland or pastureland, public or private that is grazed as an entity.

H

Habitat: The environment in which the life needs of an organism, population, or community are supplied.

Hayland: Land used primarily for the production of hay from long-term stands of adapted forage plants.

Herb: Any flowering plant except those developing persistent woody bases and stems above ground.

Herbaceous: Referring to a plant that is not woody. Herbaceous vegetation dies back to the root each year (perennials & biannuals), or dies altogether (annuals).

Herd: A group of animals, especially cattle or big game, collectively considered as a unit.

Home range: The total area traversed by a wild animal engaged in feeding, breeding, loafing, and seeking refuge during its life cycle**.**

Hybrid: An organism resulting from a cross between parents of different species, subspecies, or cultivar.

I

Idle Area (wildlife): An unused patch at least 30 feet wide and ¼ ac, consisting of one or more cover types.

Increaser plant species (increasers): Plant species of the original plant community that generally increase in relative amounts, at least for a time, under continued use. The particular species will vary due to location, kind of site, kind of grazing animals, season of use, and other environmental influences.

Indicator species: Any species (plant or animal) that by its presence, its frequency, or its vigor indicates any particular property of the site.

Indigenous: An organism born, growing, or produced naturally in a region or country; native.

Intake: The mass of forage dry matter consumed by the grazing animal per day. Usually expressed as a percent of bodyweight or pounds per day.

Intensive grazing management: Grazing management where a grazing unit is subdivided into subunits (paddocks) with grazing periods typically less than five days. Usually involves an increase in stocking rates, forage utilization, labor, and results in increased production per unit area or per animal. Preferred term is "Management intensive Grazing" because it is management and not necessarily grazing that is intensified.

Intensive rotational management: Synonymous with "intensive grazing management".

Interspersion (wildlife): The distribution of diverse cover types and plant species in a limited area. The degree to which environmental types are intermingled or interspaced on a landscape. A measurement of system unit location or relationship. It is the intermixing of units of different habitat types.

Invader plant species (invaders): Plant species that were absent in undisturbed portions of the original plant community, but will invade under disturbance or continued overuse.

K

Key management species: 1. Those forage species whose use serves as an indicator of the degree of use of associated species. 2. Those species on which management of a specific unit is based.

L

Landscape: All the natural features, such as fields, hills, forests, and water that distinguish one part of the earth's surface from another part; usually that portion of land or territory which the eye can comprehend in a single view, including all of its natural characteristics.

Land Use plan: A composite of information, ideas, policies, programs, and activities related to existing and potential uses of land within a given area; such describes the recommended location and intensity of development for both public and private land uses such as residential, commercial, industrial, recreational, and agricultural.

Legume: A plant capable of removing nitrogen from the air and adding it to the soil by way of its root system. Important for forage production to dilute the effects of endophyte infected fescue.

Life cycle: The stages through which an organism passes during its existence.

Limiting factor: A factor whose absence, deficiency, or excessive concentration exerts some restraining influence upon a population through incompatibility with species requirements or tolerance. The parameter or item in an animal's habitat that outweighs all others in limiting productivity.

Livestock: Domestic animals produced or kept primarily for farm, ranch, or market purposes; livestock includes beef and dairy cattle, hogs, sheep, goats, and horses.

M

Management unit: An area of land that has distinct boundaries, usually fenced, so that it may be managed separately from other units; i.e., fields, paddocks, pastures.

Monoculture: the raising of crops of a single species, generally even-aged.

Multiple use: The use of land for more than one purpose; e.g., grazing of livestock, wildlife production, reacreation, watershed, and timber production. Multiple use is not necessarily the combination of uses that will yield the highest economic return or greatest unit output.

N

Native species: A species that is a part of an area's original fauna or flora.

Natural resources: The air, land, soil, water, plants, animals, minerals, sources of energy, and other persons upon which and whom man depends on for his necessities, needs, and wants.

Natural revegetation: The natural re-establishment of plants; the propagation of new plants over an area by natural processes.

Niche: The functional role of an organism or population in its community. Each component has a certain function or role in the scheme of "nature".

Nitrogen fixation: The conversion of elemental nitrogen to organic combinations or to forms readily usable in biological processes. The conversion is normally carried out by bacteria living symbiotically in legumes, or by free-living soil bacteria.

Nitrogen-fixing plant: A plant that can assimilate and fix, with the aid of bacteria living in the root nodules, the free nitrogen of the atmosphere. Legumes with the associated rhizobium bacteria in the root nodules are the most important nitrogen-fixing plants.

Nutrients: Those elements of compounds essential to growth and development of living things: carbon, oxygen, nitrogen, potassium, phosphorus, etc.

O

Optimum yield: The maximum sustained yield of any harvestable crop.

Organism: Any living thing.

Overstocking: The placing of a number of animals on a given area that will result in overuse at the end of the planned grazing period.

P

Paddock: A subdivision of land within a grazing cell (can be temporary or permanent).

Palatability: The plant characteristics or conditions that stimulate a selective response by animals.

Pan: A horizon or lay in soil that is strongly compacted, indurated, or very high in clay content.

Parent material (soils): The unconsolidated, more of less chemically weathered mineral or organic matter from which the solum of soils has developed by pedogenic processes. The C horizon may or may not consist of materials similar to those from which the A and B horizons developed.

Pasture: an area devoted to the production of forage, introduced or native, which is harvested by grazing. In most countries, "pasture" refers only to a planted grass sward.

Pasture improvement: Any practice of grazing, burning, mowing, fertilizing, liming, seeding, scattering droppings, contour furrowing, or other methods of management designed to improve vegetation for grazing purposes.

Pasture management: The application of practices to keep pasture plants growing actively over as long a period as possible so that they will provide palatable feed of high nutritive value.

Patch-Burn Graze: A technique that manages habitats and forage in a complementary manner. Under this type of management, fire and grazers interact to create a patchwork of habitat structures and densities. Fire is used on only part of the pasture (typically 1/3) to produce lush new growth that attracts the grazing animals. Unburned portions, being less palatable, are afforded long rest periods to rebuild roots and vertical structure. The following year, a previously unburned portion is fired, shifting grazing pressure to this new patch and allowing last year's heavily utilized patch to rest and recover. In essence, on a given acre, this technique results in one year heavy use followed by two or more years of rest. In this manner, grassland wildlife benefit by having multiple habitat types (nesting, brooding, roosting) provided within close proximity to one another. Pastures under PBG management need only perimeter fences (grazers are free to roam the entire unit, but mostly stay in the present year's burned unit). Pastures are stocked based on the size of the entire pasture, not just the present year's burned patch. To date this technique has only been used on native warm season pastures and prairies.

Perennial plant: A plant that normally lives three or more years.

Permanent pasture: Grazing land occupied by perennial pasture plants or by self-seeding plant, usually both, which remains unplowed for many years.

Pesticide: Any substance or chemical applied to kill or control weeds, insects, algae, rodents, and other undesirable pests.

pH: A numerical measure of acidity or hydrogen ion activity. A pH value of 7.0 is neutral, pH values below 7.0 are acid; pH values above 7.0 are alkaline.

Photosynthesis: The food making process in green plants. Sunlight is used to convert water and carbon dioxide into carbohydrates and oxygen, in the presence of chlorophyll.

Pollution: The condition caused by the presence in the environment of substances of such character, and in such quantities, that the quality of the environment is impaired or rendered offensive to life.

Population: A group of organisms of the same kind.

PPM (parts per million): The ratio of the numbers of parts of a substance in air or a liquid to one million.

Prairie: A tract of level to hilly land that has a dominance of grasses and forbs, a scarcity of shrubs, and is treeless. The natural plant community consists of various mixtures of tall, mid, and short growing native species, respectively known as true prairie, mixed prairie, and shortgrass prairie. Native grasslands in Missouri dominated by warm-season grasses and perennial herbs with very few trees (<10 percent cover).

Prescribed Burning: The deliberate use of fire as a tool under conditions by which the area to be burned, the intensity of heat, and the rate of spread are controlled so as to achieve predetermined, professionally recommended objective for silviculture, wildlife management, grazing, fire-hazard reduction, etc.

Primary productivity: The rate at which organic matter is stored by photosynthetic and chemosynthetic activity of producer organisms (autotrophs); e.g. grams per day.

R

Reproductive potential: The maximum rate of increase in number of individuals of a species or population under the most optimum conditions, in contrast to actual reproduction obtained under existing conditions.

Residual: The amount of forage remaining after a grazing period. Expressed as mass of dry matter per acre or as height from ground level. Not synonymous with residue.

Residue: Dead, decaying plant material present on the soil surface.

Rest period: The length of time between two consecutive grazing periods on a particular paddock.

Riparian land: Land situated along the bank of a stream or other body of water.

Roost: The place, or the support upon which, birds rest—especially at night.

Roosting Cover: For quail, roosting habitat is characterized by vegetation 1-3 feet tall, consisting primarily of herbaceous species. Roosting habitat is typically relatively open at ground level, with abundant bare ground and little dense overhead obstruction that might hinder birds from escaping a predator.

Root zone: The part of the soil that is penetrated, by plant roots.

Rotation grazing: A system of pasture utilization during which short periods of heavy stocking are followed by periods of rest for plant recovery during the same season.

Roughage: A feed, such as hay, with high fiber content and low total digestible nutrients.

Runoff (hydraulics): That portion of precipitation on a drainage area that is discharged from the area in stream channels.

S

Savanna: Grasslands interspersed with open-grown, widely spaced, orchard-like scattered trees, or groupings of trees. Savannas are generally dominated by prairie species and herbs.

Seasonal grazing: Grazing restricted to a specific season.

Selective grazing: The tendency for grazing animals to graze certain plants in preference to others.

Severe grazing: Grazing intensity which exceeds the growth rate of a plant, but is only harmful to the plant if the intensity continues for several seasons so the plant can't complete either its reproductive or carbohydrate storage cycles. The plant can't maintain or replace itself.

Shrubs (Shrubby Cover): Relatively short (1-15') woody vegetation with multiple stems and dense, intertwined branches. Usable shrubby cover will not have a dense sod understory.

Slope: The degree of deviation of a surface from the horizontal, measured in a numerical ratio, percent or degrees. Expressed as a ratio or percentage, the first number is the vertical distance (rise), and the second is the horizontal distance (run), as 2:1 or 200 percent. Expressed in degrees, it is the angle of the slope from the horizontal plane with a 90 degree slope being vertical (maximum), and 45 degrees being a 1:1 slope.

Soil: The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of plants.

Soil classification: The systematic arrangement of soils into groups or categories on the basis of their characteristics.

Soil loss tolerance (T): The maximum average annual soil loss (expressed in tons per acre per year) that should be permitted on a given soil.

Soil survey: A general term for the systematic examination of soils in the field and in laboratories: their description and classification; the mapping of kinds of soil; the interpretation of soils according to their adaptability for various crops, grasses, and trees; their behavior under use or treatment for plant production or for other purposes; and their productivity under different management systems.

Species (both singular and plural): A natural population or group of populations that transmit specific characteristics from parent to offspring. They are reproductively isolated from other population with which they might breed.

Species diversity: The ratio of the number of species in a community to the number of individuals in each species. (Low diversity occurs when there are few species, but many individuals in each species.)

Standing crop: 1. The total biomass of an area at a given time. 2. The quantity of a given species at a given times.

Stocker: A beef animal in the period between weaning and feedlot placement.

Stocking: The release of wildlife species that have been captured, or propagated in captivity, into a suitable habitat.

Stocking rate: The number of animals, animal units, or total animal liveweight assigned to a grazing unit for an extended period of time. Usually expressed on a per acre basis.

Structure: The vertical and horizontal arrangement of herbaceous and woody vegetation.

Succession: The stages through which an ecosystem passes from less complex to more complex, i.e., from bare ground to oak hickory forest in MO**.**

Sustained yield: A condition in which the rate of utilization or consumption of a resource does not exceed the rate of recovery or production.

Sward: Grass covered soil.

Temporary pasture: A pasture, usually consisting of annual plants, intended to provide grazing for only a short period.

Tillage: The operation of implements through the soil to prepare seedbeds and root beds, control unwanted vegetation, aerate the soil, and cause faster breakdown or organic matter.

Transect: A cross section of an area used as a sample for recording, mapping, or studying vegetation and its use. A transect may be a series of plots, a belt, strip, or line, depending on why it is being used.

U

Undergrazing: An intensity of grazing in which the available forage is not fully utilized.

V

Vegetation: The sum total of plants that cover an area; plants in general.

Vegetation type: A plant community with distinguishable characteristics.

W

Warm-season plant: A plant that completes most of its growth during the warm portion of the year, generally late spring and summer. For example, warm-season grasses start growth when the soil temperature reaches 55 degrees (F) and nearly stops growing when it reaches 90 degrees (F).

Water penetration: The depth to which irrigation water or precipitation penetrates soil before the rate of downward movement becomes negligible.

Watershed: The land area that drains toward a natural surface water system.

Wildlife: Undomesticated animals, considered collectively.

Wildlife management: The technique of producing sustained annual crops of wildlife.

Woodland: Natural communities with an overstory of trees ranging from 30 to 100% canopy closure with a sparse understory or (midstory) and a ground layer rich in forbs and graimoids. The ground layer has patchy to dense cover all growing season as opposed to forests where ground layer cover peaks in spring. (This does not refer to scattered trees in a pasture or hayfield.)

SUGGESTED REFERENCES

The following curriculum guides are available from the "Instructional Materials Laboratory" (I.M.L.), Columbia, Missouri.

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10-1203-I & 10-1203-S "Crop & Grassland Plant Identification" (1997)
10-4853-I & 10-4853-S "Fish & Wildlife Management"
10-5050-I & 10-5050-S "Soil Science"
10-1200-S "Grass & Legume I.D.
10-1220-V "Rotational Grazing" video

The following guidesheets are available from the county University of Missouri Extension Center.

G4650 - Establishing Forages
G4651 - Renovating Grass Sods With Legumes
G4515 - Annual Lespedeza
G4550 - Alfalfa
G4620 - Bermudagrass
G4639 - White, Ladino & Sweet Clover
G4640 - Birdsfoot Trefoil
G4610 - The Bluegrasses
G4673 - Big Bluestem, Indiangrass and Switchgrass
G4674 - Caucasian Bluestem
G6710 - Orchardgrass
G4638 - Red Clover
G4646 - Tall Fescue
G2095 - Backgrounding Calves - Part 1
G2096 - Backgrounding Calves - Part 2
G2101 - Grass Tetany
G2072 - Grain and Protein Supplements For Beef Cattle on Pasture
G2062 - Wintering Beef Cows
G2037 - The Systems Concept of Beef Production
G2099 - Hot Weather Livestock Stress
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Waller, Steven S., Lowell E. Moser, Patrick E. Reese; Understanding Grass Growth: The Key To Profitable Livestock Production. Available through: Trabon Printing Co., Inc., 430 Bannister Road, Kansas City, MO 64131

Weeds of the North Central States, N.C. Regional Pub. No. 36, Circular 718 of the University if Illinois, Ag. Experiment Station, Urbana, IL

Wildlife Management For Missouri Landowners, Pitts, David E., Mo. Dept. of Conservation, Box 180, Jefferson City, Mo. 65101. (Booklet free upon request)

MISSOURI GRASSLAND EVALUATION

Form #602MO-3

INCORRECT ✓ ✗ ▬ ⊙ CORRECT ●

TEAM NAME / ADDITIONAL INFO

TEAM # (0000–9999)

CODE (00–99)

LAST NAME (A–Z)

FIRST NAME (A–Z)

GRASSLAND CONDITION

Appraisal of Existing Conditions

1. Pasture Type	A B C D E F
2. Growth Stage	A B C D E
3. Sward	A B
4. Weed / Brush Control	A B
5. pH_S Range	A B C D E F
6. Fertilizer Option	00–99
7. Limestone Rate	00–99

GRASSLAND CONDITION

Pasture Improvement

1. Livestock Management	A B C D E F
2. Additional Forage	A B C D
3. Forage Planting	A B C D
4. Fertilizer Option	00–99
5. Limestone Rate	00–99

GRASSLAND CONDITION

Matching Livestock and Forage

1. Quality Requirement	A B C D E
2. Nutritional Needs	A B

3. Consumption (lbs/day)

Spring	Summer	Fall	Winter
0,000–9,999	0,000–9,999	0,000–9,999	0,000–9,999

4. Forage Availability:

Spring		Summer		Fall		Winter	
Adequate	Not Adequate	Adequate	Not Adequate	Adequate	Not Adequate	Adequate	Not Adequate
A	N	A	N	A	N	A	N

WILDLIFE HABITAT

Appraisal of Existing Conditions	
1. Dominant Grass	A B
2. Forbs	A B
3. Bare Ground	A B
4. Vegetation	A B C
5. Idle Area	A B C
6. Cover	A B C
7. Field Size	A B C D
8. Crop Field	A B C

Wildlife Exam	
1	A B C D E
2	A B C D E
3	A B C D E
4	A B C D E
5	A B C D E
6	A B C D E
7	A B C D E
8	A B C D E
9	A B C D E
10	A B C D E
11	A B C D E
12	A B C D E
13	A B C D E
14	A B C D E
15	A B C D E
16	A B C D E
17	A B C D E
18	A B C D E
19	A B C D E
20	A B C D E

Quality of Habitat		
○ Poor	○ Fair	○ Good

Limiting Habitat Factors	
A. Ground cover thick and/or continuous	Y N
B. Inadequate nesting cover	Y N
C. Inadequate brood cover	Y N
D. Insufficient escape cover	Y N
E. Insufficient plant diversity	Y N

Management Practices	
1. Establish and/or fence escape cover	Y N
2. Lightly disc strips on the contour	Y N
3. Use prescribed fire	Y N
4. Adjust stocking rate	Y N
5. Overseed with wildlife friendly forbs	Y N

SOIL INTERPRETATION

Soil Evaluation	
1. Surface Texture	A B C D E
2. Chert and Gravel	A B C D
3. Slope	A B C D E F
4. Rooting Depth	A B C D
5. Drainage	A B C D E F G
6. Surface Depth	A B C D
7. Permeability	A B C D E F G
8. Water Capacity	A B C D E
9. Land Capability Class	A B C D E F G H
10. Major Factors	A B C D

Forage Adaptation	Adapted	Not Adapted
1.	A	N
2.	A	N
3.	A	N
4.	A	N
5.	A	N
6.	A	N
7.	A	N
8.	A	N
9.	A	N
10.	A	N

PLANT IDENTIFICATION

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Each column: 0 0 A / 1 1 P / 2 2 / 3 3 / 4 4 / 5 5 / 6 6 / 7 7 / 8 8 / 9 9

GRASSES & GRASS-LIKE
01. Barley, Little
02. Barnyard Grass
03. Bermuda Grass
04. Bluegrass (Kentucky)
05. Bluestem, Big
06. Bluestem (Old World)
07. Bluestem, Little
08. Bromegrass, Smooth
09. Broomsedge (Broomstraw)
10. Crabgrass
11. Downy Chess (Downy Brome, Cheat Grass)
12. Eastern Gamagrass
13. Fall Panicum
14. Fescue (Tall)
15. Foxtail (Giant, Green & Yellow)
16. Indiangrass
17. Johnsongrass
18. Nimblewill
19. Orchardgrass
20. Purple Top
21. Reed Canary Grass
22. Ryegrass
23. Sedges
24. Switchgrass
25. Timothy

WOODY PLANTS
26. Blackberry/Dewberry
27. Black Cherry
28. Coralberry (Buckbrush)
29. Dogwood
30. Elm
31. Grape
32. Greenbriar
33. Gooseberry
34. Hickory
35. Honeysuckle (Bush or Japanese)
36. Locust (Black or Honey)
37. Oak, Black or White
38. Osage Orange
39. Persimmon
40. Poison Ivy
41. Red Cedar (Juniper)
42. Rose (Multiflora or Wild)
43. Sassafras
44. Sumac
45. Walnut
46. Wild Plum

FORBS
47. Bull Nettle (Horse)
48. Chicory, Common
49. Cinquefoil
50. Cocklebur, Common
51. Croton
52. Curly Dock
53. Daisy Fleabane
54. Dandelion
55. Field Bindweed
56. Goldenrod (Prairie)
57. Hemp Dogbane
58. Horseweed
59. Ironweed
60. Lambsquarter
61. Milkweed, Common
62. Mullein
63. Nodding Spurge
64. Oxeye Daisy
65. Perilla Mint
66. Pigweed
67. Plantain
68. Poison Hemlock
69. Pokeweed
70. Queen Anne's Lace
71. Ragweed (Common, Giant, Lanceleaf)
72. Red Sorrel
73. Smartweed
74. Spotted Knapweed
75. Thistle (Tall, Musk, Bull)
76. Three-Seeded Mercury
77. Wild Indigo (Blue, Cream, White)
78. Yarrow, Common
79. Yellow Wood Sorrel

LEGUMES
80. Alfalfa
81. Birdsfoot Trefoil
82. Cats Claw Sensitive Briar
83. Clover, White
84. Clover, Red
85. Clover, Sweet
86. Clover (Little Hop)
87. Goat's Rue
88. Illinois Bundleflower
89. Lespedeza (Korean, Common)
90. Lespedeza, Sericea
91. Partridge Pea
92. Tick Trefoil (Beggar Tick)
93. Vetch (Common, Hairy)