Landscape Features Influencing the Decline of Bobwhite Quail in Iowa

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Abstract

The southern region of Iowa has long been an area that has provided viable habitat for bobwhite quail (*Colinus virginianus).* In recent years the number of bobwhite have declined dramatically. This has resulted in an increasing pressure to address the decline in bobwhite populations in Iowa. This study uses geographic information systems to determine changes in land use for 72 randomly selected sections in the southern 1/3 of Iowa. This study gains an understanding of how changing agricultural practices have altered the landscape in Iowa's quail range. Aerial photography from the 1940s, 1960s and 1980s were used for this study. FRAGSTATS was used to analyze summary data from each year after conversion to grids.

Introduction

The bobwhite quail (*Colinus virginianus),* hereafter called bobwhite, stand about six inches tall and have a body length of about eight inches. They are mostly chestnut brown, white and black, with a brown graying toward the tail. Bobwhites eat large amounts of weed seeds (ragweed, beggarweed, foxtail, switch grass, pigweed and others), insects, and waste grains (corn, wheat, grain). Bobwhite discover food by scratching through ground litter.

A typical bobwhite grouping or covey will contain 10 to 30 birds; the birds range up to a quarter-mile daily and live on 10 to more than 100 acres of land. A covey of birds function as a unit. They forage the same areas, loaf in the same cover and roost together at night. This makes habitat a very critical component of a successful covey.

Bobwhite are heavily dependent on the availability of viable winter habitat. Without adequate food and cover (habitat), the population will not flourish; thus when winters are hard and long, bobwhite numbers plummet. Taylor and Burger (2000) found in the winter season bobwhite tend to occupy landscapes exhibiting great heterogeneity, patch diversity, and interspersion of small, complex patches of grassland, row-crop and wooded habitats. The lack of these habitat qualities combined with several hard winters may cause widespread mortality.

Bobwhite have long been an important economic and recreational resource for the state of Iowa. The decline of the bobwhite population over the last couple of decades has resulted in increasing pressure to address the issue. It is estimated over the last 3 decades the number of Iowa Quail hunters has

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declined 29%, total harvest is down 71%, and harvest per hunter has declined 62% as illustrated in Table 1 (Bogenshutz, 2001).

Table 1. Mean hunters, harvest, and harvest per hunter for quail the last 30 years in Iowa.

Period	Hunters	Harvest	Harvest/ Hunter
1967-76	88,126	867,589	10.22
1977-86	77,198	420,252	5.15
1987-96	62,558	252,875	3.91

Bobwhite population declines have been noted throughout most of their range since the 1960s (Brennan, 1991; Church at al., 1993). Most studies indicate that changes in bobwhite abundance are related to changes in availability of various habitat components (Kabat and Thompson, 1963; Vance, 1976; Exum et al., 1982; Klimstra and Rosenberry, 1975). Taylor and Burger (2000) noted anthropogenic actions in agriculture ecosystems, alters both the composition and structure of landscapes. These actions tend to simplify and reduce landscape heterogeneity. Old farming practices allowed for a variety of crops, thick hedgerows, brushy fields and pasture lands. Recent trends toward larger holdings and clean-farming (all ground is in production) have reduced the diversity of food and cover which bobwhite prefer. The recent increases in row crops have come at the expense of other essential habitats. This has resulted in an overall decrease in habitat quality throughout much of the bobwhite range. Vance (1976) noted more than a sevenfold increase in hectares of soybean and nearly total elimination of grasses from 1939 to 1974 in a 1,000 hectare area in southeastern Illinois.

The Pennsylvania Game Commission emphasizes brush and abandoned fields, open pinelands, and farms as preferred habitat. They label the bobwhite as a “bird of farmland.” The Game Commission concludes ideal bobwhite habitat consists of 30-40 percent grassland, 40-60 percent cropland, 5-20 percent brushy cover, and 5-40 percent woodland, with all types of vegetation well mixed. Bobwhite require dense brush for protection from predators and shelter while open grass or weedy areas provide nesting habitat.

The future of the bobwhite population in Iowa depends on agricultural practices and their impacts on land use. Leopold (1933) noted changes in land use have resulted in loss of habitat and ultimately decline of the bobwhite population in northern Iowa in the late 1800s and early 1900s. This decline becomes especially critical in the winter seasons, when bobwhite are most reliant on quality habitat. Row crops such as soy beans, corn, wheat, and milo have been recorded as important winter foods for bobwhite (Stoddard, 1931; Rosene, 1969; Exum et al., 1982).

This study investigates how land use practices in southern Iowa have changed from the 1940s to the 1980s. It is widely believed current farming practices have detrimentally altered the habitat of bobwhite. This project provides more information in regard to land use changes that have occurred in the study area. Previous research has been limited in quantifying changes in land use for the state of Iowa. Through the use of aerial photos and interpretation, this project will quantify changes that have occurred over time. This project identifies significant changes in land use that may have aided the decline in bobwhite populations in

southern Iowa. Understanding changes in land use from the past 40 years may provide valuable information for future management plans in hopes of restoring bobwhite populations to southern Iowa.

Data Collection

Aerial photography was acquired from the Iowa Department of Natural Resources. All data were developed through aerial photo interpretation from acquired photos.

Habitat Data

The habitat data were developed using the ArcView digitizer extension. Aerial photography varied in quality depending on the year they were taken. Photos from the 1940s tended to be of the lowest quality, with the resolution of the photo being the main problem. This made determination of land use difficult in certain instances. The photos from the 1960s had the best overall clarity, allowing for much easier interpretation. The 1980s photos were of quality between the 1940s and 1960s photos. To remain consistent, all land use interpretation of the photos were performed by the same individual.

Methods

A random sample of 72 public land survey sections in Iowa's southern bobwhite range were obtained for analysis (Figure 1). Aerial photography (1:20,000 scale) was obtained from local or national USDA-NRCS offices for each selected section. Photos covering three time periods, the 1940s, 1960s, and 1980s, were collected for each section. Land use classifications were established using categories most often reported in the literature as being meaningful to bobwhite (Taylor and Burger, 2000). The initial classifications consisted of the following:

110 Cropland (Tilled)
111 Row Crop (Corn, Soybeans)
112 Small Grains (Oats, Hay)
120 Pasture (Cleared, not tilled)
122 Pasture (<25% Woody)
123 Pasture (26%-50% Woody)
124 Pasture (51% - 75% Woody)
125 Pasture (>76% Woody)
126 Grass Strip (Waterway)
127 Grass Fallow
200 Farmstead (Barn, Buildings, Farmyard)
311 Wooded Strip
312 Wooded Block
320 Fallow (Ungrazed-under 1/3 Brush)
330 Fallow (>1/3 Cover is Brush/Small Trees)
340 Sand
410 Road Right of Way (Grass)
420 Road Right of Way (Wooded)
430 Road Right of Way (Grass/Wood)
500 Water (Pond, lake, stream)
600 Other (Developed-towns, cemetery)
710 Railroad Right of way (Grass)
720 Railroad Right of way (Wooded)
730 Railroad Right of Way (Grass/Wood)

Figure 1. Project Study Area.

The corner coordinates of each section were placed into an ArcView project to allow for spatial registration of the mylar depicting land use for each section. All land use interpretation

information were then transferred onto the mylar using a fine tipped marker.

After completion of interpretation, the mylar were placed on the digitizing board and the section corners marked on the mylar were registered to the appropriate section corners stored within the ArcView project. Following accurate registration, all data were digitized and attributed with land use code within the ArcView project. Individual coverages were created for each section from each year. Upon completion of digitizing, Arc/Info tools were utilized to clean and build each coverage.

All photos were interpreted following the same procedure. Features were outlined as polygons and coded with the appropriate land use code. Linear features such as streams, small roads, grassy/woody strips were identified using a thin dashed line.

Each Town/Range/Section in the study area contained coverages representing land use from the 1940s, 1960s and 1980s. Arc/Info tools were used to merge and create land use coverages from each time period for the study area. These coverages contained land use information based on initial land use classifications. Additional fields allowed for grouping of land use classes to more general categories.

Two fields were added reducing the number of land classifications from 24 to 15 and 10 respectively. The addition of these fields was due to the difficulty in obtaining the same level of detailed land use description off of photos from different years. This required grouping of more specific land use classes into more general categories. The field consisting of 15 land use classes was used for analysis of changes in land use over time. Arc ToolBox was used to generate summary statistics for these 15 land use classes. Grouped land use classifications consisted of the following:

110 Cropland (Tilled)
120 Pasture (Cleared, not tilled)
122 Pasture (<25% Woody)
123 Pasture (26% - 50% Woody)
124 Pasture (51% - 75% Woody)
125 Pasture (>76% Woody)
126 Grass Strip (Waterway)
311 Wooded Strip
312 Wooded Block
320 Fallow (Ungrazed -- Under 1/3 Brush)
330 Fallow (>1/3 Cover is Brush/Small Trees)
410 Right of Way (Grass)
420 Right of Way (Wooded)
500 Water (Pond, Lake, Stream)
600 Other (Developed-towns, cemetery, etc.)

In addition, coverages were converted to Grids (5 meter cell size), using Arc Toolbox. These grids were used for analysis with Fragstats software (McGarigal and Marks. 1994). Fragstats allows quantitative comparisons of patch, class, and landscape structural makeup of landscapes. Coverages were converted based on land use classification containing 10 different classes and consisted of the following:

110 Cropland (Tilled)
120 Pasture (Cleared, not tilled)
122 Pasture (<50% Woody
124 Pasture (>50% Woody)
126 Grass Strip
312 Wooded
320 Fallow (Ungrazed -- Under 1/3 Brush)
330 Fallow (>1/3 Cover is Brush/Small Trees)
500 Water (Pond, Lake, Stream)
600 Other (Developed-towns, cemetery, etc.)

Results

Summary statistics generated by Arc Toolbox allowed for analysis of land use and changes in land use over time. Just over 74,000 acres of land were digitized for analysis in this study. The study area

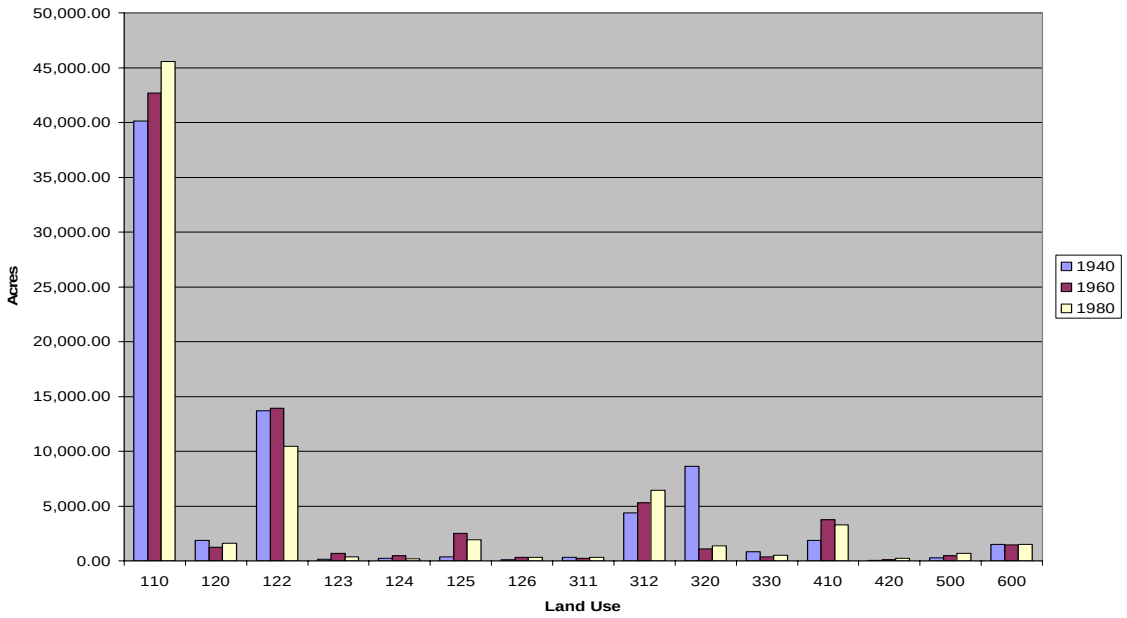


Figure 2. Yearly comparison of land use acres.

was consistent for each of the three time periods. The majority of land use consisted of cropland in each of the three time periods. Cropland accounted for just over 40,000 acres in the 1940s, nearly 43,000 acres in the 1960s and 45,500 acres in the 1980s (Figure 2). Changes were also observed in the range habitat category. Combining all types of range habitat, a reduction of habitat over time was found. In the 1940s, just over 16,300 acres of range were present. By the 1980s, range habitats were reduced to just over 14,400 acres of land, a 12% loss.

Changes over time in land use effect the composition of a landscape. These changes can affect landscape habitat suitability for a particular species depending upon its habitat requirements. In terms of overall landscape classification, cropland made up 54% of land use in the 1940s, 57% in the 1960s, and 61% in the 1980s (Figure 3). This 7% increase in relation to the overall landscape was the largest increase of any one particular land use found in this study. After investigating each individual section, the largest increase in cropland from the 1940 photo to the 1980 photo was found to be 38%. The largest decrease in cropland for any one section was found to be negative 15%.

The largest loss of a single land use in terms of landscape for the entire study area occurred in fallow land. In the 1940s, fallow land made up nearly 12% of the overall landscape. By the 1980s, fallow lands had been reduced to only 1.8% of the overall landscape (Figure 3).

The largest loss in terms of overall acreage of land use was found in fallow land (Ungrazed - under 1/3 brush). In the 1940s, just over 8,600 acres existed. By the 1980s this number had been reduced to less than 1,400 acres. This is a loss of 7,200 acres, accounting for a decrease of over 83%. Another significant loss was found in pastureland (<25% woody). In the 1940s, over 15,000 acres of pastureland existed. By the 1980s, this land use had been decreased to just over 12,000 acres,

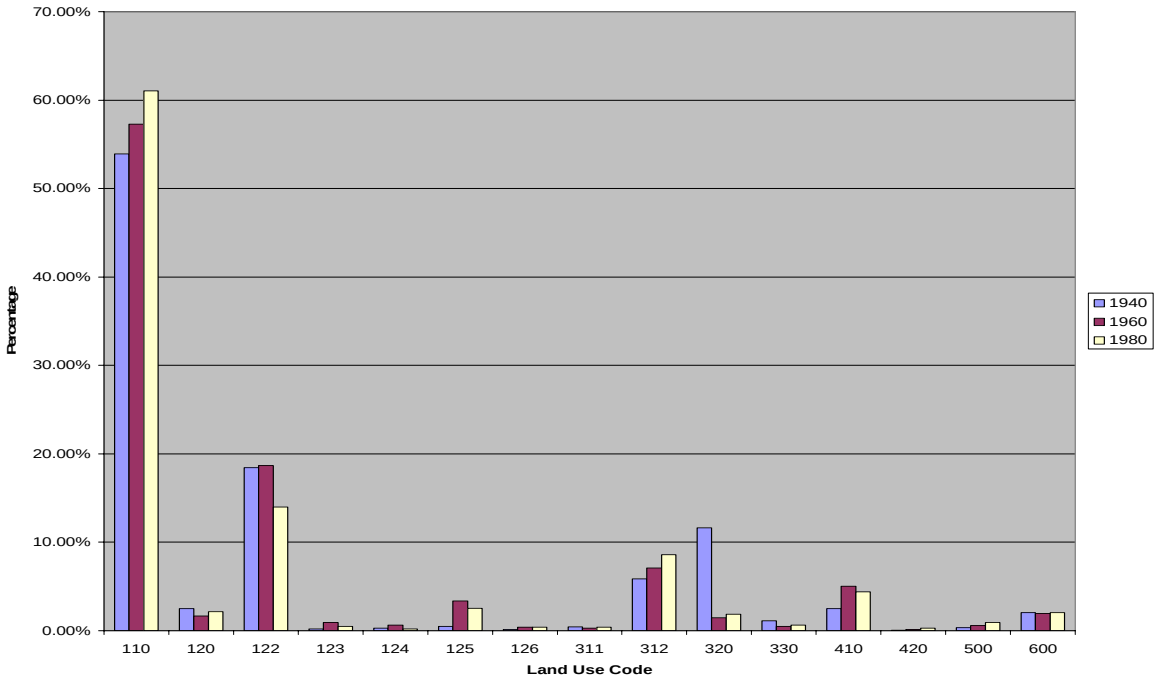


Figure 3. Yearly comparison of percent land use composition.

a 20% decrease.

The largest increase of land use in terms of overall acres occurred in cropland. From the 1940s to the 1980s less than 5,500 additional acres of farmland were created in the study area; this is a 14% increase. Increases in wooded habitat were also found. From the 1940s to the 1980s just over 2,000 additional acres of wooded habitat were found, an increase of 32%.

In addition, average habitat patch sizes were determined (Figure 4). The most significant changes were found in the reduction in the average size of pastureland (<25% woody), woody block, fallow (<1/3 brush/trees) and oldfield (>1/3 brush/trees). The average size of pastureland (<25% woody) in the 1940s was found to be nearly 30 acres. By the 1980s, this same land use averaged just over 14 acres in size; this was not even half of the original patch size. The average size of woody habitat in the 1940s was found to be just over 23 acres. By the 1980s, this same habitat was found to average 14 acres in size. The average size of fallow fields were slightly larger than 18 acres in the 1940s and has decreased to 3.5 acres in the 1980s. The average size of oldfield was approximately 13 acres in the 1940s and decreased to 3.5 acres in the 1980s (Figure 4).

Slight increases were realized in the average size of cropland fields from the 1940s to the 1980s. The average size cropland field in the 1940s was found to be about 16 acres, while in the 1980s, the average cropland field was 18 acres. In the 1960s, the average cropland field was found to be 13 acres.

Analysis of the small linear features showed very similar values from all years (Figure 5). Linear features consisted of small creeks, road-side ditches (grassed or wooded) or grass strips. Some linear features were difficult to identify due to the quality of the photo.

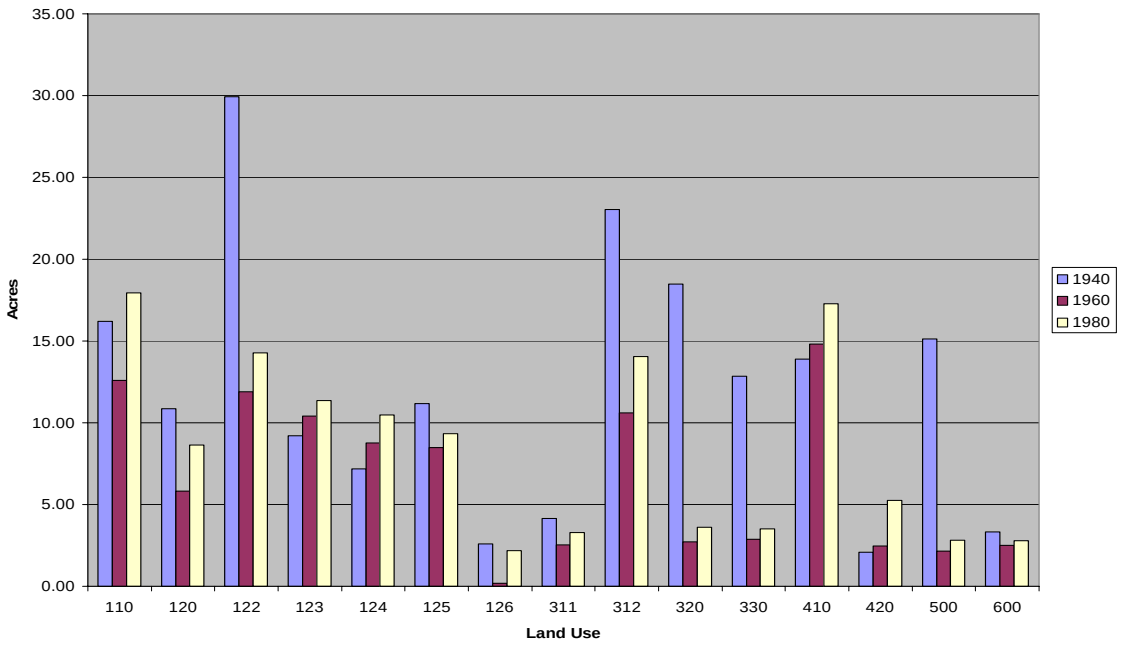


Figure 4. Yearly comparison of average patch sizes.

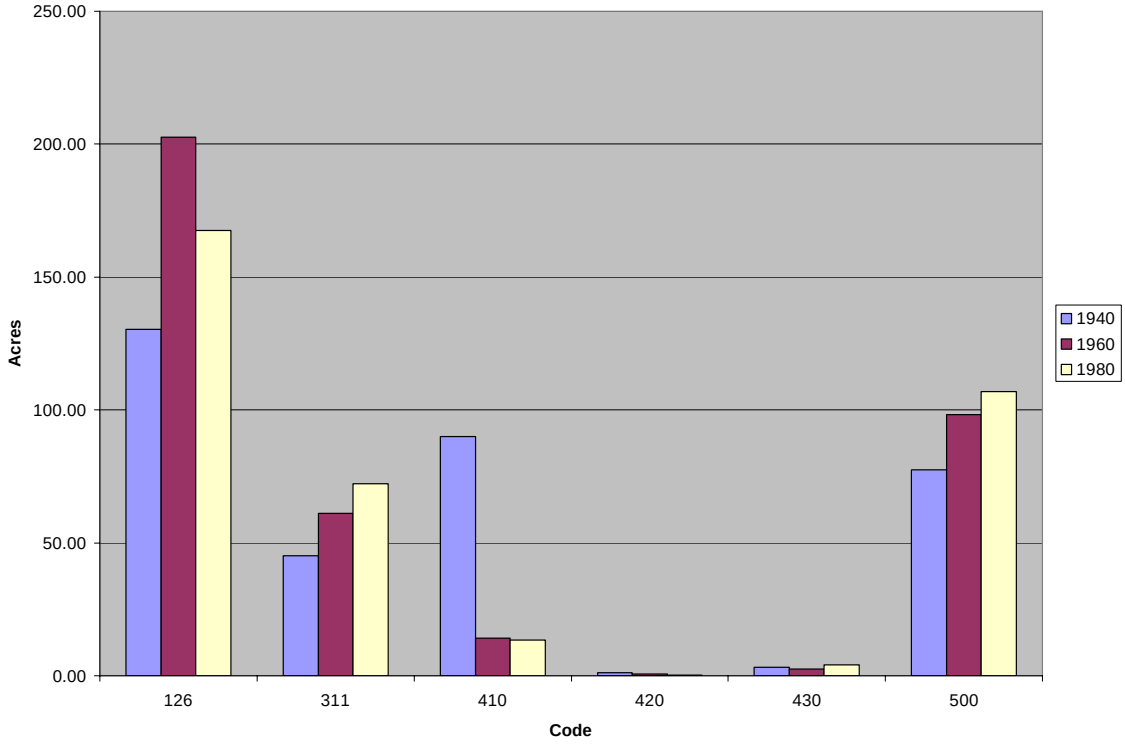


Figure 5. Yearly comparison of linear features.

Section Comparison

Due to the fact that land use interpretations were performed on a section by section basis, random sections were selected for brief analysis. All previous analysis evaluated all sections as a whole. These sections were not a continuous geographic area. In total, this study consisted of 72 sections in the southern half of Iowa. By analyzing a single section for changes over time, at a localized level, one could see how the landscape is changing. Land use managers could use this information to analyze on a small scale how changes have occurred and subsequently develop management plans based on these changes.

The first section analyzed was located in the south western portion of Iowa. This section showed major changes in land use from the 1940s to the 1980s. The most significant changes were found in cropland, pastureland, and woodland. In the 1940s, cropland made up 35%, pastureland 25%, and woodland 33% of the landscape. In the 1980s, these same land use categories changed significantly in their composition of the landscape, whereby cropland made up 66%, pastureland 7%, and woodland 18%, respectively (Figure 6).

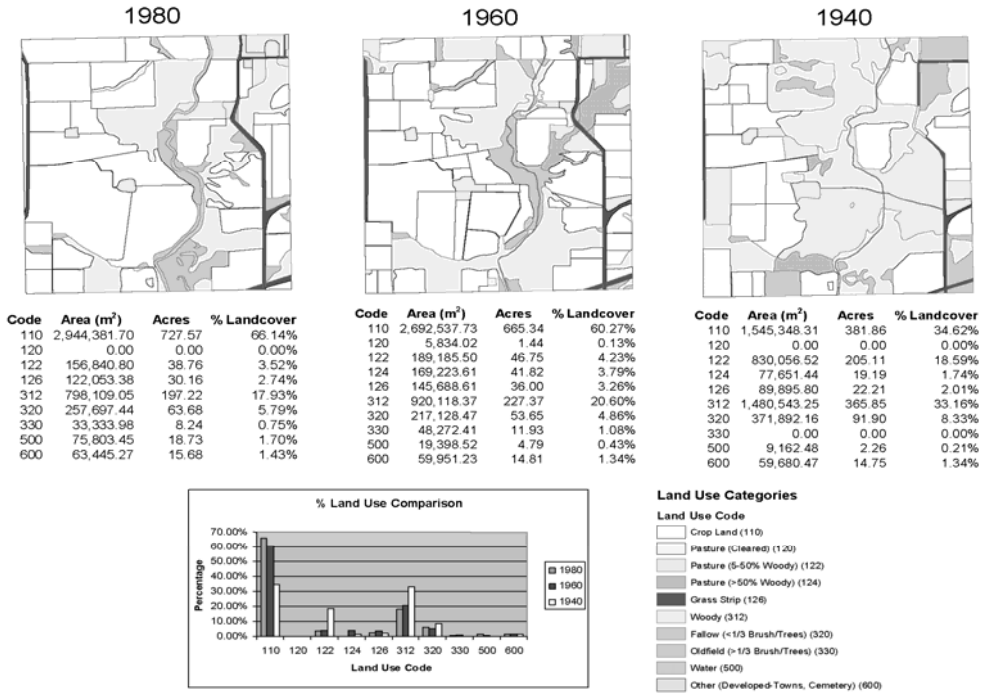
The next section, located in south central Iowa, showed more gradual changes than the first section. The most significant changes were again seen in cropland, pastureland, and woodland. In the 1940s, the landscape consisted of 49% cropland, 48% pastureland, and < 1% woodland. By the 1980s, the landscape had changed to consist of 55% cropland, 33% pastureland, and 6% woodland (Figure 7).

Fragstats/SAS Analysis

After conversion of data to grid format, all sections were grouped by year and analyzed using Fragstats. The initial Fragstats analysis returned values for all available variables in the class and land metrics. It was determined that the information returned for the land metrics would not be valuable for this study due to the fact the that sections were not a continuous geographic area. Furthermore, analysis in SAS statistical program, would be conducted on the 72 variables returned from the class metric in Fragstats.

These results were collected and prepared for a principal component factor analysis in SAS. The goal of the factor analysis was to reduce the number of variables and to identify relationships between variables that make up the landscape. The 72 variables identified in Fragstats were analyzed using SAS software. Due to the high number of variables identified in Fragstats, SAS was used to look for correlations between these variables. Analysis of correlation, determined the total number of relevant variables to be 30. Correlations values greater than .60 were deemed significant and removed from further analysis. These 30 variables were isolated and further studied using SAS.

Principal component factor analysis was performed for each year class on the 30 remaining variables from the class metrics. The analysis revealed 3 factors explained 75% of the total variance in the class metrics from the 1940s. The same analysis determined 3 factors accounted for 70% of the total variance in both the 1960s and 1980s. Further analysis revealed the variables that made up these factors differed slightly from the 1940s to the 1960s and 1980s (Table 2).

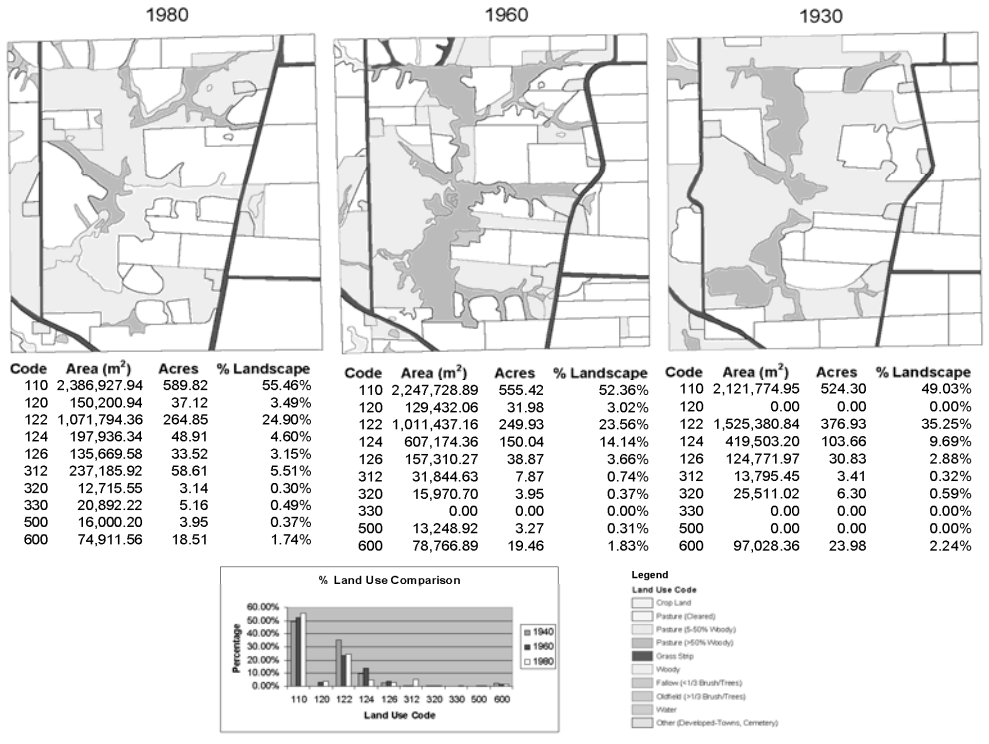


Code	Area (m²)	Acres	% Landcover
110	2,944,381.70	727.57	66.14%
120	0.00	0.00	0.00%
122	156,840.80	38.76	3.52%
126	122,053.38	30.16	2.74%
312	798,109.05	197.22	17.93%
320	257,697.44	63.68	5.79%
330	33,333.98	8.24	0.75%
500	75,803.45	18.73	1.70%
600	63,445.27	15.68	1.43%

Code	Area (m²)	Acres	% Landcover
110	2,692,537.73	665.34	60.27%
120	5,834.02	1.44	0.13%
122	189,185.50	46.75	4.23%
124	169,223.61	41.82	3.79%
126	145,688.61	36.00	3.26%
312	920,118.37	227.37	20.60%
320	217,128.47	53.65	4.86%
330	48,272.41	11.93	1.08%
500	19,398.52	4.79	0.43%
600	59,951.23	14.81	1.34%

Code	Area (m²)	Acres	% Landcover
110	1,545,348.31	381.86	34.62%
120	0.00	0.00	0.00%
122	830,056.52	205.11	18.59%
124	77,651.44	19.19	1.74%
126	89,895.80	22.21	2.01%
312	1,480,543.25	365.85	33.16%
320	371,892.16	91.90	8.33%
330	0.00	0.00	0.00%
500	9,162.48	2.26	0.21%
600	59,680.47	14.75	1.34%

Figure 6. Section Comparison: South Western Iowa Individual Section (T70N R39W Sec. 02).



Code	Area (m²)	Acres	% Landscape
110	2,386,927.94	589.82	55.46%
120	150,200.94	37.12	3.49%
122	1,071,794.36	264.85	24.90%
124	197,936.34	48.91	4.60%
126	135,669.58	33.52	3.15%
312	237,185.92	58.61	5.51%
320	12,715.55	3.14	0.30%
330	20,892.22	5.16	0.49%
500	16,000.20	3.95	0.37%
600	74,911.56	18.51	1.74%

Code	Area (m²)	Acres	% Landscape
110	2,247,728.89	555.42	52.36%
120	129,432.06	31.98	3.02%
122	1,011,437.16	249.93	23.56%
124	607,174.36	150.04	14.14%
126	157,310.27	38.87	3.66%
312	31,844.63	7.87	0.74%
320	15,970.70	3.95	0.37%
330	0.00	0.00	0.00%
500	13,248.92	3.27	0.31%
600	78,766.89	19.46	1.83%

Code	Area (m²)	Acres	% Landscape
110	2,121,774.95	524.30	49.03%
120	0.00	0.00	0.00%
122	1,525,380.84	376.93	35.25%
124	419,503.20	103.66	9.69%
126	124,771.97	30.83	2.88%
312	13,795.45	3.41	0.32%
320	25,511.02	6.30	0.59%
330	0.00	0.00	0.00%
500	0.00	0.00	0.00%
600	97,028.36	23.98	2.24%

Figure 7. Section Comparison South Central Iowa Individual Section (T69N R24W Sec. 03).

Table 2. SAS results.

1940's Class Metrics

Factor	Variables	% Landscape
Factor 1	CA, PLAND, NP, PD	37.00%
Factor 2	TE, ED, LSI	25.00%
Factor 3	PARA	13.00%

1960's Class Metrics

Factor	Variables	% Landscape
Factor 1	CA, PLAND, NP, PD, LPI, TE, ED	30.00%
Factor 2	LSI, GYRATE, SHAPE	25.00%
Factor 3	PARA	14.00%

1980's Class Metrics

Factor	Variables	% Landscape
Factor 1	CA, PLAND, NP, PD, LPI, TE, ED	29.00%
Factor 2	LSI, GYRATE, SHAPE	25.00%
Factor 3	PARA	15.00%

CA - Class Area
PLAND - Percent Landscape
NP - Number of Patches
PD - Patch Density
LPI - Largest Patch Index
TE - Total Edge
ED - Edge Density
LSI - Land Shape Index
Gyrate - Radius of Gyration (measure of patch extent)
Shape - Shape Metric
PARA - Patch Area Metric

Results from this analysis showed slight variation between the years. The three factors from the 1940s accounted for 5% more variance in the landscape than the 1960s or 1980s. The factors involved in the variance were also different in the 1940s. Total edge (TE), edge density (ED) and land shape index (LSI) made up the second factor, accounting for 25% of the landscape. Both total edge and edge density were smaller components of Factor 1 from the 1960s and 1980s. This result implies that total edge and edge density were a more significant component in the landscape in the 1940s, accounting for 25% of the landscape. This would imply that in the 1940s edge habitat was more abundant than in the subsequent years. This may also verify the theory of greater nesting habitat being available in the 1940s.

Discussion

By randomly selecting 72 sections from southern Iowa, the goal was to provide a representative sample of land use for the state of Iowa. It was largely believed changes in land use had resulted in decline in the bobwhite population. Various methods of analysis were performed with data allowing for further detailed analysis. The overall landscape analysis provided trends, showing changes over time in the study area. This information can be used to analyze changes in farming practices including cropland, rangeland, and fallow lands on a regional level.

More detailed analysis comparing individual sections provides more localized information on land use changes. This information can be used to look at trends in specific sections within the study area. This data could be used to contact landowners and educate them with habitat management practices.

Results from Fragstats, analyzed in the SAS program, revealed edge habitat was a more important variable in the factors that comprise the landscape in the 1940s than it was in the 1980s.

Management of land use for bobwhite in the state of Iowa is going to depend on management of farming practices. Rosenberry and Sudkamp (1998) stated heterogeneous, patchy landscapes containing moderate amounts of row crops and grassland along with abundant woody edge as being most associated with bobwhite populations in Illinois. The removal of edge habitat for the creation of more cropland lowers the abundance of quality habitat available for the bobwhite. This reduction may lead to a reduction in breeding and over wintering habitat for the bobwhite.

Guthery (1997) states bobwhite can benefit from the addition of "usable space" rather than attempts to improve existing bobwhite habitat. With the landscape of Iowa being dominated by flat agricultural land, creation of additional habitat will have to be the result of agricultural programs and policies. Many areas may be deemed inhospitable to bobwhite due to current land use practices. It is important to identify potentially suitable habitats and create micro-conditions within these areas to make them more attractive to bobwhite.

Conclusions

Land use in the southern portion of Iowa did show changes from the 1940s through the 1980s. The greatest change in terms of acres was found in cropland. Nearly 5,500 additional acres of cropland were found in the 1980s compared to the 1940s; this showcased an increase of 14% for the study area. These changes may be the result of modern farming technology that allows larger cropland fields. This results in large tracts of land being used exclusively for crops at the expense of fallow, rangeland, and edge habitat. Increases were also found in woodland; approximately 4,000 acres of additional woodland were found in the 1980s compared to 1940s.

The SAS analysis revealed 3 factors made up 75% of the landscape in the 1940s and 3 factors made up 70% of the landscape in both the 1960s and 1980s. The differences were evident in the variables that made up these factors. The 1940s showed edge density and total edge habitat accounted for 25% of the landscape. In both the 1960s and 1980s, these variables were 1 of 7 variables that made up 30% of the landscape. This analysis revealed that edge was a bigger factor in the landscape in the 1940s.

A model of bobwhite habitat in Missouri indicated open land should constitute 75-90% of the total landscape. This open land should be made up of 50-60% cropland (38-54% of the total landscape) and 20-30% grassland (15-27% of the total landscape) (Dailey, 1989). Applying this model to data collected in this study illustrates the deviation over time from the model bobwhite habitat (Table 3).

Table 3. Land Use Break-Down (% shown as % of total land use).

Land Use	1940	1960	1980
Open Land	90%	85%	84%
Cropland	54%	57%	61%
Grassland	33%	23%	19%

The 1940s is the only time period in which all three criteria are met. By the 1960s, the percent cropland exceeds the models recommendations and by the 1980s it far exceeds the 38-54% model. Over time, a 6% loss of open space, a 7% increase in cropland and a 14% loss of grassland were found. The transition to less open space, more cropland and less grassland may all lead to a reduction in quality bobwhite habitat.

The greatest habitat loss in this study was found to be fallow land. These were classified as un-grazed lands under 1/3 brushy cover. In the 1940s, just over 8,600 acres existed. By the 1980s, this number had been reduced to less than 1,400 acres, a loss of 7,200 acres, accounting for a decrease of over 83%. Many of these fallow lands may have been converted to croplands. Taylor and Burger (2000) stated increasing the proportion of row crop at the expense of fallow areas reduces

habitat quality. Decreases in acreage from were also found in rangeland < 25% woody, approximately 3,300 acres were lost.

Suitable bobwhite habitat within agricultural landscapes consists of smaller, irregularly shaped fields of row crops, idle fields, and pastures interspersed with woody and herbaceous cover, this creates a mosaic of several stages suitable for bobwhite (Exum et al., 1982).

As farming practices evolve, farmers have the ability to put more land into production. As these changes occur, it is important farmers are aware of the implications of their changes to the landscape. The removal of edge habitat, depletion of grasslands and movement towards mono-agricultural practice all can have a detrimental effect on the bobwhite. Farmers must be educated on simple ways to fragment their fields and provided valuable habitat to the bobwhite.

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Appendix A. Land use code descriptions/signature patterns.

110 – Cropland (tilled) The signatures of these lands were easily identified. Photos from the early planting season, showed evidence of till patterns as a result of early season planting. Photos from later in the season showed v-shaped patterns depicting cropland cultivation. Crops such as corn, were evident on late season photos by utilizing a stereoscope. Late season photos, showed evidence of post season tilling. Generally, these lands were located short distances from the farmstead with tractor lanes connecting fields. Also evident in later year photos were hay bails lined up on the sides of the fields or evenly spaced out in the field after cutting.

120 – Grassland (Cleared, not tilled) These lands showed no evidence of tilling. They contained no trees and were being used for grazing of animals. Cattle trails were evidence of the land being used for grazing practices. These lands were generally located close to the farmstead allowing for easy access by cattle.

122 – Range (<25% woody) These lands were similar to the features described for land use class 120. The only difference being these lands contained some scattering of large growth trees. Typically cattle trails were evident surround these trees, used as a shade source.

123 – Mostly Range (26%-50% woody) These lands were similar to lands described in code 122. The difference being, these lands were greater than 26% but let than 50% woody.

124 – Mostly Woody (51%-75% Woody) These lands were similar to lands described in code 123. The difference being, these lands contained greater than 50% but less than 75% woody cover. The evidence of cattle trails surrounding the trees and in the open areas identified these lands.

125 – Woody (76%> Woody) These lands were similar to lands described in code 124. The difference being, these lands contained greater that 76% woody cover.

126 – Grass Strip These lands were typically present separating croplands. These lands were easily spotted as long narrow strips of land separating lands usually containing the same characteristics.

311 Non-Agricultural Land (wooded strip) These lands were un-grazed strips of wooded habitat. These lands consisted of narrow rows of trees isolated from larger groups of woody habitat.

312 – Non-Agricultural Land (wooded) These were land which were not being utilized in any way for agricultural purposes. Typically, these lands were located long distances from the farmstead. They were clearly wooded in nature and were not cleared in any way.

320 – Non-Agricultural Land (Grassland) These lands were un-grazed and under 1/3 brush land. Generally, located far distances from the farmstead these lands were undisturbed and did not contain any old growth forest habitat. Small brush land was commonly present but not in great abundance.

330 -- Non-Agricultural Land (Scrub) These lands were un-grazed and over 1/3 of the land consisted of brush/small trees. These lands were similar to lands described in code 320. The difference being these lands contained an abundance of brush and small trees. These lands were un-disturbed by agricultural practices.

410 – Railroad Road plus roadside ditches (Grassy ditch) These lands included the road or railroad along with the ditches on either side. The ditches in this code were grassy in habitat.

420 – Railroad Road plus roadside ditches (Woody ditch) These lands included the road or railroad along with the ditches on either side. The ditches in this code were woody in habitat.

500 – Water (Pond, Lake, Stream, Slough) This classification included any bodies of water.

600 – (Other) These lands consisted of towns, cemeteries, sand or developed lands