Bobwhite Quail Habitat Evaluation and Management Guide

E-904

Oklahoma State University • Division of Agricultural Sciences and Natural Resources
• Oklahoma Cooperative Extension Service

Bobwhite Quail Habitat Evaluation and Management Guide

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Photos: Courtesy of the Oklahoma Department of Wildlife Conservation.

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Overview of Bobwhite Quail Habitat Management

The Habitat Evaluation portion on page 4 will help you identify specific limitations of the habitat on the ranch for bobwhites. However, there are some preliminary observations that can aid in accessing a ranch's potential for good bobwhite quail habitat. The following steps will help you in assessing potential for bobwhite quail.

Was it ever good quail habitat?

Some landowners have purchased land for the purposes of managing bobwhite quail only to learn the potential is very low. Likewise, land managers may make the mistake of attempting to create habitat for bobwhite quail where the potential is low. The presence of suitable native vegetation types is not random and is explained by the Climate-Soil-Vegetation Type Interaction Model (Figure 1). Managing habitat for quail where potential is low will have little influence on quail abundance and is always expensive. To assess habit potential, use the following steps.

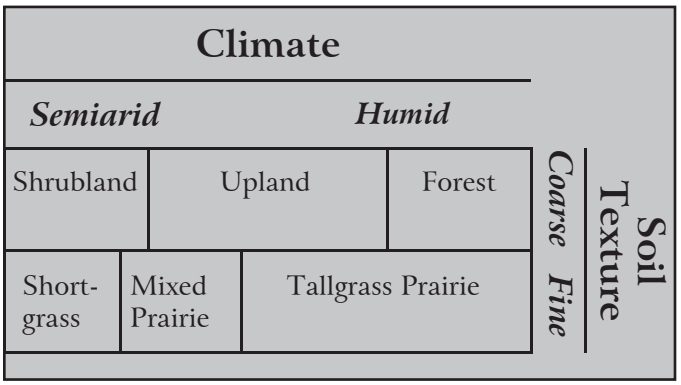

Figure 1. Climate-Soil-Vegetation Type Interaction Model.

1. Find the general location of the land on the Duck and Fletcher Map (Figure 2 located on the inside back cover) or other potential vegetation map if not in Oklahoma. Does the land in question have vegetation types that are potentially good bobwhite quail habitat? The following vegetation types from Duck and Fletcher have **high potential** to make good bobwhite quail habitat:
   - Sand sage grassland
   - Shinnery oak grassland
   - Mesquite grassland
   - Post oak/blackjack oak forest (a.k.a., Cross Timbers)
   - Oak-hickory forest
   - Oak-pine forest

   Tallgrass prairie, mixedgrass prairie, and shortgrass prairie vegetation types (Duck and Fletcher map) have **limited potential** to provide good bobwhite quail habitat. Except for localized areas, such as brushy draws, these prairie habitat types do not support the woody plants that bobwhite quail require.

2. Obtain a USDA Soil Survey and Ecological Site Guide(s) for the land (from USDA Natural Resources Conservation Service county office). Some of this material will be available on the USDA NRCS web site at http://esis.sc.egov.usda.gov/. Group the soils occurring on the land into their respective ecological sites (soils the produce similar native plant communities) using information from the Soil Survey or Ecological Site Guides. Use Table 1 to determine the potential of each Ecological Site to make good bobwhite quail habitat.

Is the land in question still bobwhite quail habitat?

While the Duck and Fletcher Map and Ecological Site Guides provide information on vegetation potential, there is no guarantee that the habitat potential remains. Changes in land use have altered many of the historical native pant communities, often to the detriment of the bobwhite quail. To determine if the potential remains, use the steps below.

1. Verify that the native plant communities are present on the land. Native plant communities are the foundation of bobwhite quail habitat. The key indicator species are native warm season grasses such as little bluestem, big bluestem, Indian grass, switch grass in combination with many warm and cool season native annual, perennial forbs, and legumes. Learn to identify and understand the ecology of the plants that are important to bobwhite quail. Remember, "every plant tells a story." A good starting point is to obtain a copy of the ***Field Guide to Oklahoma Plants*** (Tyrl et al. 2002) published by Oklahoma State University and available from the Rangeland Ecology and Management Program at 405.744.6421.

2. Identify poor habitat or those vegetation types that would be expensive and difficult to restore. Introduced forages such as Old World bluestem, tall fescue, and bermuda grass have no place in bobwhite quail habitat management. If introduced grasses are present, they must be replaced with a mixture of warm-season native grasses, forbs, and legumes to be useful to bobwhite quail. These mixtures are available from most seed dealers.

Table 1. Bobwhite quail habitat potential ratings* for Ecological Sites found in Oklahoma.

Ecological Site	ID Number	Rating	Ecological Site	IDNumber	Rating
Alkali Bottomland	080AY001OK	4	Loamy Bottomland	078XY050OK	8
Alkali Bottomland	085AY001OK	4	Loamy Bottomland	080AY050OK	8
Boulder Ridge	082BY004OK	0	Loamy Bottomland	084AY050OK	8
Breaks	070AY005OK	1	Loamy Bottomland	085AY050OK	8
Breaks	085AY005OK	1	Loamy Bottomland	112XY050OK	6
Clay Flats	078CY064OK	3	Loamy Bottomland	116AY050OK	6
Clay Flats	078XY064OK	3	Loamy Bottomland	118XY050OK	6
Clay Prairie	080AY065OK	4	Loamy Bottomland	119XY050OK	6
Clay Prairie	085AY002OK	5	Loamy Bottomland	133BY050OK	6
Clay Prairie	133BY002OK	4	Loamy Breaks	078XY005OK	1
Clay Prairie	078CY065OK	6	Loamy Breaks	080AY005OK	1
Clay Prairie	078XY031OK	6	Loamy Prairie	077EY056OK	5
Clay Prairie	085AY003OK	6	Loamy Prairie	078CY056OK	5
Clayey Breaks	078XY006OK	1	Loamy Prairie	078XY056OK	5
Claypan Prairie	078XY010OK	3	Loamy Prairie	080AY056OK	5
Claypan Prairie	085AY010OK	3	Loamy Prairie	082BY056OK	5
Claypan Prairie	112XY010OK	3	Loamy Prairie	085AY056OK	5
Claypan Prairie	080AY010OK	3	Loamy Prairie	112XY056OK	5
Claypan Prairie	080AY011OK	3	Loamy Prairie	118XY056OK	5
Deep Sand	077EY014OK	10	Loamy Prairie	119XY060OK	5
Deep Sand	077XY014OK	10	Loamy Prairie	133BY060OK	5
Deep Sand	078XY014OK	10	Loamy Prairie	078XY057OK	5
Deep Sand	080AY014OK	10	Loamy Prairie	112XY059OK	5
Deep Sand Savannah	078CY017OK	10	Loamy Prairie	116AY059OK	5
Deep Sand Savannah	078XY018OK	10	Loamy Prairie	112XY061OK	5
Deep Sand Savannah	080AY018OK	10	Loamy Prairie	112XY060OK	5
Deep Sand Savannah	084AY018OK	10	Loamy Prairie	117XY056OK	5
Deep Sand Savannah	084BY018OK	10	Loamy Saline Bottomland	078CY047OK	4
Deep Sand Savannah	118XY020OK	8	Loamy Savannah	112XY062OK	8
Deep Sand Savannah	133BY020OK	8	Loamy Savannah	117XY062OK	8
Deep Sand Savannah	084AY020OK	8	Loamy Savannah	118XY062OK	8
Deep Sand Savannah	078XY017OK	9	Loamy Savannah	119XY062OK	8
Depressional Upland	077AY098OK	0	Loamy Savannah	133BY062OK	8
Depressional Upland	077EY098OK	0	Malpais Upland	070AY054OK	6
Depressional Upland	078CY098OK	0	Meadow	078XY090OK	0
Depressional Upland	080AY099OK	0	Meadow	080AY090OK	0
Dune	077XY022OK	9	Reseeded Clay	080AY880OK	3
Dune	078XY022OK	9	Reseeded Clay Prairie	078XY865OK	3
Dune	080AY022OK	9	Reseeded Clay Prairie	085AY827OK	3
Edgerock	085AY026OK	3	Reseeded Claypan	112XY810OK	3
Eroded Shale	078XY067OK	0	Reseeded Claypan Prairie	076XY810OK	3
Granite Hills	082BY036OK	0	Reseeded Claypan Prairie	080AY810OK	3
Gyp	078XY038OK	3	Reseeded Deep Sand	077AY814OK	6
Hardland	070AY039OK	3	Reseeded Disturbed Land	119XY899OK	0
Hardland	077AY040OK	3	Reseeded Hardland	077EY840OK	1
Hardland	077EY040OK	3	Reseeded Hardland	078XY842OK	1
Hardland	077XY040OK	3	Reseeded Limy Sandy Prairie	077EY849OK	2
Hardland	078XY041OK	3	Reseeded Limy Upland	077EY848OK	2
Hardland	078XY042OK	3	Reseeded Loamy Prairie	078XY856OK	5
Heavy Bottomland	080AY045OK	8	Reseeded Loamy Prairie	080AY856OK	5
Heavy Bottomland	084BY045OK	7	Reseeded Loamy Prairie	082BY856OK	5
Heavy Bottomland	085AY045OK	7	Reseeded Loamy Prairie	084AY856OK	5
Heavy Bottomland	112XY045OK	7	Reseeded Loamy Prairie	085AY828OK	5
Heavy Bottomland	118XY045OK	7	Reseeded Loamy Prairie	112XY856OK	5

Ecological Site	ID Number	Rating	Ecological Site	IDNumber	Rating
Heavy Bottomland	078XY045OK	7	Reseeded Loamy Prairie	117XY856OK	6
Heavy Bottomland	078XY044OK	7	Reseeded Loamy Prairie	119XY860OK	6
Limestone Ridge	082BY048OK	3	Reseeded Loamy Savannah	116AY862OK	6
Limy Prairie	078CY057OK	8	Reseeded Loamy Savannah	117XY862OK	6
Limy Sandy Plains	077EY049OK	8	Reseeded Loamy Savannah	118XY862OK	6
Limy Upland	077AY055OK	3	Reseeded Loamy Savannah	119XY862OK	6
Limy Upland	077EY048OK	3	Reseeded Loamy Savannah	133BY862OK	6
Loamy Bottomland	076XY050OK	8	Reseeded Sandy Land	078XY834OK	7
Loamy Bottomland	077XY050OK	8	Reseeded Sandy Plains	077AY871OK	7
Loamy Bottomland	078CY050OK	8	Reseeded Sandy Prairie	078XY873OK	7
Reseeded Sandy Prairie	080AY873OK	7	Seep Meadow	078CY089OK	0
Reseeded Sandy Prairie	078XY817OK	8	Shale	078XY100OK	4
Reseeded Sandy Prairie	084AY876OK	8	Shallow	077XY082OK	4
Reseeded Sandy Prairie	084BY876OK	8	Shallow Clay Prairie	078XY066OK	4
Reseeded Sandy Prairie	085AY876OK	8	Shallow Clay Prairie	080AY080OK	4
Reseeded Sandy Prairie	112XY875OK	8	Shallow Prairie	080AY083OK	4
Reseeded Sandy Prairie	116AY875OK	8	Shallow Prairie	085BY083OK	4
Reseeded Sandy Prairie	117XY875OK	8	Shallow Prairie	085XY083OK	4
Reseeded Sandy Prairie	118XY875OK	8	Shallow Prairie	112XY087OK	4
Reseeded Sandy Prairie	119XY875OK	8	Shallow Prairie	117XY083OK	4
Reseeded Sandy Prairie	133BY829OK	8	Shallow Prairie	112XY083OK	4
Reseeded Shallow	077EY882OK	7	Shallow Prairie	112XY086OK	4
Reseeded Shallow Prairie	078XY883OK	7	Shallow Prairie	078XY083OK	4
Reseeded Shallow Prairie	080AY883OK	7	Shallow Prairie	078XY084OK	4
Reseeded Shallow Savanna	084AY889OK	7	Shallow Sandstone	070AY099OK	4
Reseeded Shallow Savanna	118XY888OK	7	Shallow Sandy Prairie	078CY074OK	7
Reseeded Shallow Savanna	119XY888OK	7	Shallow Savannah	084AY088OK	8
Reseeded Slickspot	080AY891OK	0	Shallow Savannah	084AY089OK	8
Reseeded Very Shallow	078XY898OK	3	Shallow Savannah	084BY088OK	8
Saline Bottomland	078CY046OK	4	Shallow Savannah	085AY088OK	8
Saline Bottomland	078XY046OK	4	Shallow Savannah	116AY088OK	8
Sandy Bottomland	077XY068OK	10	Shallow Savannah	117XY088OK	8
Sandy Bottomland	078XY068OK	10	Shallow Savannah	118XY088OK	8
Sandy Bottomland	080AY068OK	10	Shallow Savannah	119XY088OK	8
Sandy Bottomland	084AY068OK	10	Slickspot	078XY091OK	0
Sandy Bottomland	112XY068OK	10	Slickspot	080AY091OK	0
Sandy Bottomland	118XY068OK	10	Slickspot	112XY091OK	0
Sandy Plains	077AY071OK	9	Slickspot	118XY091OK	0
Sandy Plains	077EY072OK	9	Smooth Chert Savannah	116AY092OK	6
Sandy Plains	078XY072OK	9	Smooth Chert Savannah	119XY092OK	6
Sandy Prairie	078CY073OK	9	Subirrigated	078XY095OK	5
Sandy Prairie	078XY073OK	9	Subirrigated	080AY095OK	5
Sandy Prairie	080AY073OK	9	Subirrigated	084AY095OK	5
Sandy Savannah	084BY076OK	10	Subirrigated	084BY095OK	5
Sandy Savannah	085XY076OK	10	Subirrigated	112XY095OK	4
Sandy Savannah	112XY077OK	10	Subirrigated - Mod. Saline	078XY096OK	5
Sandy Savannah	116AY075OK	10	Subirrigated - Saline	078XY097OK	5
Sandy Savannah	117XY075OK	10	Subirrigated - Saline	080AY097OK	5
Sandy Savannah	118XY075OK	10	Subirrigated - Nonflooded	080AY094OK	5
Sandy Savannah	119XY075OK	10	Very Shallow	076XY098OK	4
Sandy Savannah	133BY075OK	10	Very Shallow	077XY099OK	4
Sandy Savannah	084AY076OK	10	Very Shallow	078XY098OK	4
Sandy Savannah	084AY075OK	10	Very Shallow	080AY098OK	4
Savannah Breaks	084AY079OK	7	Very Shallow	085XY098OK	4
Savannah Breaks	117XY079OK	7	Very Shallow	112XY098OK	4
Savannah Breaks	118AY079OK	7	Very Shallow	117XY098OK	4
Savannah Breaks	119XY079OK	7			

* Potential ratings on a scale of 0-10 with 10 being the best suited for quail habitat. Scale reflects the woody component and vegetative (bare ground) characteristics typified by the native plant community. These sites are being updated so contact your local USDA-NRCS field office.

Closed canopy native forests, such as Cross Timbers, can be excellent bobwhite habitat, but may require extensive and expensive habitat restoration treatments to achieve the goal. Natural resource professionals are available from several agencies and private groups to help with a management plan.

3. Drive roads surrounding the land and/or look at aerial photos to determine the quality of surrounding habitat. Large tracts (5,000 acres or more) of good habitat are required to have a viable bobwhite quail population. Bobwhite abundances have a direct relationship to the amount of woody and prairie vegetation on the landscape. Islands of good habitat (e.g. 160 acres) in a sea of poor habitat, (e.g. cropland, introduced forages, closed canopy forests, and eastern redcedar) are not viable.

Habitat Evaluation

Introduction

The northern bobwhite (*Colinus virginianus*) is the most well-known and popular upland game bird in Oklahoma and many other states. The bobwhite occurs statewide and its numbers are directly related to land use, management practices, and weather. The main influences on Oklahoma's landscape and bobwhite quail habitat have been farming, conversion of native plant communities to introduced forages, fire suppression, and urban sprawl. Grazing practices on native grasslands such as multi-paddock rotational grazing or herbicide use have reduced the diversity of native plants that bobwhite quail need for survival (Fuhlendorf and Engle 2001). Also in native forest, the lack of fire and proper thinning has eliminated herbaceous and low woody cover that bobwhites require (Masters et at. 1996). Conversion of forestland to pastureland dominated by monocultures of introduced grasses has also had an impact.

Overuse by cattle has reduced herbaceous fuels to the point that fire cannot move across the landscape and thus has allowed eastern redcedar, which is a direct debit to bobwhite habitat, to invade (Bidwell et al. 2002, 2003; Boyd and Bidwell 2001, 2002; Boyd et al. 2001; Guthery et al. 2002; Harrel et al. 2001; Masters and Waymire 2001; Renwald 1978). Farming has eliminated bobwhite quail habitat by conversion of native plant communities to introduced crops or forages (e.g., tall fescue, bermuda grass, Old World bluestem). Other negative influences on the bobwhite's remaining habitat are fire suppression, overgrazing, multi-paddock grazing systems, herbicide use, and urban sprawl. Ironically, all of these negative influences often occur together as land parcels decrease in size.

Cattle grazing is an excellent management tool if the grazing pattern is patchy (Fuhlendorf and Engle 2001). Continuous grazing at a moderate to light stocking rate will produce patches (see OSU Fact Sheet, F-2871, Stocking Rate: The Key to Successful Livestock Production). However, the best way to produce patches for bobwhite and other wildlife is to use the fire-grazing interaction also know as **Patch Burning or Rotational Grazing without Fences** (see page 19).

Much of the state's land is still in native vegetation. Lands in native vegetation with coarse textured soils (sandy, gravelly, etc.) (Figure 1) still have the potential to provide habitat for bobwhite quail. However, the quality of habitat will vary from poor to excellent depending on how the land is managed.

The purpose of this guide is to provide a means to systematically evaluate the suitability of habitat for bobwhite quail. The guide can also be used to evaluate nonnative vegetation such as introduced pasture or cropland. It is designed to allow you to inventory existing habitat conditions and to determine what is/are the limiting factor(s) that keep the bobwhite from fully using the habitat. The limiting factor(s) are those habitat elements that are limited in occurence or missing. Those limited or missing elements must be improved or developed before the habitat becomes usable.

Habitat Evaluation Guide Components

Home Range and Carrying Capacity

The size and shapes of the bobwhite's home range is thought to vary according to the suitability of habitat within the home range. The home range will sometimes exceed 80 acres but genrally averages between 20 and 40 acres (Bartholomew 1964; Lehman 1946; Mangold 1950; Murphy and Baskett 1952). However, Madison et al. (2000) and Walsh (2004) recently reported similar home ranges from 20 to just over 300 acres in Kansas and western Arkansas, respectively. Covey home ranges often overlap and there is considerable interchange of individuals between coveys. Individual movements are most pronounced in the spring and fall in what is termed "shuffles." These movements routinely exceed one mile in western Oklahoma. However, some areas in the southeast rarely experience a "shuffle." An individual quail covey can occupy as little as four acres; however, the average density on well managed areas is one covey per 15 acres (Rosene 1969). Carrying capacity for quail averaged over several years rarely exceeds one bird per acre. However, densities exceeding four birds per acre on very intensively managed areas in the southerneastern states have been reported (B. Palmer, pers. comm. 2002).

The bobwhite quail restricts its activities to a home range that varies in size depending on the **kind**, **amount**, **condition**, and **interspersion** of the required habitat components. All the requirements for the bobwhite's livelihood, must be found within this area. The actual size and shape of the home range is determined

by the inherent limits of how far the bobwhite can travel and the quality of various habitat elements within the home range. Actual home ranges are not marked by permanent boundaries, nor are they the same from year to year or season to season.

The bobwhite is primarily a species of transitions from early to mid-seral stages of plant succession, annual and perennial forbs (sometimes called weeds) resulting from disturbance of the plant community (Stoddard 1931), and differences in soil texture. The bobwhite is most abundant where native grasses, forbs, legumes, brushy native prairie, and shrubs occur together and are closely intermixed (Edminster 1954). Bobwhite abundance is determined by the composition and size of herbaceous and woody shrub patches (Guthery et al. 2001, 2002; Masters et al. 2002).

Habitat Requirements

Nesting Cover

Bobwhites build nests on the ground in dead warm-season grass clumps left from the previous growing season. In forested areas, nests are often within 50 feet or less of an opening. Little bluestem and other bunch grasses of similar growth habit make up the majority of nest sites (Wiseman 1977). Weeping lovegrass is also used for nesting cover when close to other habitat requirements (De Arment 1950) such as low woody cover. Broomsedge bluestem is a primary nesting cover throughout much of the eastern part of the U.S. (Rosene 1969). Practically all tall warm season grasses are used for nesting, but native bluestems, Indiangrass, switchgrass, and sideoats grama compose the majority of nesting sites within Oklahoma. A recent study in western Oklahoma showed that woody structure was also important in nest site selection (Townsend et al. 2001). Nests generally had about 50% cover of grasses and 20 to 30% cover of low woody plants within 1.5 feet of the nest site. Warm-season native short grasses such as buffalograss, blue and hairy grama, and introduced grasses such as bermuda grass are not used for nesting. Because of their growth habit, Old World bluestems may be used for nesting if other habitat requirements are available, but other negative attributes preclude it from being considered desirable. Cool season grasses such as tall fescue, smooth brome, tall wheatgrass, annual bromes, and wild ryes are seldom used for nesting.

Nesting Cover Criteria

Nesting Cover Quantity: The optimum percentage of native prairie is 30 to 40% within the bobwhite's home range (Edminster 1954). Taking the lowest percentage (30%) and applying it to the minimum home range size (15 acres) suggests 4.5 acres or more of native prairie is needed to optimize nesting cover.

Nesting Cover Height: Bobwhites begin nesting in Oklahoma after covey break up in April. Tall and mid-height warm season grasses from the previous season (last year's dead growth) must be available for nesting at that time. Grasses must be of sufficient height (6 to 8 inches) to conceal quail, thus requiring light or no use by grazing animals.

Nesting Cover Diameter: Bobwhites prefer thick nesting cover greater than 1 foot in diameter. Nesting cover often includes more that one plant in close proximity (less than 6 inches apart).

Brood Cover

High insect availability for food is required for nesting hens and quail broods (Hurst 1973). Open areas of herbaceous plants or grain and seed crops are used for feeding. These areas must contain bare ground. Also, areas that have been burned produce green forage earlier than unburned areas and thus will attract high concentrations of insects. These areas are sometimes called "bugging grounds."

Brood Cover Criteria

Brood Cover Quantity: 30 to 40% of the bobwhite's home range should be open grassy areas with 40 to 60% in food-producing plants such as native annual and perennial forbs or planted crops (Edminster 1954). Applying the common percentage (40%) to the minimum home range size limit results in a 6 acres or larger area, of either native prairie or crops for optimum brood habitat value.

Accessibility of cover to quail chicks: Quail chicks require herbaceous plants spaced far enough apart to provide travel corridors. Dense, tangled vegetation or heavy mulch on the soil surface presents obstacles for the movement of young chicks and restricts food accessibility (Hurst 1973).

Protective Cover

Protective cover is used for loafing and is necessary for escaping from avian predators. Low-growing, dispersed woody plants, shrubs, resprouting trees, and upright growing forbs are used for this type of cover because they provide a visual screen from aerial and ground predators. Clumps of protective cover are called coverts. Protective cover must also persist during cold and hot weather when thermal protection is needed.

Protective Cover Criteria

Protective Cover Quantity: 5 to 20% of the bobwhite's home range should be brush or shrub cover (Edminster 1954). The least percentage (5%) of the minimum home range size limit (15 acres) requires 0.75 acres or more to optimize the quantity of low-growing woody plants for protection.

Protective Cover Composition: Living, low-growing woody plants such as plums, blackberries, sumacs, and buckbrush provide the best protection because they are persistent over a number of years. Brush piles are

only temporary protection, although they last longer than dense herbaceous plants such as cudweed or sunflowers.

Protective Cover Canopy Density: Protective cover should completely conceal quail from aerial predators (Stoddard 1931). Protective cover should be thick, several feet above the ground, but relatively open at ground level to permit quail movement underneath (Umber et al. 1979).

Covert Size: The protective cover area (covert) may be as small as 10 feet in diameter; however, greater than 30 feet in diameter is preferred (Roseberry and Klimstra 1984). Woody cover dispersed over a large area is ideal (Guthery et al. 2002).

Food

The diet of adult bobwhite quail consists of insects, grass and forb "greens," and seeds. Fruits of native shrubs and trees are also important. Seeds from cultivated crops are also used if available. Seeds are eaten throughout the year. Insects are high in protein and are eaten during the spring, summer, and fall, especially by adult females (Davis 1964). Because of their high dietary energy and protein requirement, insects are the primary food for quail broods during their first few weeks of life (Hurst 1973). Insects are high in energy and fat.

Food Criteria

Food Quantity: A single adult bobwhite quail consumes an average of 0.05 pounds of food per day (Edminster 1954). Applying that consumption rate to the average size covey (14.3 birds) (Rosene 1969) results in a daily consumption rate of 0.72 pounds per covey per day. Enough food must be produced in the fall to last through the winter until the critical month of March (Rosene 1969). This means that at least 130 pounds of food (0.72 pounds per covey per day times 182 days = 131 pounds) has to be produced and available for this period. Generally this amount can be produced easily in 0.25 acre food plots if soil fertility and weather conditions are ideal (Allen and Waters 1962). However, naturally occurring foods do not always produce this heavily and may require greater than a 0.25 acre area to provide adequate amounts of food. Naturally occurring foods are recommended over cultivated food plots or feeders because of their nutritional diversity. Forty to 60% of the bobwhite's home range should be in prairie with abundant forbs (i.e. weedy), shrubland, or open forest. Cropland may also provide foods (Edminster 1954), although this is less desirable because cropland does not provide space all year. By applying 40% (Edminster 1954) to the minimum quail home range size limit of 15 acres, then 6 acres or more of naturally occurring forbs (i.e. weeds) would be needed to optimize the bobwhite's food requirements, assuming adequate precipitation.

Food Variety: Over a hundred different plants have been recorded in the diets of Oklahoma quail (Baumgartner 1952; Bird 1931; Lee 1948; Peoples 1992; Rollins 1981; Wiseman 1977). The importance of food variety to animal populations has been well documented. Variety provides fulfillment of nutritional requirements, increases selectivity, helps ensure production, and distributes the period of use (Preacher 1978). Variety is best fulfilled by native plant communities. In contrast, food plots and feeders alone may have a negative effect on reproduction because of the lack of diversity of essential amino acids in the bobwhite's diet and can facilitate the spread of diseases. Research has shown that bobwhites use about 2% of feed from feeders. The rest is consumed by other animals (Guthery et al. 2004).

Food Accessibility: Bobwhites secure most of their food on the ground or from the layer of leaves and stems on the soil surface (Rosene 1969). If seeds are to be found by quail, they must be seen on bare ground or in litter that is sparse and can be moved easily (Rosene 1969). If seeds drop into a thick mat of stems and leaves they become inaccessible to quail. Bobwhite quail require at least 25% bare soil. Sandy soils provide better interspersion of plant canopies and bare ground than fine-textured (clay) soils.

Water Requirements

Surface water is not essential for bobwhites, although it may be used if provided. Water needs are usually met by succulent herbs, insects, dew, and snow (Rosene 1969). Also, metabolic water is produced during digestion and provides an additional source of water. Surface water such as ponds, creeks, and overflow from windmills produce micro-habitats, which can provide green, succulent vegetation and insects during dry or unfavorable weather conditions.

Interspersion

Bobwhites prefer habitat where herbaceous and woody plants are interspersed. The closer one requirement is to another results in less distance quail must travel for their needs. On sandy sites with native vegetation in central and western Oklahoma, interspersion is usually good if proper grazing and fire have been used. Optimal bobwhite habitat in central Oklahoma is composed of closely interspersed patches of grasses, forbs, vines, shrubs, and mottes of low-growing shrubs and trees (De Arment 1950). In the thinned woodlands of eastern Oklahoma (basal area of 40 to 60 square feet/acre) where frequent fire is used, woody sprouts will provide adequate interspersion of herbaceous and low woody plant growth (Cram et al. 2002).

Interspersion Criteria

The importance of interspersion depends on the habitat present. Patchy habitats with imbedded low woody structure require lower interspersion than patches that are of similar or homogenous vegetation structure.

The optimum amount of interspersion is as follows: 30 to 40% native prairie or early seral stage forest (dominated by grasses and forbs) in 5 to 20 acre patches; 40 to 60% in early to mid-seral stage prairie (high annual and perennial forb component) or cultivated crop fields in 1 to 5 acre patches; 5 to 20% brushy (shrubs or tree sprouts) cover in 0.25 to 1 acre patches; and 5 to 40% open woodland in 5 to 20 acre patches (Edminster 1954). Later research has shown the woodland or forest component to be unnecessary if shrubland species are present. These percentages and sizes have been used to construct ratings for the various habitat requirement quantities and an overall interspersion index. In typical agricultural operations that include pastures or croplands along with woodlands, interspersion is important. In brushy prairie interspersion is already present because each patch contains necessary elements (Guthery et al. 2001; 2002). In open woodlands where dispersed woody vegetation is abundant and less than 3 feet tall the interspersion criteria is met (Cram et al. 2002; Masters et al. 2002).

General Instructions

An overall limiting factor can be calculated from the values assigned to each habitat requirement. The overall limiting factor value is determined by selecting the lowest value assigned to any of the requirements. These values represent the general quality of habitat and identify the factor that is limiting the bobwhite quail population within the conceptual home range.

The following procedures describe the method for inventorying existing habitat conditions, rating the element criteria, and calculating the habitat quality and limiting factor values. Since the system is based primarily on the kinds, amounts, condition, and arrangement of plants, inventories should be performed during the growing season. However, habitat can be evaluated year-round as long as the observer conceptualizes growing season conditions. For example, nest cover should be evaluated during the nesting season. Thermal (protective) cover should be evaluated in the winter and late summer. This may be most critical because over winter survival affects the base population.

Ratings

Ratings for the various habitat criteria range from 1 (poor) to 10 (excellent). The number of ratings per criteria depends on the number of variables that can be practically measured and levels of management that can be practically applied.

Procedures

Step 1 - Determine the practicability of managing the bobwhite on the land unit of interest. For example, if the unit is in wheat or introduced pasture such as bermuda grass, it is not practical to manage for bobwhite quail without extensive vegetation change and expense. The procedures outlined in Overview of Bobwhite Quail Habitat Management (page 1) should aid in this decision.

Step 2 - Determine the intensity of management that you wish to use. Do you want high intensity management where bobwhite quail is the primary species of concern? Is the bobwhite a secondary species of concern behind beef cattle, goats, white-tailed deer, or a combination of species? Do you want moderately intensive management where farming and beef cattle or other combinations are the primary land use with bobwhite quail as a secondary land use? Or, do you wish to make few if any changes to your current operation and wish to provide the minimum habitat necessary to maintain bobwhite quail?

Step 3 - Select areas that represent the conceptual home range of bobwhite quail. The size of the home range will be determined by the intensity of the management that you want to use. If high intensity management is desired, small home ranges will be used. If medium intensity management is desired, medium-sized home ranges will be used, etc. Conceptual home ranges may be square, rectangular, triangular, or any other shape that is practical to evaluate and manage. The conceptual home range may consist of one field or may cross field or land use/cover boundaries. A single home range may represent the entire operating unit, or several home ranges may be superimposed over the entire unit. A portion of the operating unit may be evaluated by evaluating one or more conceptual home ranges. The designation of the conceptual home range, however, must always be within your operating unit and must always be within specified home range size limits.

Step 4 - Examine the home range area to assure that all required elements are present. If any element is missing, a "0" value is recorded on that element's quantity criteria rating, which means that the habitat is unsuitable for bobwhite quail unless that habitat element is going to be provided. Some requirements may be filled by more than one element. For example, native herbaceous plants (forbs, grasses, or legumes) fulfill the bobwhite quail's food requirement and brood habitat requirement. When this occurs, the criteria and rating will be adjusted to account for the situation.

Step 5 - Evaluate each required habitat element by matching habitat conditions with the ratings for the various criteria. Specific instructions are contained in the next section and the evaluation form.

Step 6 - Determine the limiting factor value, which is the lowest numeric value ranking within each requirement (e.g. nesting cover), for each requirement.

Step 7 - Determine the overall habitat value. This value is represented by the lowest value in the summary.

Step 8 - Assess the elements or criteria that are limiting or missing and prepare a management plan that addresses the limiting factors.

Instructions for Completing the Bobwhite Quail Habitat Evaluation Form

Bobwhite Quail

Home Range: 15 to 80 acres

Habitat Requirements: Nesting cover, brood habitat, protective cover, food, and interspersion.

Nesting Cover Criteria

Nesting cover quantity

Nesting cover is defined as any open native grass area where at least 10% of the plant community is composed of tall-mid perennial warm season bunch grasses, i.e., big and little bluestem, silver bluestem, broomsedge, splitbeard bluestem, Indiangrass, switchgrass, sideoats grama, weeping lovegrass, or others that reach a height of at least 8 inches at maturity. Nesting cover **does not** include cool season grasses, such as bromes, fescue, and wild ryes; warm season grasses such as uniolas, Old World bluestems, Johnson grass, buffalo grass, blue grama, vine mesquite, and bermuda grass or annual grasses such as crabgrass and sprangletops.

Note: The same area that provides food may also qualify for nesting cover, provided that the criteria for each requirement is met.

Nesting cover height (use by grazing, mowing, or burning) - rated for the nesting season (April 1 to September 30) and last year's growth.

Light - less than 25% (by weight) of the year's growth removed. Only part of the tops of grasses and other plants used (more than 8 inches stubble height for preferred grasses).

Moderate - 26 to 50% (by weight) of the year's growth removed (6 to 8 inches stubble height for preferred grasses).

Close - 51 to 75% (by weight) of the year's growth is removed (4 to 6 inches stubble height for preferred grasses).

Severe - more than 75% (by weight) of the year's growth is removed (less than 4 inches for preferred grasses).

Note: Quail usually nest in the dead growth of preferred warm season bunch grasses left from the previous growing season. Nests have also been observed in low density blackberry bushes surrounded by sparse grasses and forbs. Areas will not qualify as nesting cover unless at least some of the previous season's growth of preferred grass species remain prior to nesting (April 1-September 30).

Nesting cover diameter

Measures of nesting cover diameter can include more than one preferred plant if they are in close proximity (less than 6 inches apart).

Adequate - 12 inches or greater in diameter
Inadequate - less than 12 inches in diameter

Brood Cover Criteria

Brood cover quantity

Brood cover is defined as any area that provides lush green forage and associated insects during the time of brood rearing (June 30 to October 15). These areas are generally open, consisting of the new growth of native warm season forbs and grasses or cultivated crops.

NOTE: The same areas that provide either food or nesting cover may also qualify for brood cover, provided that the criteria for each requirement is met.

Screening cover

Screening cover is defined as the canopy provided by shrubs and warm season herbaceous plants (legumes, forbs, grasses, or crops) formed at a height above which the brood is foraging (6 inches).

Accessibility of cover to quail chicks

Open conditions beneath indicates that the brood can move freely beneath the herbaceous canopy, or that vegetation at less than 6 inches in height contains continuous trails or openings throughout the plant community.

Moderately open conditions indicates that the brood can move through the near ground vegetation only with some difficulty, or the vegetation at less than 6 inches contains trails or openings, but they are not continuous throughout the plant community.

Rank vegetative growth indicates that the brood can move through the near ground vegetation only with a great deal of difficulty, or the vegetation at less than 6 inches is matted and thick, with few or no trails or openings.

NOTE: Interpolations can be made if existing conditions do not precisely fit the criteria.

Protective Cover Criteria

Protective cover (escape, loafing, and thermal) quantity

Protective cover is defined as any woody plants or brush piles arranged densely enough to form a canopy that provides protection from predators and weather. These areas of protection, or coverts, must be at least 10 feet in diameter and must be fairly open beneath the canopy to permit easy movement by bobwhite. Protection from predators comes first from lack of being detected. Escape is second. Good nesting/loafing/brood rearing cover is protection from detection by predators.

NOTE: Protective cover requirements are most critical during the summer and winter, therefore cover should be evaluated in both seasons. Eastern redcedar (*Juniperus virginiana*) or ashe juniper (*Juniperus ashei*) with a canopy of at least 10 feet in diameter and touching the ground can be valuable protection for bobwhite during

ice and snow storms. One of these trees per 20 acres is sufficient; however the inherent ecological problems (invasiveness) that these juniper species cause will preclude their use on most land.

Protective cover composition

Living woody plants include live vascular plants whose woody stems are persistent throughout the winter. Trees with canopies close to the ground, half-cut trees, resprouting trees, shrub thickets, brambles and vines, and oak mottes are examples. In park like stands of trees, woody sprouts scattered throughout the understory provide good cover.

Brush piles may be included only if the pile forms overhead protection and the ground beneath the canopy is open to movement throughout the pile. Brush piles made without creating an open condition underneath will not qualify.

Protective cover canopy density

Canopy closure should be measured by selecting a representative area of protective cover (also referred to as a covert or motte). This may be a single low growing tree or shrub, but is usually a thicket or clump of woody plants. All measurements should be made at a height of no more than 3 feet. Canopy closures above that height do not provide adequate protection from predators or inclement winter weather. Closure at the sides of the cover is also important.

Canopy closure includes both canopy closure providing overhead protection above and canopy closure providing protection horizontally at the quail's level. Canopy closure estimates must therefore be made at 3 feet, a height which will account for both cover needs. The combination of covert size and canopy closure yielding the highest possible rating value should be recorded.

Protective cover diameter

The *covert or motte* should be about 30 feet in diameter to facilitate escape and thermal protection.

Food Criteria

Food abundance

Food is defined as the seeds of any of the important quail food plants listed in Table 2 (page 10).

Very abundant is defined as, if 100 paces were taken in a representative portion of the plant community, the foot would strike an important quail food plant on more than 50% of the paces.

Abundant is defined as, if 100 paces were taken in a representative portion of the plant community, the foot would strike an important quail food plant on 30 to 50% of the paces.

Moderately abundant is defined as, if 100 paces were taken in a representative portion of the plant community, the foot would strike an important quail food plant on less than 10 to 30% of the paces.

Sparse is defined as, if 100 paces were taken in a representative portion of the plant community, the foot would strike an important quail food plant on less than 10% of the paces.

Food diversity

The major food groupings are provided by species in Table 2. We assume that more functional groups (grasses, forbs, legumes, and woodys) equal greater diversity of food. Food plants are included in this criteria when it is not difficult to observe the presence of important food plants listed in Table 2 in a casual examination of the home range and when the abundance of those plants appears great enough to contribute to quail food needs.

Food accessibility

Light plant litter is defined as less than 50% coverage of the soil surface with dead leaves and stems from the previous season's growth.

Moderate plant litter is defined as 51 to 70% coverage of the soil surface with dead leaves and stems from the previous season's growth.

Heavy plant litter is defined as 71 to 90% coverage of the soil surface with dead leaves and stems from the previous season's growth.

Very heavy plant litter is defined as more than 91% coverage of the soil surface with dead leaves and stems from the previous season's growth.

NOTE: The area selected for estimating food accessibility must fall within the same boundary as where the majority of food is produced.

Interspersion

Interspersion index

The habitat elements that provide nesting cover, brood cover, protective cover, and food have greater value if they are in close proximity of each other throughout the home range. To measure the interspersion of these elements, use aerial photography or walking transects to determine the number of times the habitat components change along a north-south line and an east-west line at the widest part of the home range. If the area is a mosaic of prairie, shrubs, and trees, space transects close enough together to account for the diversity.

Table 2. Important Food Plants by Region.

Common Plant Name	Functional Group	Oak/ Hickory	Pine/ Hardwood	Cross Timbers /Tallgrass Prairie	Mixed/ Short-grass Prairie	Shinnery Oak	Sand Sage
Beefsteak plant	forb	X	X	X			
Crotons	forb	X	X	X	X	X	X
Dayflower	forb		X	X	X	X	X
Dock	forb	X	X	X	X		X
Goats beard	forb			X			
Golden waxweed	forb		X	X	X	X	
Lambsquarter	forb	X	X	X	X	X	X
Pigweed	forb	X	X	X	X	X	X
Pokeweed	forb	X	X	X			
Queens delight	forb			X	X	X	X
Ragweeds	forb	X	X	X	X	X	X
Smartweeds	forb	X	X	X	X	X	X
Snakeweed	forb			X		X	X
Spurges	forb	X	X	X	X	X	X
Sumpweed	forb	X	X	X			X
Sunflowers	forb	X	X	X	X	X	X
Three-seeded mercury	forb	X	X	X		X	X
Corn	grass	X	X	X	X	X	X
Crabgrass	grass	X	X	X	X	X	X
Dropseeds	grass			X	X	X	X
Foxtail	grass	X	X	X	X	X	X
Johnson grass	grass	X	X	X	X	X	X
Love grasses	grass	X	X	X	X		X
Panicums	grass	X	X	X	X	X	X
Paspalum	grass	X	X	X	X	X	X
Sorghums	grass	X	X	X	X	X	X
Sprangletops	grass			X	X		
Wheat/rye	grass			X	X	X	X
Cowpeas	legume				X		X
Desmodiums	legume	X	X	X			
Ground cherry	legume	X	X	X	X		
Hemp sesbania	legume		X	X			
Hog peanut	legume	X	X	X			
Milk pea	legume	X	X	X			
Native Lespedezas	legume	X	X	X			
Partridge pea	legume	X	X	X	X		X
Pencil flower	legume	X	X				
Soybean	legume	X	X	X			
Tephrosia	legume	X	X	X			
Vetch	legume	X	X	X	X	X	X
Wild beans	legume	X	X	X	X		X
Wild peas	legume	X	X	X			
Ash	woody	X	X	X			
Black locust	woody legume			X	X	X	X
Blackberry	woody	X	X	X			
Blackgum	woody	X	X				
Cherry	woody	X	X				
Chittamwood	woody	X	X	X	X	X	X
Dogwoods	woody	X	X	X	X		
Elderberry	woody	X	X	X			
Grapes	woody	X	X	X	X	X	X
Hackberries	woody	X	X	X			
Maple	woody	X	X				
Oak (acorns)	woody	X	X	X	X	X	X
Pine (seed)	woody		X				
Poison ivy	woody	X	X	X	X		
Sumac	woody	X	X	X	X	X	X
Sweetgum	woody	X					

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Bobwhite Quail Habitat Evaluation Form

Size of Home Range or Evaluation Area (Acres) _____

Management Unit Name _____

Management Unit Number _____

Type(s) of vegetative cover within home range or evaluation area (assign percent coverage).

Vegetation cover type	*Percent*
Prairie	
Shrubland	
Forest	
Introduced Pasture	
Cropland	
Other	

HABITAT REQUIREMENTS Essential habitat components needed for survival and propagation of bobwhite quail, these components include (A) nesting cover, (B) brood cover, (C) protective cover, (D) food, and (E) interspersion. Circle the lowest value and enter it in the box. Enter the score from each box on page 21.

A. NESTING COVER: Warm season tallgrass or midgrass.

Rating Criteria for Nesting Cover:

1. Nesting Cover Quantity - Evaluate the plant community.

	Value
30 to 50% or more of home range is a plant community with preferred grasses	10
20 to 30% of home range is a plant community with preferred grasses	7
10 to 20% of home range is a plant community with preferred grasses	4
1 to 10% of home range is a plant community with preferred grasses	2
Home range does not have plant community with preferred grasses	1

Lowest Value ☐ = A.1

2. Nesting Cover Height - Evaluate herbaceous height that will remain during nesting season.

Presence of last year's growth from April 1 to September 30.	Value
Degree of utilization Light or None (>8")	10
Degree of utilization Moderate (6 to 8")	8
Degree of utilization Close (4 to 6")	4
Degree of utilization Severe (<4")(check the appropriate box) grazing☐, mowing☐, or burning☐*	2

*Nesting cover that is burned or mowed during nesting season will be treated the same as severe utilization caused by grazing.

Lowest Value ☐ = A.2

3. Nesting Cover Diameter - Evaluate the diameter of the nesting cover. Can include one or more preferred plants if they occur within 6 inches.

	Value
One foot or greater in diameter (≥1)	10
Less than one foot in diameter (<1)	2

Lowest Value ☐ = A.3

B. BROOD COVER: Native herbaceous and woody plants and some agricultural crops.

Rating Criteria for Brood Cover:

1. Brood Cover Quantity - Evaluate the area for plants and insect abundance.	Value
40% or more of home range is a plant community with shrubs, warm season grasses, legumes, forbs, or crops	10
30 to 40% of home range is a plant community with shrubs, warm season grasses, legumes, forbs, or crops	8
20 to 30% of home range is a plant community with shrubs, warm season grasses, legumes, forbs, or crops	6
10 to 20% of home range is a plant community with shrubs, warm season grasses, legumes, forbs, or crops	4
1 to 10% of home range is a plant community with shrubs, warm season grasses, legumes, forbs, or crops	2
None of the home range is a plant community with shrubs, warm season grasses, legumes, forbs, or crops	0

Lowest Value [ ] = B.1

2. Screening Cover - Above height of a quail (6 inches).	Value
Canopy cover 50% or greater above height of 6 inches	10
Canopy cover 30 to 50% above height of 6 inches	8
Canopy cover 10 to 30% above height of 6 inches	6
Canopy cover 1 to 10% above height of 6 inches	2
No canopy cover above height of 6 inches	0

Lowest Value [ ] = B.2

3. Shrub, Grass, Forb, and Legume Accessibility - Below height of 6 inches (travel corridor).	Value
Open condition below a height of 6 inches	10
Moderately open condition below a height of 6 inches	5
Closed or rank condition below a height of 6 inches	0

Lowest Value [ ] = B.3

C. PROTECTIVE COVER (escape, loafing, and thermal): Shrubs, low growing trees, or brush piles.

1. Protective Cover Quantity - Evaluate the plant community area coverage.	Value
15 to 25% of the home range is comprised of woody plants	10
10 to 15% of the home range is comprised of woody plants	6
30 to 50% of the home range is comprised of woody plants	6
50 to 70% of the home range is comprised of woody plants	4
70% or greater of the home range is comprised of woody plants	2
10% or less of the home range is comprised of woody plants	2

Lowest Value [ ] = C.1

2. Protective Cover Composition - Evaluate the plant community.	Value
Living woody shrubs, low growing trees, or resprouting trees	10
Artificial cover including brush piles or shelters	4
Larger trees without extensive low growing stems or no woody plants within the home range	0

Lowest Value [ ] = C.2

3. Protective Cover Canopy Density - Evaluate the woody canopy closure.	Value
80% or greater canopy cover at 3 feet high	8
60% to 80% canopy cover at 3 feet high	10
40 to 60% canopy cover at 3 feet high	6
20 to 40% canopy cover at 3 feet high	4
Less than 20% canopy cover at 3 feet high	2

Lowest Value [ ] = C.3

4. Protective Cover Diameter - Evaluate woody cover.	Value
30 feet or greater diameter	10
20 to 30 feet in diameter	8
10 to 20 feet in diameter	6
10 feet or less in diameter	2

Lowest Value [ ] = C.4

D. FOOD: Seeds of native herbaceous and woody plants or crops.

Rating Criteria for Food:

1. Food Quantity - Size of food producing plant community.	Value
40% or more of home range is a food producing plant community	10
30 to 40% of the home range is a food producing plant community	8
20 to 30% of the home range is a food producing plant community	6
10 to 20% of the home range is a food producing plant community	4
1 to 10% of the home range is a food producing plant community	2
None of home range is a food producing plant community	0

Lowest Value [ ] = D.1

2. Food Abundance - Abundance of food producing plants (step transect).	Value
Food plants are very abundant and comprise 50% or more of plants in food producing area	10
Food plants are abundant and comprise 30 to 50% of plants in food producing area	8
Food plants are moderately abundant and comprise 10 to 30% of plants in food producing area	6
Food plants are sparse and comprise 1 to 10% of plants in food producing area	4
Food plants do not occur within home range	0

Lowest Value [ ] = D.2

3. Food Diversity - Based on occurrence of 4 major food groups within the native plant community. (grasses, forbs, legumes, and woodies)	Value
Food plants represented by all 4 of the major food groups	10
Food plants represented by 3 of the 4 major food groups	7
Food plants represented by 2 of the 4 major food groups	5
Food plants represented by 1 of the 4 major food groups	2

Lowest Value [ ] = D.3

4. Food Accessibility - Availability of seed is dependent on the percent of bare ground.	Value
75% or more of the ground is bare	10
50 to 75% of the ground is bare	7
25 to 50% of the ground is bare	5
25% or less of the ground is bare	2

Lowest Value [ ] = D.4

E. SPATIAL ARRANGEMENT: The spatial arrangement of herbaceous and woody cover provides the habitat components including nesting cover, brood habitat, protective cover, and food.

Rating Criteria for Spatial Arrangement:

1. Do nesting cover, brood cover, protective cover, and food usually occur within 150 feet of each other?

	Value
Yes	10
With in 300 yards	5
No	0

Lowest Value [ ] = E.1

2. Distance to woody protective cover. What proportion of the area is within 150 feet of protective cover?

	Value
≥80%	10
>60 to 79%	8
>40 to 59%	6
≥20 to 39%	4
<19%	0

Lowest Value [ ] = E.2

Summary of Limiting Factors for Bobwhite Quail

Criteria	Rating score from evaluation form	Management Recommendations
A. Nesting Cover		
A.1. Nesting Cover Quantity	☐	**D,E**
A.2. Nesting Cover Height	☐	**B,C**
A.3. Nesting Cover Diameter	☐	**B,C***
B. Brood Cover		
B.1. Brood Cover Quantity	☐	**A,B,C,E,I,J**
B.2. Screening Cover	☐	**B,C,E,I,J**
B.3. Shrub, Grass, Forb, or Legume Accessibility	☐	**A,C,I,J**
C. Protective Cover		
C.1. Loafing Cover Quantity	☐	**A,E,F,G,H***
C.2. Loafing Cover Composition	☐	**E,F**
C.3. Loafing Cover Density	☐	**I,L**
C.4. Diameter	☐	**I**
D. Food		
D.1. Food Quantity	☐	**A,B,C,D,E,I,J,K**
D.2. Food Abundance	☐	**A,B,C,D,E,I,J,K**
D.3. Food Diversity	☐	**A,B,C,D,E,I**
D.4. Food Accessibility	☐	**A,B,C,I,J,K**
E. Spatial Arrangement (a.k.a., interspersion)		
E.1. Do nesting cover, brood cover, protective cover, and food usually occur within 150 feet of each other?	☐	All practices
E.2. Distance to woody protective cover	☐	**D,E,F**

* Rating maybe indicative of site limitations, checked Ecological Site Guide.

The lowest habitat element score equals the limiting factor value for bobwhite quail habitat in the home range being evaluated. Some elements cannot be changed because of soil type or site degradation from soil erosion. Adequate habitat should be maintained on 5,000 acres to have a viable bobwhite population. Since many people do not own this amount of land, neighbors should be involved to make habitat management work for the bobwhite quail.

Land Management Practices to Correct Limiting Factor(s)

A. Prescribed Fire: Of all the management options available to land managers, none have more potential to restore and maintain bobwhite quail habitat. Prescribed fire is an inexpensive and natural process that can be used to manipulate the various habitat elements that are important to the bobwhite. Fire can stimulate food producing plants such as forbs, increase insect abundance, change the structure of woody vegetation, and increase the amount of bare ground. Fire will also control invasive plants such as eastern redcedar. See OSU publications:

E-927 Using Prescribed Fire in Oklahoma
E-947 Invasion of Oklahoma Rangelands and Forests by Eastern Redcedar and Ashe Juniper
F-2876 Eastern Redcedar Control and Management – Best Management Practices to Restore Oklahoma's Ecosystems
F-2877 Fire Effects in Oklahoma
F-2878 Fire Prescriptions for Maintenance and Restoration of Native Plant Communities

B. Prescribed Grazing: Proper grazing management cannot be emphasized enough. Without proper grazing, bobwhite habitat cannot be managed and fuel for prescribed fire cannot be maintained. Moderate, light, or no stocking may be appropriate depending on the Ecological Site and regional location. In some situations, primarily in areas exceeding 30 inches of annual precipitation, no grazing will result in habitat degradation because the vegetation becomes too thick. Grazing systems that encourage even grazing distribution (cell grazing, multi-paddock grazing, management intensive grazing, etc.) should be avoided. Continuous stocking at a moderate to light stocking rate will provide adequate habitat structure and composition. See OSU Publications:

E-926 Grazing Management on Rangeland for Beef Production
F-2871 Stocking Rate: The Key to Successful Livestock Production
F-2875 Intensive Early Stocking

C. Patch Burning or Rotational Grazing Without Fences: The fire-grazing interaction is as old as our native plant communities and is how the system was managed by Native Americans for thousands of years. The concept is simple: Burn part of an area and let the grazing animals go where they wish, which will be the burned area. The next year burn a different area, the same thing will happen. The area burned the previous years will be temporarily dominated by forbs (i.e. weeds), which make excellent brood cover, foraging areas, seed production, and bare ground. In areas of 25 inches of rainfall or greater, a 3-year rotation works well. For areas with less than 25 inches, a four or five year rotation will be needed. This management system provides all of the habitat elements except for woody cover. Woody cover, depending on the plant species and region (soils/climate), will be burned with a different frequency or left unburned. Livestock performance on patch burning is similar to other grazing systems and provides control of sericea lespedeza, a noxious weed. See OSU Publications:

Patch Burning: Rotational Grazing without Fences
F-2873 Ecology and Management of Western Ragweed
F-2874 Ecology and Management of Sericea Lespedeza

D. Establishing Native Warm Season Grasses, Forbs, and Legumes: Establishment in cropland coming out of crop production provides nesting cover, brood cover, and food. If adjacent woody cover is available, all of the bobwhite's requirements can be met. However, trying to establish native plants into introduced planting such as bermuda grass, Old World bluestem, or tall fescue is possible but expensive and difficult. Established stands of introduced plants will probably need to be cultivated and chemically treated with herbicides for several years to eliminate introduced plants. See USDA-NRCS for conversion guidelines. Also see OSU Publication:

F-2581 Reseeding Marginal Cropland to Perennial Grasses, Forbs, and Legumes

E. Forest Thinning and/or Creating Opening in Native Forests: Many forests are too thick to provide bobwhite habitat. The removal of trees by commercial thinning or prescribed fire is necessary to restore and maintain forests and bobwhite habitat. Trees should be thinned to 40 to 60 square feet of basal area per acre to meet the bobwhite's habitat requirements. This treatment will result in sprouting woody plants for cover, increases in grass for nesting cover, and increases in forbs for brood and adult food and cover. In areas where the historical forest has been removed by farming, dozing, or herbicides, consult with a forester for the appropriate native trees needed to restore the Ecological Site. See OSU research publication: Pushmataha Forest Habitat Research Area.

F. Restoring Native Woody Plants: Planting woody plants in prairies or shrublands should only be done to restore areas that historically had a woody component (see NRCS Ecological Site Guides). In areas that normally support native woody vegetation (Figure 1) such as sand plum, sand shinnery oak, or sand sagebrush, use the USDA-NRCS Ecological Site Guides to determine the appropriate species. Some species may not be available for purchase.

G. **Brush Pile Construction**: Constructing brush piles can provide protective cover for bobwhite but are short-lived and should be accompanied by planting native woody plants for long-term benefits. Brush piles can be constructed from a variety of material including downed trees, old fence post, and wooden pallets. For brush piles to be functional for bobwhite quail they must be elevated 8 to 12 inches off of the ground. Brush piles can be elevated by using base supports from tree trunks, cinder blocks, boulders, and/or pipe. Brush piles are labor intensive and expensive to construct.

H. **Herbicide Application:** Herbicide can be an effective tool to reducing woody cover and controlling invasive plants. Herbicide is often used in combination with prescribed grazing and prescribed fire in a management system. Herbicide is relatively expensive and is seldom needed when an appropriate fire program is used. Herbicide use must follow all label instructions.

I. **Strip Disking**: Strip disking in late winter is routinely used to disturb the soil which creates early successional plants such as annual forbs (i.e. weeds), which provide excellent brood cover and food resources/accessibility (bare ground). Strip disking is relatively inexpensive and works better than food plots. Disking around sand plum thickets will cause the plum thicket to increase in size and density. Patch burning will provide the same benefits and reduce the costs even more.

J. **Planting Food Plots:** Food plots are commonly used to attract and concentrate birds for harvest. Food plots can serve as an emergency food source during times of extended snow/ice coverage provided seeds remain in heads above the snow/ice. Attempting to increase habitat suitability with food plantings can be an expensive practice with outcomes marginal at best. Manipulating native vegetation through proper grazing, prescribed burning, timber thinning, and patch burning are less expensive practices that have a longer life expectancy. For intensive quail management, a 1 acre food plot is recommended for every 15 to 30 acres of habitat. Food plots intended for bobwhite quail should be located within 50 yards of escape cover. Commonly planted warm season crops include corn, sunflowers, soybeans, Proso millet, browntop millet, and milo. Because they typically provide overhead canopy, bare ground, and attract insects, warm season plantings can provide brood rearing habitat.

K. **Feeders**: Bobwhite quail feeders concentrate coveys and make them easier to find when hunting. However, research has shown that only about 2% of the food in feeders is eaten by bobwhite quail. The rest of the food is eaten by non-targeted wildlife such as raccoons, white-tailed deer, mourning doves, rodents, and other critters that can reach the feeder. Although feeders are popular, they are expensive to maintain and are a distraction from restoring or maintaining bobwhite quail habitat. Research has also shown that feeders will not increase the quail population.

L. **Fence Exclusion:** Woody cover mottes may appear sparse or thin as a result of damage from livestock. Shrubs that have been broken are often indicative of livestock damage. Livestock damage can be corrected by erecting a fence for the purpose of exclusion. However, this practice has been shown to have negative impacts on bobwhite quail and lesser prairie-chicken because of collisions with fences.

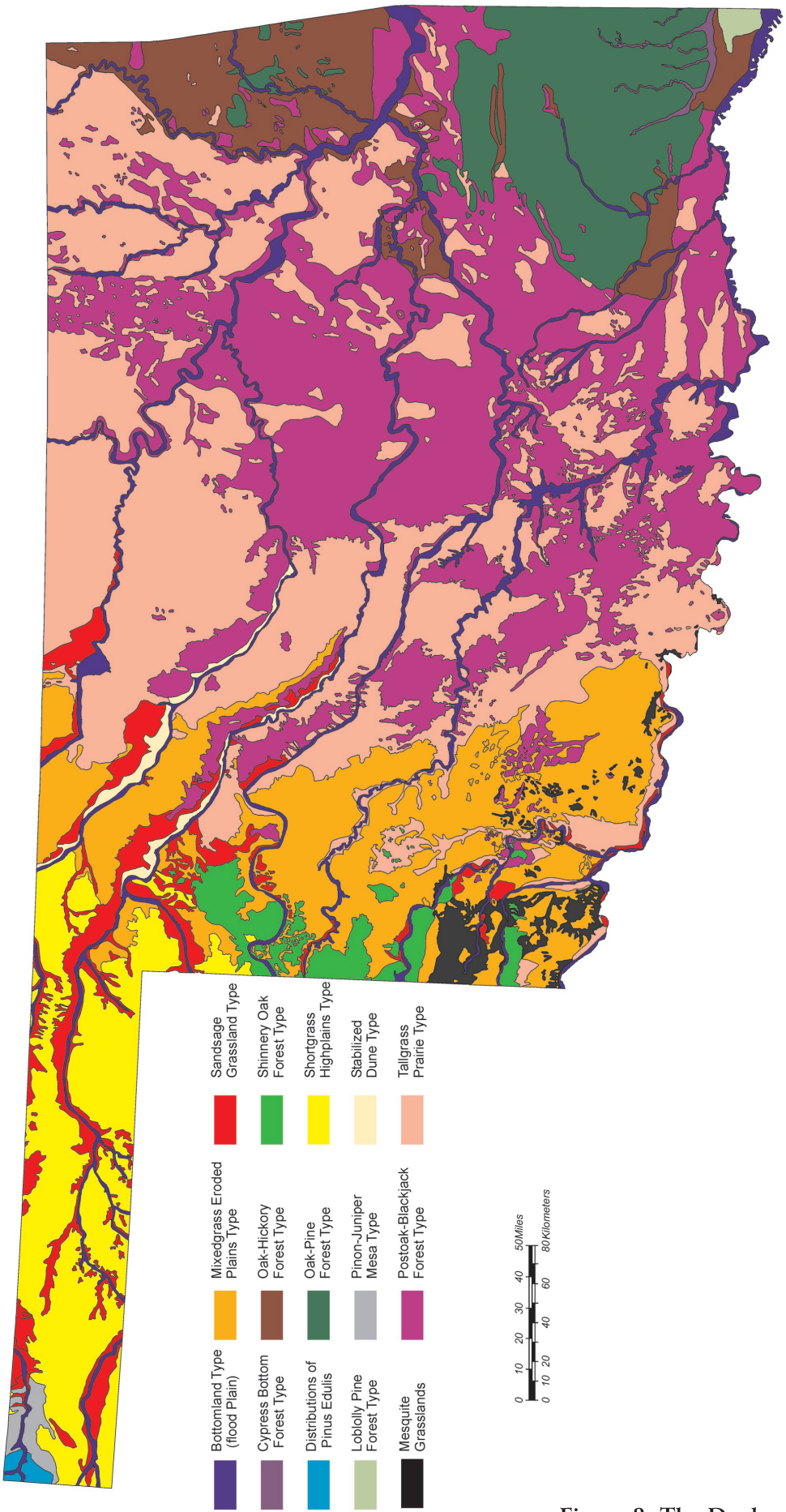
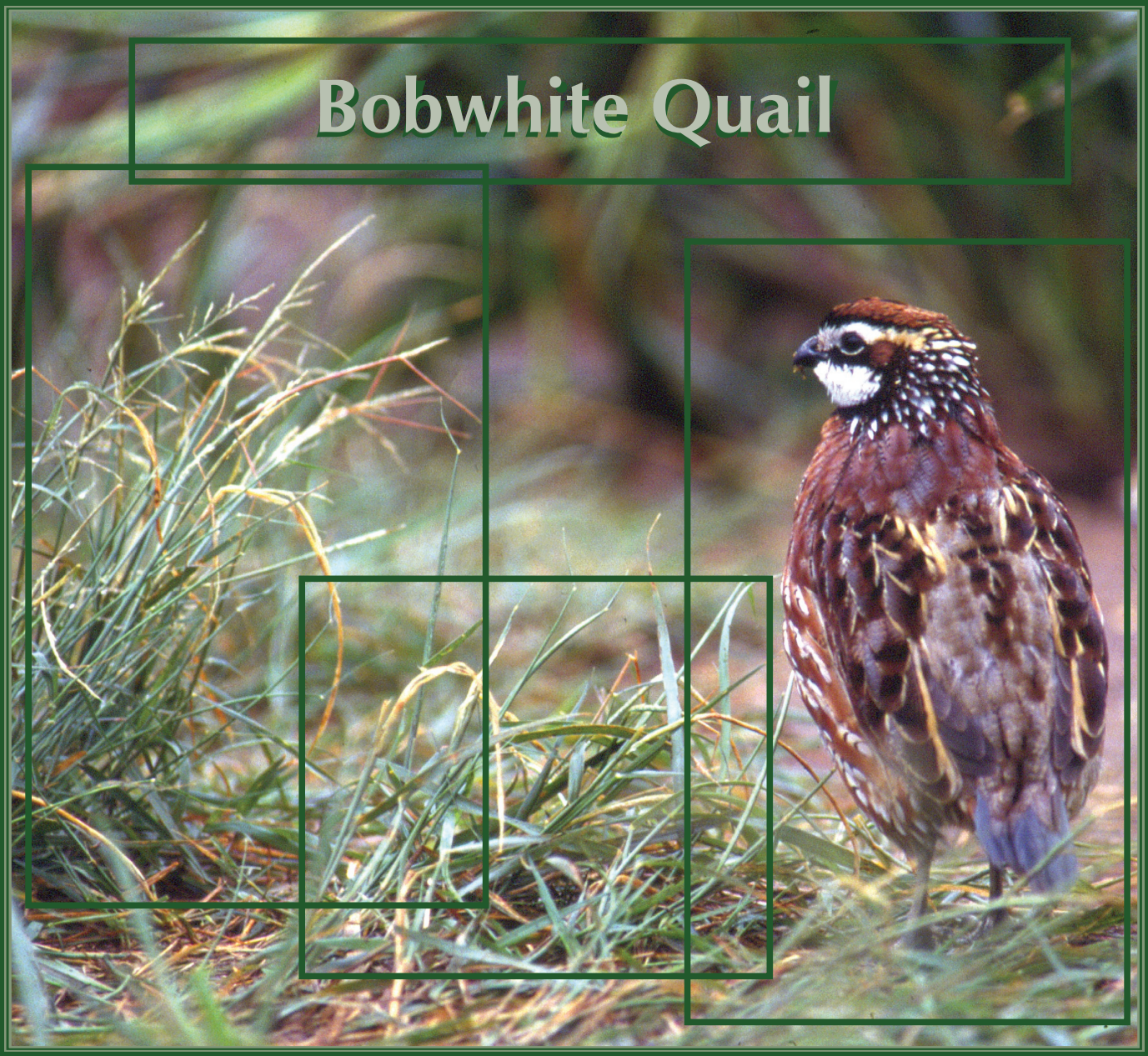


Figure 2. The Duck and Fletcher Map.

Bobwhite Quail



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