Evaluation and management of grasslands at the Dubuque Technology Park for grassland bird diversity

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INTRODUCTION AND METHODS

The 2022 State of the Birds Report described three key findings (North American Bird Conservation Initiative 2022):

1) 1 in 4 breeding birds (3 billion birds) have been lost from the United States and Canada in the last 50 years

2) 70 tipping point species were identified that have lost ⅔ of their populations in the past 50 years and are on track to lose another 50% in the next 50 years

3) U.S. birds exhibit downward trends in every habitat except wetlands, where decades of investment in wetland restoration have resulted in dramatic gains

Grassland birds have experienced the largest population losses of any terrestrial biome (North American Bird Conservation Initiative 2022). The eastern Great Plains are especially problematic due to habitat loss, tree and shrub encroachment, and pesticide application. Fifteen of 24 grassland species have decreased in population size since 1970 (-34%, Figure 1). Eight of the 24 grassland species are classified at Tipping Point Species, or species with especially high priority for conservation because of their high vulnerability to extinction, their high urgency, and their steep population declines. These species, including

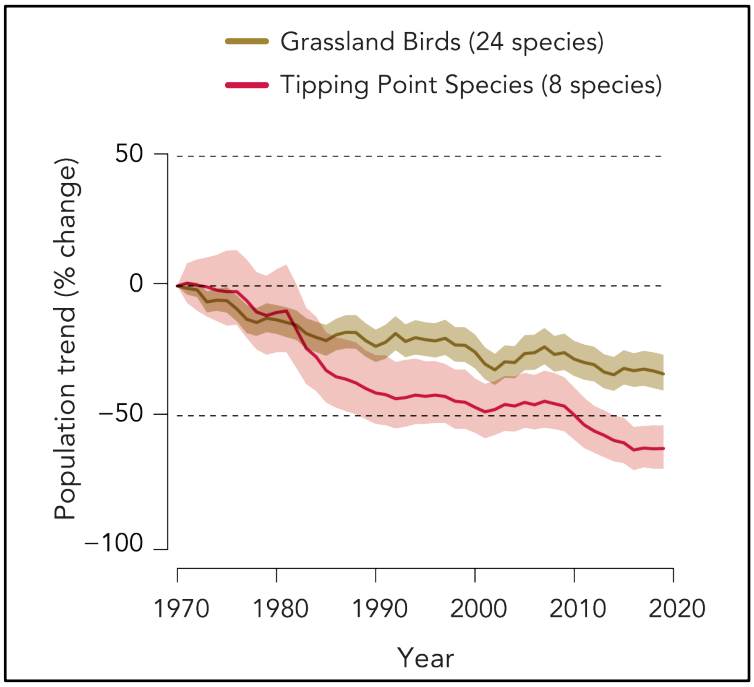

Figure 1. Population trends for grassland bird species from 1970 to 2020. From State of the Birds, 2022.

Table 1. Grassland birds identified as endangered, threatened or special concern in Iowa.

Endangered
Northern Harrier (*Circus cyaneus*)
Short-eared Owl (*Asio flammeus*)
Threatened
Henslow's Sparrow (*Ammodramus henslowii*)
Special Concern
None

mountain plover, Sprague's pipit, Henslow's sparrow, chestnut-collared longspur, bobolink, lesser prairie chicken, and LeConte's sparrow, collectively exhibit a population decline of -62% (Figure 1).

Three grassland birds are currently listed as endangered, threatened or special concern in Iowa (Table 1). However many of Iowa's grassland species are identified as species of Greatest Conservation Need (GCN, Table 2) by Ehresman (2006). Species of GCN was an outcome of developing the Iowa Wildlife Action Plan.

This report will address a request from the Dubuque Audubon Society to survey and evaluate the grasslands located at the Dubuque Technology Park (Figure 2). The central research goal was to ascertain their value for grassland birds and provide commentary on what management practices are needed to protect and enhance these grassland habitats for bird conservation. Historic aerial photos from 1937, 1970s and 1994 (Figures 3-5) show this area was extensively farmed. It appears the technology park was developed between 1994 and 2002. Fayette and Nordness soils are present on the site. Both indicate the native vegetation was forest or woodland. Thus forest clearing must have occurred to prepare the land for farming. The study site was visited on July 24, 2023. The grasslands were labeled A to E and each was observed on a meandering survey. Notes on the plant species composition and structure were made and photographs taken. The bird species observed in the grassland units were also noted.

Table 2. Iowa grassland birds identified as species of Greatest Conservation Need and classified by their sensitivity to habitat fragmentation (Ehresman 2006).

High Sensitivity	Moderate Sensitivity	Low Sensitivity
Northern Harrier	Sedge Wren	Northern Bobwhite
Greater Prairie Chicken	Grasshopper Sparrow	Field Sparrow
Upland Sandpiper	Eastern Meadowlark	Dickcissel
Short-eared Owl		
Bobolink		
Henslow's Sparrow		

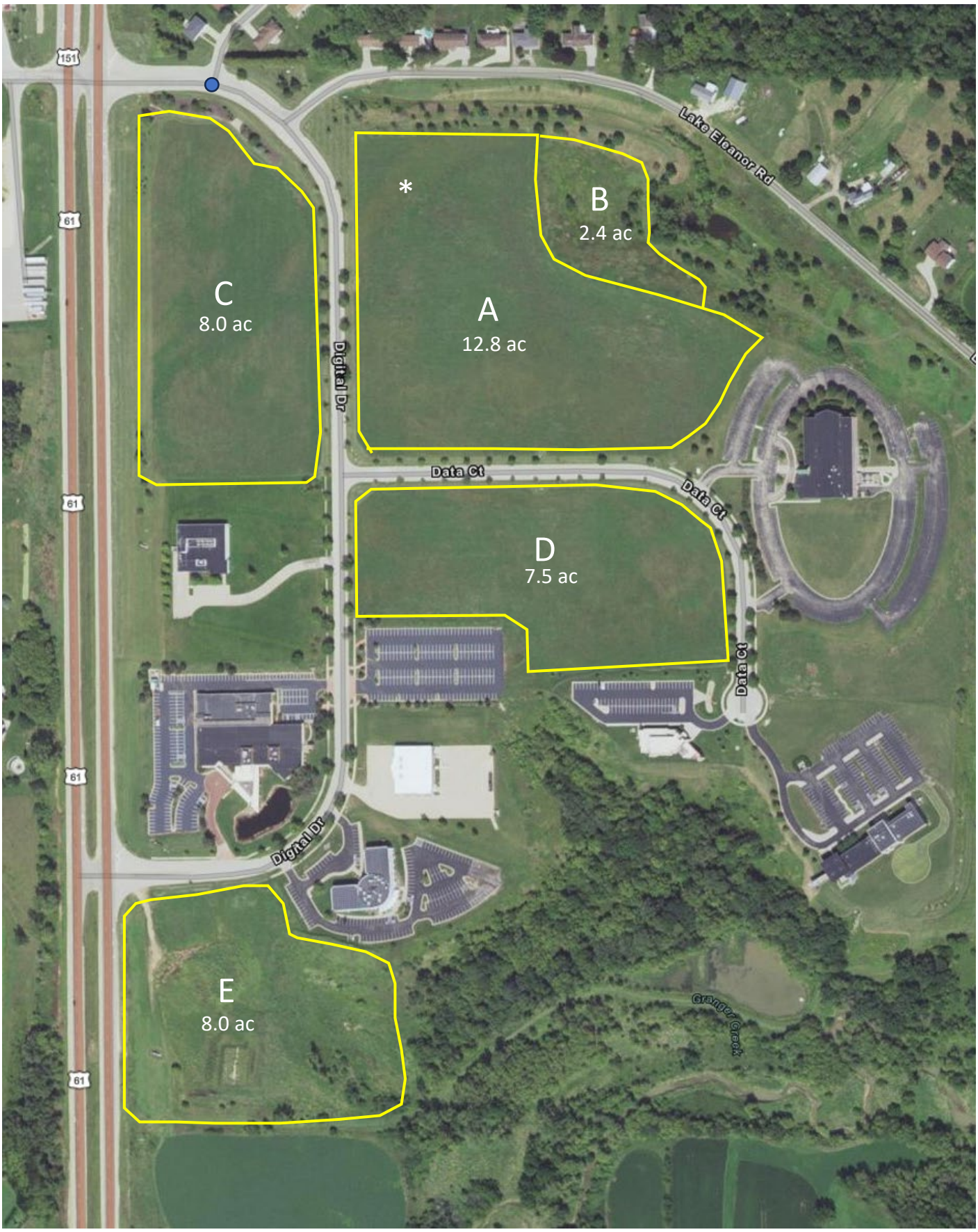

Figure 2. Grasslands located at the Dubuque Technology Park, located at the junction of Lake Eleanor Road and Highway 61, one mile south of the E.B. Lyons Nature Center. Grassland survey units are labeled A-E.

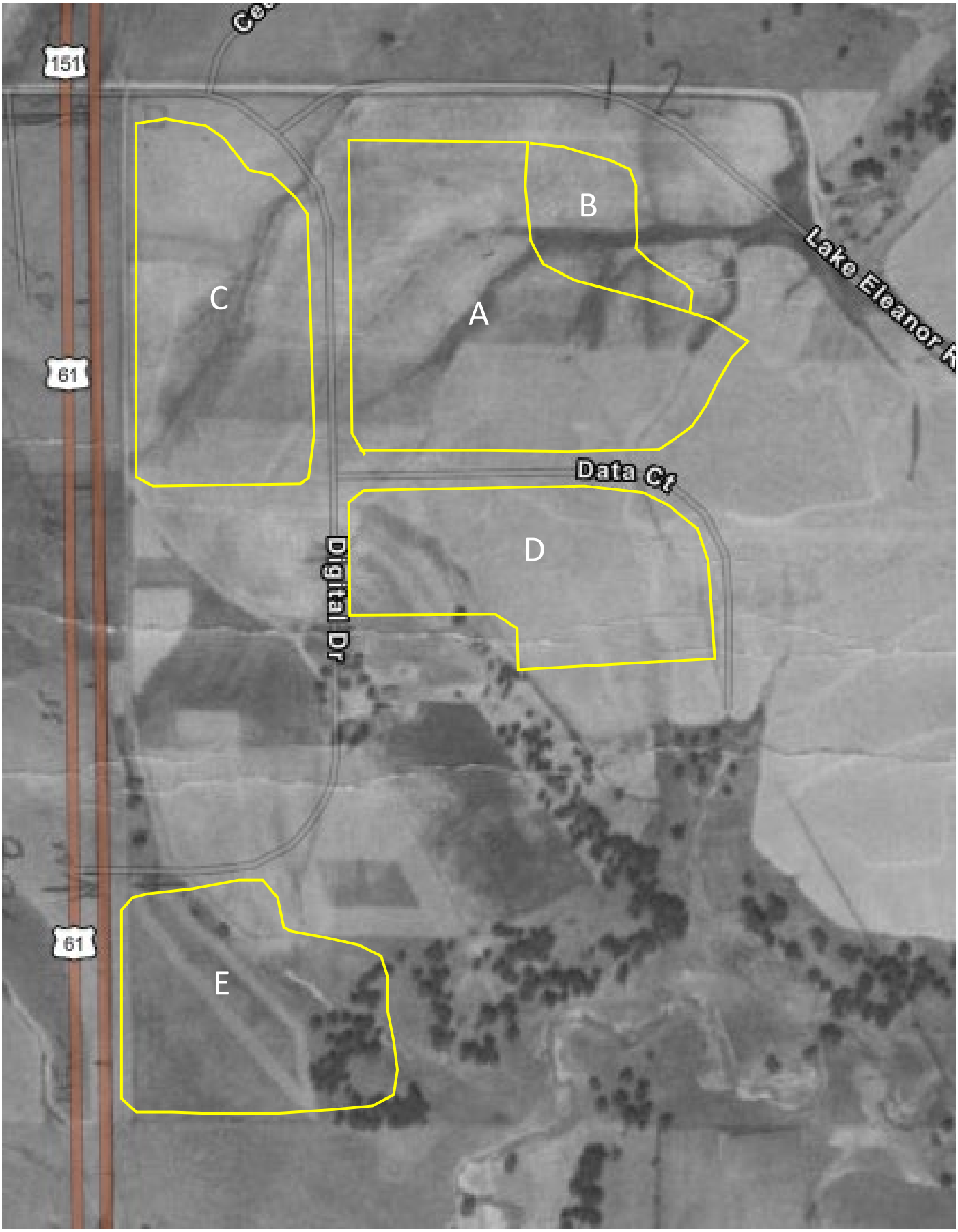

Figure 3. Grasslands A-E located at the Dubuque Technology Park overlain on a 1937 black and white aerial photo.

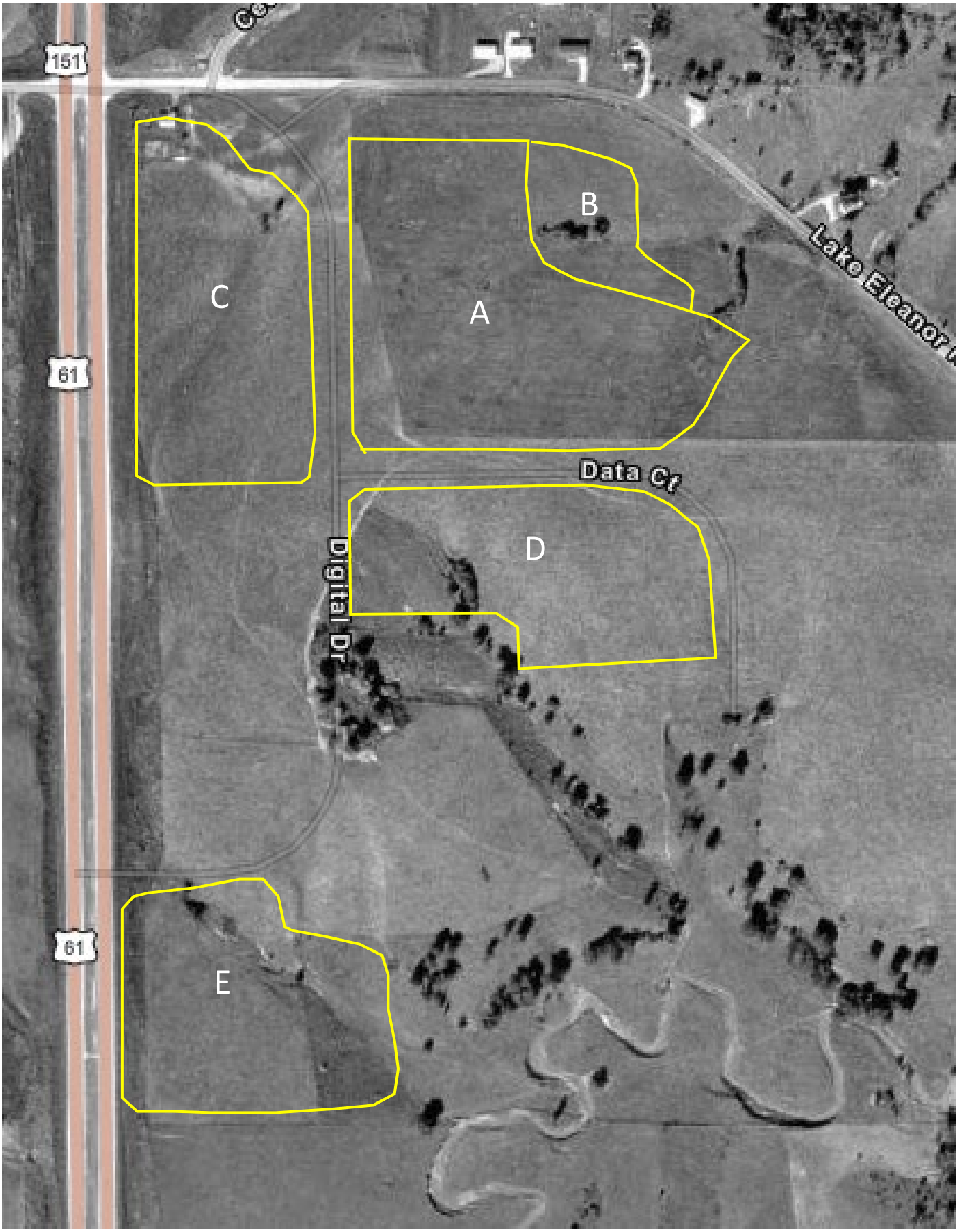

Figure 4. Grasslands A-E located at the Dubuque Technology Park overlain on a 1970s black and white aerial photo.

Figure 5. Grasslands A-E located at the Dubuque Technology Park overlain on a 1994 black and white aerial photo.

RESULTS

Most vertebrate wildlife species utilize certain habitats that result from the plant community and ecosystem that is preferred, or in other words the type of environment the species has evolved in and adapted to. Wildlife species utilize habitats for food, water, space and for concealment/cover during reproduction, escape from predators, protection from weather, and rest. The structure of the vegetation, also described as its physical architecture, is the important feature of the habitat more so than the plant species composition. Vegetation structure is characterized by vegetation height, density, its heterogeneity or patchiness, types and amounts of plant growth forms, the amount of litter/thatch, and the presence of rocks, boulders, logs and snags. Plant species composition is only important in that it determines the types of growth forms, potential plant heights and the amount of clonal growth (which usually contributes to increased patchiness).

Table 3. Unit A grassland species composition. Species in blue font are non-native; those in boldface are invasive.

Graminoids	Forbs	Woody
Smooth brome	**Bird's foot trefoil**	**Multiflora rose** (shrub)
Timothy	**Wild carrot**	Green ash (shrub)
Witchgrass	**Red clover**	
Kentucky bluegrass	Daisy fleabane	
Sedge species	Tall/Canada goldenrod	
Quackgrass	**Crown vetch**	
Redtop	Common milkweed	
Plains oval sedge	Wild bergamot	
	Canada thistle	
	Frost aster	
	American germander	
	Curly sour dock	
	Sunflower species	

Unit A vegetation is fairly similar to that in an abandoned pasture. The height of the vegetation ranged from 30 cm to 100+ cm. The lowest vegetation heights occurred in patches dominated by Kentucky bluegrass and sedges; the tallest plants were forbs like goldenrod and wild carrot. Vegetation density was fairly high, with a 50/50 ratio of forbs to grasses. Homogeneity was moderate to high. It appeared that good perches for birds were few, mainly some sunflower, wild carrot and goldenrod. Dense patches of crown vetch and bird's foot trefoil were present. It's not clear if these patches are useful or a detriment to grassland birds. They form a thick, dense and tangled layer that lacks grasses and other species. There was very little litter, perhaps due to haying? A fairly large patch of Canada thistle is present at the location shown by the asterisk (*) in Figure 2. Bobolinks and meadowlarks were observed.

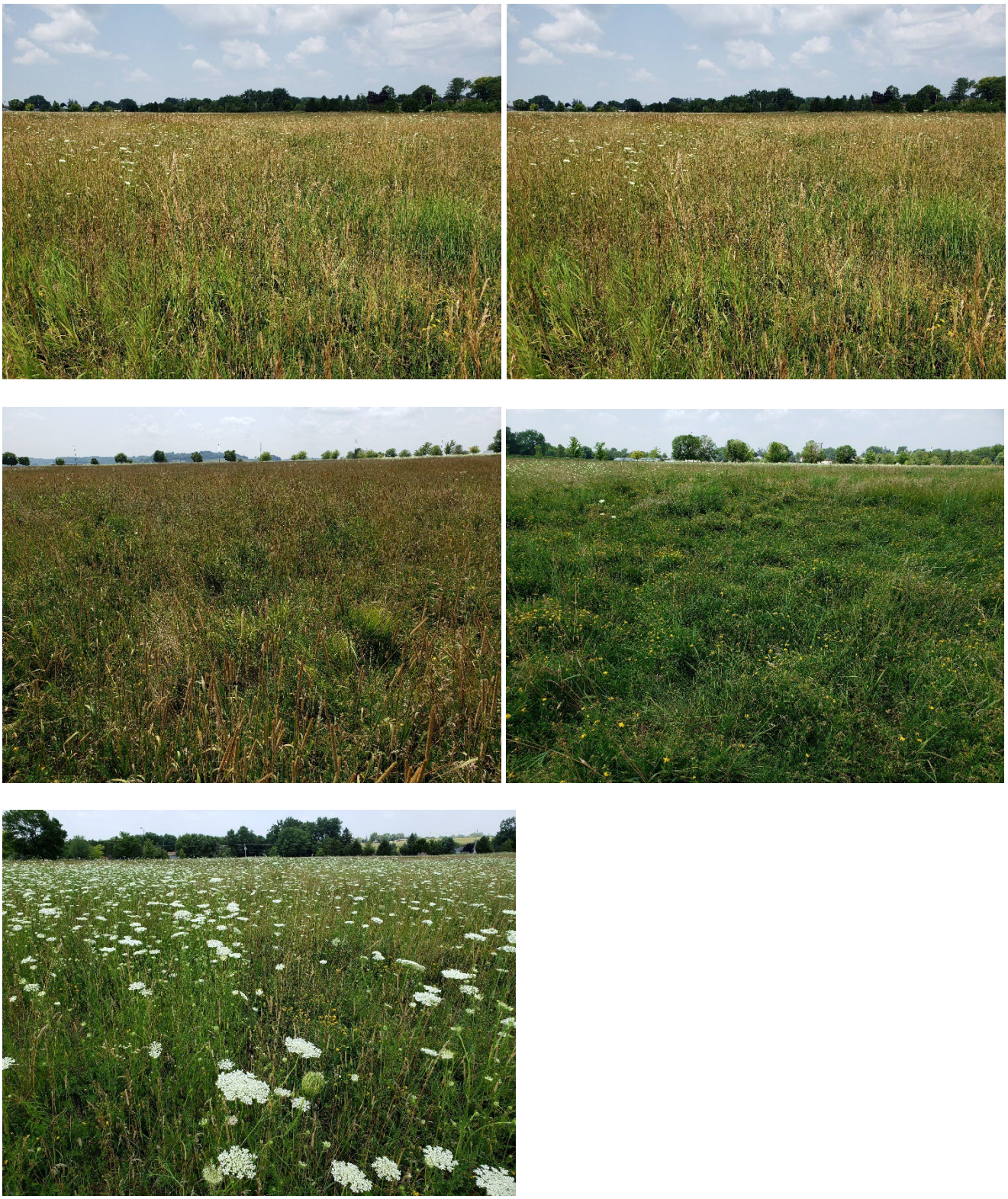

Figure 3. Photos showing Unit A grassland. The center right photo illustrates an area of dense bird's foot trefoil, the lower photo demonstrates an area of high wild carrot frequency.

Table 4. Unit B grassland species composition. Species in blue font are non-native; those in boldface are invasive.

Graminoids	Forbs	Woody
Smooth brome	**Bird's foot trefoil**	**Flowering crabapple** (tree)
Orchard grass	**Wild carrot**	Green ash (shrub, sapling)
Reed canary grass	**Red clover**	Box elder (tree)
Kentucky bluegrass	Giant ragweed	Wild grape (shrub)
Switchgrass	Tall/Canada goldenrod	American elm (tree)
Quackgrass	**Crown vetch**	Bur oak (tree)
	Wild parsnip	Black walnut (tree)
	Prickly lettuce	
	Canada thistle	
	Frost aster	
	American germander	
	English plantain	

Unit B grassland occurs on moderately steep slopes that face south, east and north. The bottoms of the slopes converge in a lowland drainageway. It presents greater structural diversity than Unit A due to a greater growth of forbs and higher amounts of woody vegetation. Vegetation heights range from 25 cm to 100+ cm. Bird perches are plentiful.

Figure 4. Photos showing Unit B grassland.

Table 5. Unit C grassland species composition. Species in blue font are non-native; those in boldface are invasive.

Graminoids	Forbs	Woody
Smooth brome	**Bird's foot trefoil**	none
Kentucky bluegrass	**Crown vetch**	
Switchgrass	**Wild carrot**	
	Common milkweed	
	Daisy fleabane	

The vegetation in the southern half of Unit C appeared to be shorter and less dense than the vegetation in the northern half. Vegetation heights in many areas in the southern portion ranged from 15 cm to 25 cm, while vegetation in the northern section ranged from 20 cm to 75 cm. Large patches of crown vetch were present in the north half. There may be differences in the soil that contribute to variation in the growth of the vegetation. Meadowlarks were observed.

Vegetation height in the above right photo is 20 cm to 35 cm. In the photo to the left vegetation height is 45 cm to 75 cm.

Figure 5. Photos showing Unit C grassland. The top 2 photos illustrate the relatively short vegetation height present in the southern half.

Table 6. Unit D grassland species composition. Species in blue font are non-native; those in boldface are invasive.

Graminoids	Forbs	Woody
Smooth brome	**Bird's foot trefoil**	none
Kentucky bluegrass	**Crown vetch**	
Sedge species	Common St. Johnswort	
Switchgrass	Sulfur cinquefoil	
	Yarrow	

Unit D grassland is very similar in species composition and structure to Unit A grassland. One difference is that Unit D has more Kentucky bluegrass and less smooth brome. Bird's foot trefoil is frequent to very common. Its occurrence in dense patches creates some patchiness and heterogeneity, but it has little if any value for nesting grassland birds. Vegetation height varies from 25 cm in patches of sedge species to 70 cm for switchgrass and bird's foot trefoil. The vegetation in the eastern third is shorter than in the rest of the grassland. Bobolinks and meadowlarks were observed.

Figure 6. Photos showing Unit D grassland. The photo in the lower right shows the shorter and less dense vegetation present in the eastern portion of the grassland.

Table 7. Unit E grassland species composition. Species in blue font are non-native; those in boldface are invasive.

Graminoids	Forbs	Woody
Quackgrass	**Bird's foot trefoil**	Cottonwood (seedling, shrub, sapling)
Kentucky bluegrass	**Crown vetch**	
Fescue species	**Poison hemlock**	
Reed canary grass	**Wild carrot**	
Squirrel-tail barley	**Wild parsnip**	
	Canada thistle	
	White sweet clover	
	Prickly lettuce	
	Bull thistle	
	Black medick	
	Common evening primrose	
	Giant ragweed	
	Gray-headed coneflower	
	Prairie sage	
	False sunflower	

Figure 7. Photos showing Unit E grassland.

Unit E grassland contains moderately steep slopes and mounds that appear to be coarse, infertile soils that were dumped in the area. Some areas, like the mounds, have a very high forb/grass ratio. Many invasive species are present. Dickcissels and mourning doves were observed.

The grasslands at the Dubuque Technology Park are mainly two types of plant association – cool-season grasslands and cool-season grassland/forb meadows. In both cases the dominant grasses are non-native pasture forage species. The presence of forbs with a total frequency of 50% or more distinguishes the cool-season grassland/forb meadow. It is obvious that in their current condition they are providing suitable habitat for at least some grassland birds. Management of these grasslands for grassland bird conservation and diversity should consider the grassland structure that is utilized by grassland birds (Table 8). While many of the species in Table 8 do not occur or are uncommon in Dubuque County (e.g., burrowing owl, Henslow's sparrow, lark sparrow, LeConte's sparrow, greater prairie chicken, sharp-tail grouse, Jackson et al. 1996), they are included to illustrate the importance of diverse grassland structure in supporting birds. Vegetation structure is a key factor in creating niches in an ecosystem, and a reliable predictor of ecosystem productivity (LaRhue et al. 2023).

Grassland animals have evolved through millions of years of interaction with grassland environments. Understanding the natural factors that have affected grassland bird evolution and diversity helps recognize the strategies best utilized by grassland managers. The natural environmental factors that have been important in grassland development and maintenance and therefore bird evolution include herbivory, fire, drought, climate, geology, topography, soil and soil disturbance. These factors affect both the species

Table 8. Grassland structure and habitat preferences of grassland birds (from Ehresman 2006). Brackets [ ] indicate information added by T. Rosburg.

Bird Species (Common Name)	Habitat Preference
Northern harrier	large grassland tracts of 250+ acres [tall and dense]
Greater prairie chicken	large grassland complexes of 2,000 acres [patchy, with grazed areas]
Sharp-tailed grouse	prairie grassland with patches of trees or shrubs
Northern bobwhite	medium height grasslands with shrubs and forbs
Upland sandpiper	short to medium height grassland with forbs
Burrowing owl	short height grasslands
Short-eared owl	large grassland tracts 250+ acres
Common nighthawk	grasslands with bare areas for nesting
Sedge wren	tall grass with infrequent disturbance
Loggerhead Shrike	short grassland/savanna with thorny shrubs or small trees
Bell's vireo	shrubby habitat within grasslands, in riparian areas or savannas
Dickcissel	medium high grass with sparse forbs
Field sparrow	grasslands with low shrubs
Lark sparrow	sand prairie with sparse herbaceous vegetation, woodland edges
Grasshopper sparrow	medium height grass with forbs
Henslow's sparrow	tall grass and infrequent disturbance [a mulch layer, no trees]
Nelson's sharp-tailed sparrow	undisturbed, tall, coarse grassland on wetland edges
Le Conte's Sparrow	grassy meadows; marsh edges
Bobolink	medium height grass with forbs
Eastern meadowlark	grassland with some trees; savanna
[Vesper sparrow]	[early successional grassland with sparse vegetation and bare soil]
[Eastern kingbird]	[open grassland with few scattered trees, savanna]
[Horned lark]	[short grass, grazed pastures, bare ground, no woody plants]

composition and structure of grasslands. For example, cattle grazing increased the number of grasshopper sparrows observed on a 415-acre prairie reconstruction in central Iowa compared to a similar size, adjacent prairie reconstruction (Rosburg 2010). In a North Dakota study investigating the effect of late summer fire on vegetation and birds, the number of sedge wrens, clay-colored sparrows, Le Conte's sparrows, savannah sparrows, and bobolinks were lowest during the first postfire growing season but generally increased and stabilized within 2-3 postfire growing seasons (Grant et al. 2010). They concluded that grassland passerines are well-adapted to frequent, periodic fires, generally corresponding to those occurring prior to Euro-American settlement of the region. Prescribed fire is important for reducing tree and shrub invasion, restoring biological integrity of plant communities, and maintaining or enhancing populations of grassland-dependent bird species. Managers in the northern mixed-grass prairie region should not be overly concerned about reductions in bird abundances that are limited mostly to the first growing season after fire (Grant et al. 2010). On the other hand, birds that prefer short grass and exposed soil, like horned larks, killdeer and vesper sparrows can be favored by spring fires.

The tools available to grassland manager to influence grassland species composition and structure are chiefly fire, livestock grazing, mowing, haying, herbicide application and interseeding. Management options for the grasslands at the Dubuque Technology Park include all of these except livestock grazing. If prescribed fire is not a practical option, haying is a good surrogate that produces many of the same effects as fire. It is also important to understand that choosing to do nothing is also a management option that, like all the other management options, can have either beneficial or negative effects. Of course, whether an effect is beneficial or negative depends on the species being considered. Thus it is easy to see that grassland management can be complicated. This is why it is important to make well, thought-out decisions and identify the reason why a particular management option (or absence of management) is used. It's important to consider what the ecological objective is that underlies each decision.

Ehresman (2006) provides a good summary of grassland management principles. He describes the following six guidelines.

1) **Avoid further fragmentation or destruction of remaining grassland habitat**

Preserving and maintaining Iowa's remaining grassland habitat, especially the largest tracts, should be a high priority

2) **Manage for larger, non-linear blocks of habitat**

A worthy goal for grassland bird managers is to provide as large a block of contiguous grassland as possible. Removing woody growth in fence lines or roadways between grassland blocks is one way to achieve this goal. Sample and Mossman (1997) suggest blocks of grassland habitat should be at least 40 acres in size. When considering the shape of a parcel, an important objective is to minimize the amount of linear edge of an area.

3) **Consolidate and connect blocks of grassland habitat**

Surrounding land use impacts the suitability of an area for nesting birds (Sample and Mossman 1997). When management for blocks of at least 50 acres is not possible, try to clump smaller tracts of grassland habitats as close to one another as possible.

4) **Manage to reduce depredation of nesting birds and their young and eggs**

Nest predation can be a serious problem for grassland bird species as can predation on adults or their recently fledged young. To reduce predation by both mammals and birds, it is suggested that grassland management tracts be as large as possible and that potential perch trees (used by raptors and Corvids) and woody vegetation corridors be removed. It should be noted that not all woody vegetation is harmful and that some shrubs in the grassland landscape can be beneficial to several GCN species, including Bell's vireo, loggerhead shrike and northern mockingbird. Historic prairie land cover included about 5% shrubs.

Patches of shrubs, or shrub islands, can be an important component of grassland structure. In most cases, the amount of woody cover should not exceed five percent.

5) **Manage to reduce cowbird nest parasitism**

Brown-headed cowbirds pose a threat to many grassland bird species when they parasitize or lay eggs in these species' nests. Female cowbirds find other bird nests to parasitize by watching from nearby perches in trees or shrubs. To decrease brown-headed cowbird nest parasitism, tall woody vegetation (perch sites) within and on the edges of grasslands should be removed. Brown-headed cowbird nest parasitism decreases the farther nests are placed from woody edges (Johnson and Temple 1990).

6) **Manage to eliminate or reduce invasive species**

Most of Iowa's grasslands are comprised of non-native species, many of which are invasive. Non-native species such as reed canary grass, fescue, crown vetch, sericea lespedeza and leafy spurge are invasive species that compete with and displace native plants. They also have a tendency to reduce diversity and create a monocultural (single species) environment that is not beneficial to most breeding birds. None of these invasive species should be planted or propagated in Iowa, and efforts should be made to eliminate or at least control their spread.

Ehresman (2006) also provides a good summary of grassland management options. His work is the source of the information in this section.

Because grasslands are disturbance-adapted systems, management involving some disturbance regime is essential. Without disturbance or specific management, upland grasslands will be invaded and eventually replaced by woody growth, excluding many grassland bird species from using the habitat. The three main management treatments that land managers typically use are prescribed burning, grazing, and mowing. While each of these management techniques can be used to attain specific objectives, it is good to rotate the use of these treatments in any specific area to maintain or increase species diversity. Timing of treatments also is important. In order to avoid destruction of nests, whenever possible conduct management treatments before birds begin nesting in the spring (before early April) or after the young have fledged (after 15 September).

Prescribed Burning – This technique is especially preferred for the management of warm-season grasses and native forbs, which have evolved with fire. Prescribed burns should be conducted in early spring from March to early April (before reptiles and amphibians are very active) or in the fall during October and November. Periodic use of fire reduces woody plant growth, eliminates thatch build up, can help reduce or control nuisance plant species, and can increase plant diversity and change plant structure. When possible, try to select grassland areas at least 250 acres in size and then divide that area into prescribed burn units no smaller than 50 acres each. Use a rotational burning program in which 20-30% of an entire area is burned each year, which will mean that each unit is burned at least once every five years. When burning small prairie remnants, do not burn over one half of the area per season. An exception to this, when you can burn an entire prairie fragment at once, is when there is another prairie remnant immediately adjacent that remains unburned.

Grazing – Grassland grazing is a valuable management technique for a number of grassland birds. It is especially useful for those species that prefer short to medium vegetation heights. Grazing can be used to control vegetation height, reduce litter accumulation, and reduce woody vegetation. Bobolinks, eastern meadowlarks, grasshopper sparrows, and upland sandpipers, in particular, greatly benefit from appropriately managed pastures. It is recommended that a rotational system involving two or more grazing units be used with light to moderate levels of grazing to provide diverse grass heights and densities. The objective is to increase the variation in grass heights and densities within and between grazing units. To maintain plant vigor, do not graze warm-season grasses in tallgrass prairie to a height of

less than 10 inches during the growing season (Skinner 1975). In cool season grass pastures, more heavy grazing can be allowed, in some cases, to create a more open landscape, like that required for booming grounds of prairie-chickens. Light grazing is defined as grazing that results in less than 40% of the vegetative cover reduced to 10 inches in height. (Therefore 60% of the vegetation is not impacted). Moderate grazing is when grazing pressure creates an average vegetation height of 8-12 inches (Skinner 1975, Skinner et al. 1984).

Mowing – This management technique, much like burning and grazing, can be used to lower vegetation height, reduce litter build up (when mowed vegetation is harvested), and control woody vegetation. As a management tool, its effects on grassland birds are most similar to those of burning. Mowing during nesting season has been shown to be detrimental to Iowa breeding birds (Frawley and Best 1991). For that reason, it is recommended that mowing not be done until after the nesting season. In areas being managed for birds, rotational mowing is recommended at a rate of once every two to four years. Species like Henslow's sparrows do best with at least a two-year mowing rotation, while grasshopper sparrows do well with annual or biennial mowing rotations (Swengel and Swengel 2001).

Management strategies depend on the bird species. Ehresman (2006) described in detail the management needs for four species – the greater prairie chicken, northern harrier, Henslow's sparrow and bobolink. The latter two provide examples of management strategies that could be implemented at the Dubuque Technology Park. Excerpts from Ehresman's (2006) treatment of these species is presented in this section.

Henslow's sparrow

Henslow's sparrow is a species that historically was very much associated with tallgrass prairie, where it nested in the tall prairie grass interspersed with forbs and prairie shrubs. It typically nests in tall, dense grass with a well-developed litter layer and a high amount of standing dead vegetation. In Iowa, Hayden Prairie State Preserve in Howard County has a long history of Henslow's sparrows during the breeding season (Dinsmore et al. 1984).

The three primary keys to management of Henslow's sparrow are 1) providing large areas with suitable habitat (tall, dense, herbaceous vegetation with well-developed litter), 2) avoiding breeding habitat disturbances during the nesting season, and 3) controlling succession using management tools (Herkert 2003). To help this declining species, it is crucial that remaining grassland habitat is protected from fragmentation. In addition, active grassland management that is necessary to maintain suitable habitat for Henslow's sparrow and other grassland species must be implemented (Herkert 1994a). Without disturbance or management, upland grasslands will be invaded and eventually replaced by woody growth, excluding Henslow's sparrow from using the habitat. Herkert et al. (1993) recommended that grassland restoration areas should be at least 125 acres and preferably larger than 250 acres in size. Other researchers suggest that at least 75 acres of contiguous grassland be provided (Zimmerman 1988, Smith 1992). If a large enough contiguous grassland is not available to allow this bird to nest, then provide a complex of smaller units located near enough to one another to encourage colonization from adjacent territories.

Other management recommendations include: never burn, mow, or otherwise disturb an entire area in one breeding season, because disturbance reduces available habitat for one or two growing seasons (Herkert et al. 1993, Melde and Koford 1996); implement a rotational disturbance regime to maintain grassland habitat (Zimmerman 1988, Herkert 1994b, Melde and Koford 1996); remove woody vegetation within and along the periphery of grassland patches to discourage predator use and to enlarge the amount of interior grassland (O'Leary and Nyberg 2000); and conduct management treatments in order to avoid

destruction of nests before birds arrive in the spring (15 April) or after the young have fledged (15 September) (Smith 1992, Hanson 1994).

The three primary management techniques used to prevent woody invasion and maintain Henslow's sparrow habitat are: burning, mowing, and grazing. The goal is to provide dense and moderately tall (> 75 inches) grassy vegetation (Smith 1992) and to remove woody vegetation when it becomes taller than the fully developed herbaceous vegetation (Smith 1992, Herkert et al. 1993). In Illinois, the use of a rotational burning program is recommended in which 20-30% of the site is burned each year. Management units should be at least 50-75 acres, if possible (Herkert 1994b). Prescribed burns should be conducted in early spring (March to early April) or late fall (October and November) (Herkert et al. 1993). In Missouri, conservation haying (one annual cut after mid-July) on a two-to-three-year rotation was found to be a more effective tool than prescribed burning (Swengel and Swengel 2001). Herkert (2003) suggested that mowing should not be allowed in areas with nesting Henslow's sparrows until after the breeding season (about 15 August). Pastures can be managed for Henslow's sparrows through use of light grazing. Light grazing is defined as grazing pressure that left less than 40% vegetative cover at 10 inches height (Skinner et al. 1984).

By using a rotational system that incorporates any of the above practices, several grassland successional stages can be maintained, and essential habitat is provided for many grassland species, including northern harrier, bobolink, grasshopper sparrow, upland sandpiper, and meadowlarks (Herkert 1994a, Zimmerman 1988).

Bobolink

The bobolink is a species of the tallgrass prairie ecosystem. It prefers habitat with moderate to tall vegetation, moderate to dense vegetation, moderately deep litter (Bollinger 1995), and without the presence of woody vegetation (Bollinger and Gavin 1992). Presently in Iowa this species is found in old fields, pastures, wet meadows, and prairie, and it seems to especially prefer old hayfields.

The keys to bobolink management are providing large areas of suitable habitat (native and tame grasslands of moderate height and density, with adequate litter), controlling succession, and protecting nesting habitat from disturbance during the breeding season (Dechant et al. 2003). Avoid disturbing (e.g., haying, burning, moderately or heavily grazing) nesting habitat during the breeding season, early May to early August. Treatments can be done in early spring (several weeks prior to the arrival of adults on the breeding grounds) or in the fall after the breeding season.

Create habitat patches larger than 25-75 acres and minimize woody edges whenever possible to decrease brown-headed cowbird brood parasitism (Bollinger and Gavin 1992). These authors also recommended creating or maintaining patches of relatively sparse, grass-dominated vegetation resembling old (>8 years since planted) hayfields.

When managing prairie for bobolinks, use a rotating treatment schedule on several adjacent grassland fragments to make a variety of successional stages available. Burn within large areas that are over 200 acres total using a rotational system; subunits of at least 75 acres in size, or about 20-30% of the total area, should be treated each year (Herkert 1994*b*). In small, isolated prairie fragments, burn less than 50-60% of the total area at a time (Herkert 1994*b*). Mow or burn patches every two to three years to prevent excessive encroachment of woody vegetation (Bollinger and Gavin 1992, Herkert 1994*a*). To create bobolink nesting habitat, graze at moderate levels to provide diverse grass heights and densities in areas where the average height of vegetation is 8-12 inches, and graze using a rotational system of two or more

grazing units (Skinner 1975). This will increase the variation in grass heights and densities within and between units. To maintain plant vigor, do not graze warm-season grasses in tallgrass prairie to a height of less than 10 inches during the growing season (Skinner 1975).

This review of grassland bird management is provided to assist Dubuque Audubon Society in its efforts to guide the management of the grasslands at the Dubuque Technology Park. Three documents are particularly important and should be reviewed for more details and information.
1) Ehresman, B.L. 2006. Managing for Iowa's birds of Greatest Conservation Need.
2) Sample, D. W., and M. J. Mossman. 1997. Managing habitat for grassland birds: a guide for Wisconsin.
3) Herkert, J. R., R. E. Szafoni, V. M. Kleen, and J. E. Schwegman. 1993. Habitat establishment, enhancement and management for forest and grassland birds in Illinois

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