The Journal of the Iowa Academy of Science: JIAS

Volume 97 | Number Article 6

1990

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Jour. Iowa Acad. Sci. 97(4):115-120, 1990

Changes in a Prairie Bird Population From 1940 to 1989

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We repeated a bird census of a prairie/field community that was done by Kendeigh (1941) in 1940. Changes in the bird populations were compared with changes in vegetation, agricultural land use for the county, and trends in urbanization. Grassland birds did decline in abundance due to causes similar to those cited in other studies. The increase in forest and edge nesting species was more unusual to this study, and probably correlated with the woody succession that had occurred.
INDEX DESCRIPTORS: Bird populations, bird census, prairie birds, plant succession, habitat changes, urbanization.

Numerous studies have indicated regional changes in bird populations (e.g., Graber and Graber 1963, Walcott 1974, Aldrich and Coffin 1980, Lowther 1984, Applegate and Willms 1987, Zaletel and Dinsmore 1985, Mayfield 1989). A value of these studies is the correlation between human-induced and/or natural habitat changes with changes in populations of nesting birds. Ultimately, such studies provide a better understanding of avian habitat selection in a changing environment.

In 1940, Kendeigh (1941) thoroughly censused the birds of a field/prairie community in northwestern Iowa. Many changes have occurred in the almost 50 years since Kendeigh's study, and we repeated his census in 1989 to quantify the present avian population.

In addition to comparing census results, we quantified habitat changes that have occurred because of both human impacts as well as natural causes. These trends in habitat changes were examined for correlations with changes in the bird populations between Kendeigh's (1941) census data and those of our study. We also examined data from the two studies and compared these data with trends in bird populations reported from other midwestern studies of grassland habitats.

STUDY AREA AND METHODS

Although the exact boundaries of Kendeigh's (1941) study area were not recorded, the disturbed prairie remnant known locally as the "old north-40" at Iowa Lakeside Laboratory (ILL) in Dickinson County, Iowa was his study area. We censused the NE quarter of the NW quarter of Sec 23 and approximately half of the SE quarter of the NW quarter of Sec 23 (Lakeville Twp.) (T99W, R37W; 43°23'N, 95°11'W). This area contained about 20.6 ha, which was barely larger than the 20 ha area used by Kendeigh. A firebreak road separated these two areas.

The study area has been partially described by Rudman and Pohl (1951) and Lowther (1983), and the following summarizes their descriptions and compliments them with our own information. The upland areas were covered with field/prairie grasses and prairie forbs dominated by Kentucky Bluegrass (*Poa pratensis*) in the low-lying areas. Scattered shrubs, including buckbrush (*Symphoricarpos occidentalis*) and smooth sumac (*Rhus glabra*) were also found in the uplands. The study area also contained riparian vegetation around 3 hanging bogs with small streams, thickets of woody plants adjacent to Miller's Bay of West Okoboji Lake, and a successional woods dominated by boxelder (*Acer negundo*) and green ash (*Fraxinus pennsylvanica*). The successional woods contained a series of maintained trails that were often bordered by Tartarian honeysuckle (*Lonicera tatarica*). A major two-lane highway bordered the study area to the west, and a paved, county road formed the northern border.

The area was never plowed, but was heavily grazed until 1930. A burn management program was initiated in the 1950's, but has not been done in a consistent fashion. However, prairie plants were more in evidence in the uplands than were described by Rudman and Pohl (1951), probably because of the burning. During the winter of 1988-89, 2 thickets of box elders, approx. 6 m diameter each, were cut along the south-western margin of the uplands, and this management is expected to continue.

Kendeigh (1941) censused brids from early June to mid-August, 1940. While he did not record the methodology or the time spent in the census, he attempted to find all nests and delineate bird territories. KKB and SRW censused the upland field/prairie habitat on 11 days (21.5 man-hours) between 5 and 25 June, 1989 during different times of the day. They used a combination of strip census with spot mapping. In addition, they attempted to locate all nests. NPB censused the hanging bogs and successional woodlands by spot mapping during the same time period. On 4 mornings (5 man-hours), between 0530 and 0700, NPB walked the maintained trails within the successional woodlands and around the hanging bogs. We pooled the data to determine the location of bird territories for the entire area. Additionally, NPB has mist netted along the trails in the successional woodland from late June to early July in 1988 and 1989.

Kendeigh (1941) grouped birds into 4 categories: species that both fed and nested on the prairie, species that nested elsewhere but fed on the prairie, species confined chiefly to forest edge, and species confined chiefly to seral communities. We modified the first category to include prairie/field habitat because the upland is a mixture of native and introduced grasses. We also lumped the latter two categories to include forest and edge habitat (Table 1) because seral stages were not easily distinguishable.

Trends in population changes between Kendeigh's study and ours were compared with trends in Breeding Bird Survey (BBS) data for Iowa from 1967-1987 (unpubl. data, BBS, U.S. Fish and Wildl. Serv.). In addition, Zaletel and Dinsmore (1985) describe the BBS and have also analyzed trends in Iowa's bird populations using 2 sets of 3 years of BBS data. Unless noted, reference to BBS will refer to the 1967-1987 data. Additional comparisons were made with Lowther (1983, 1984, 1985, 1986, 1989, 1990) who censused the upland grassland area.

Maps of woody plant succession were drawn from aerial photos obtained from ILL (1939) and the Dickinson County ASCS office (1962, 1968, 1978, 1988), and proportions of woody plants to prairie/field habitat were calculated using a Tektronix Tablet Digitizer with a planimeter program. For further comparison, photographs were also taken in what we estimated were the same locations as the photographs in Kendeigh's (1941) paper, and data on land use and demographics since 1940 were also gathered.

RESULTS

Major differences were noted between Kendeigh's (1941) census and our study (Table 1). For the species that both fed and nested in the prairie/field habitat (Table 1a), all the birds observed by Kendeigh

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Table 1. Comparison of bird populations between 1940 and 1989.

	Number of individuals 1940	1989
A. Species that both fed and nested on prairie/field		
Ring-necked Pheasant (*Phasianus colchicus*)	14±	2±
Bobolink (*Dolichonyx oryzivorous*)	16	0
Western Meadowlark (*Sturnella neglecta*)	6	1
Grasshopper Sparrow (*Ammodramus savannarum*)	16	0
Dickcissel (*Spiza americanum*)	0	4
B. Species that nested elsewhere but fed in area		
Red-tailed Hawk (*Buteo jamaicensis*)	0	1
Northern Harrier (*Circus cyaneus*)	2	0
American Kestrel (*Falco sparverius*)	2	0
Short-eared Owl (*Asio flammeus*)	1	0
Eastern Kingbird (*Tyrannus tyrannus*)	2	0
Northern Rough-winged Swallow (*Stelgidopteryx serripennis*)	0	1
Barn Swallow (*Hirundo rustica*)	5±	4
Purple Martin (*Progne subis*)	5±	1
American Crow (*Corvus brachyrhynchos*)	2	2
C. Forest and edge nesting species		
Mourning Dove (*Zenaida macroura*)	0	10
Black-billed Cuckoo (*Coccyzus erythropthalmus*)	0	1
Great Horned Owl (*Bubo virginianus*)	0	1
Northern Flicker (*Colaptes auratus*)	0	2+
Downy Woodpecker (*Picoides pubescens*)	0	2
Hairy Woodpecker (*Picoides villosus*)	0	2
Great Crested Flycatcher (*Myiarchus crinitus*)	0	1
Willow Flycatcher (*Empidonax traillii*)	4	4
House Wren (*Troglodytes aedon*)	2	12
Gray Catbird (*Dumetella carolinensis*)	2	16
Brown Thrasher (*Toxostoma rufum*)	0	4
American Robin (*Turdus migratorius*)	0	4
Yellow Warbler (*Dendroica petechia*)	18	30
Common Yellowthroat (*Geothlypis trichas*)	8	30
Red-winged Blackbird (*Agelaius phoeniceus*)	2	18
Common Grackle (*Quiscalus quiscula*)	0	20+
Brown-headed Cowbird (*Molothrus ater*)	0	9
Northern Oriole (*Icterus galbula*)	0	2
Northern Cardinal (*Cardinalis cardinalis*)	0	2
Indigo Bunting (*Passerina cyanea*)	0	4
Song Sparrow (*Melospiza melodia*)	1	16
American Goldfinch (*Carduelis tristis*)	0	14

were less abundant, and we found one species, the Dickcissel, that was not recorded in 1940. Differences were also noted for the species that nested elsewhere but fed in the study area (Table 1b). We did not see a Northern Harrier, American Kestrel, Short-eared Owl, Eastern Kingbird, or as many Purple Martins as Kendeigh, but we saw approximately the same number of Barn Swallows and American Crows. However, we recorded a Red-tailed Hawk, a Great Horned Owl, and a Great Crested Flycatcher, none of which were listed by Kendeigh. We noted increases in all forest and forest edge nesters censused by Kendeigh as well as 12 species not observed in 1940. To summarize, 6 of the 18 (33%) species observed by Kendeigh were no longer present and 10 (56%) of the original species had declined. In the prairie habitat, all of the original nesting species had decreased, and all of the original species from categories A and B (Table 1) had

Table 2. Agricultural land usage (hectares) for Dickinson County.

	1940	1988
Corn	26,258	31,567[a]
Soybeans	1,425	29,624
Oats	20,797	5,747
Hay	7,945	4,209[b]
Barley	3,153	----
Rye, Wheat, Flax, Timothy	650	----
Popcorn	31	----
Total Pasture	21,137	5,825
Permanent Pasture	10,623	2,761
Woodland Pasture	995	287
Total[c]	81,396	76,972

Source: U.S. Dept. Agric., Ia. Agric. Statistics Serv.
[a]± 10-15% for 1989
[b]−25% for 1989
[c]Excluding Permanent and Woodland Pasture

decreased. However, we noted a 95% increase in forest and forest edge species (Table 1c). Not included in Table 1 was a female Black-and-white Warbler (*Mniotilta varia*) mist netted by Bernstein on 4 July 1988 in the woodland near the lake. Rose-breasted Grosbeaks (*Pheucticus ludovicianus*) and Wood Thrushes (*Hylocichla mustelina*) have also been netted and observed in recent years, and it is possible that our data for the woodland area in 1989 underestimated typical populations.

By the end of June, hundreds of Red-winged Blackbirds, Common Grackles, and Brown-headed Cowbirds roosted in the trees, and the population of these species rose dramatically in a matter of days.

The adjacent lands to the west have remained largely agricultural in the last 49 years, and most of the county is used for agriculture (U.S. Dept. of Agric., pers. comm.). However, land usage for agriculture has changed within the county (Table 2). The total land in agriculture has dropped somewhat from 1940 to 1988, and hectares in corn has only slightly increased. However, land in pasture, hay, and grass-like species has greatly decreased, and in place of these non-row crops, soybeans have been planted.

Along with changes in land usage, chemical application has also changed. While little nitrogen fertilizer was used prior to 1966, 19,380 tons of nitrogen fertilizer were sold in Dickinson Co. in 1988 (U.S. Dept. Agric., pers. comm.). Insecticide and herbicide application has also increased, but is harder to quantify for the state or the county. D.D.T., an insecticide known to affect bird populations, was applied in Iowa largely for mosquito control starting in the late 1940's, but was phased out by the late 1960's. However, since that time, usage of other pesticides has steadily increased (H. Stockdale, pers. comm.).

Along West Lake Okoboji, the surrounding lands resembled the study area in 1940, and aerial photos showed the presence of wetlands and grassy habitats at the time of Kendeigh's study. However, this region, Wahpeton, has increased in the human population more rapidly than other parts of the county which has resulted in destruction of the natural habitats present in 1940. From 1940 to 1980, the neighboring city of Milford increased 73% and the entire Dickinson Co. increased 67%. In contrast, Wahpeton increased 475% as the lakeshore was developed (Table 3). Along with altering the land, this increase in population has led to an increase in traffic, especially in the summer when the population dramatically increased with summer residents and vacationers. Average Annual Daily Traffic along the west border, Hgwy 86, was estimated at 253 in 1938, 530 in 1941, and 2970 in 1988 with most of the traffic occurring in the summer

Table 3. Human population trends in Dickinson County.

	1940	1950	1960	1970	1980
Wahpeton, Ia	73	127	382	397	420
Milford, Ia	1202	1375	1476	1668	2076
Dickinson Co	6433	7487	7563	8246	10,746

Source: Dickinson County Courthouse

(Ia. Depart. of Transp., pers. comm.). Along with more vehicles per day, the speed of the vehicles has also increased.

Natural changes have also occurred, and the study area has changed greatly since 1940 because of plant succession (Fig. 1). During Kendeigh's study in 1940, shrubs and trees only covered about 5.4% of the area. Coverage of woody vegetation had increased to 23.2% by 1962, 24.6% by 1968, 27.2% by 1978, and 50.3% by 1988. A comparison of photographs indicated tht the upland areas have remained relatively the same since 1940, but similarities were exagerrated because of the recent cutting of box elders (Figs. 2a and b). In contrast, the lakeshore has greatly changed. While Kendeigh's photograph showed an uninterrupted view of Miller's Bay to the east in 1940, the lake could not be seen through the forest in 1989 (Figs. 3a and b). Additional changes include the invasion of shrubby vegetation in the uplands (Fig. 4).

DISCUSSION

Comparisons between Kendeigh's (1941) study and the present one are limited because both were one-year censuses. Bird populations fluctuate both yearly and locally, and neither study can claim total accuracy regarding the breeding birds. However, some trends were evident.

A potential source of discrepancy between the 2 studies was the greater time Kendeigh spent for his census. This difference would have caused us to underestimate late breeders or double brooded birds such as the Western Meadowlark, Grasshopper Sparrow, Dickcissel, American Goldfinch, House Wren, Gray Catbird, Brown Thrasher, Common Yellowthroat, Red-winged Blackbird, and Song Sparrow. However, with exception of the Western Meadowlark and Grasshopper Sparrow, we found more individuals of these species than did Kendeigh. Lowther (1983, 1984, 1990) has observed 1-3 Western Meadowlarks and 1-3 Grasshopper Sparrows on the upland grassland

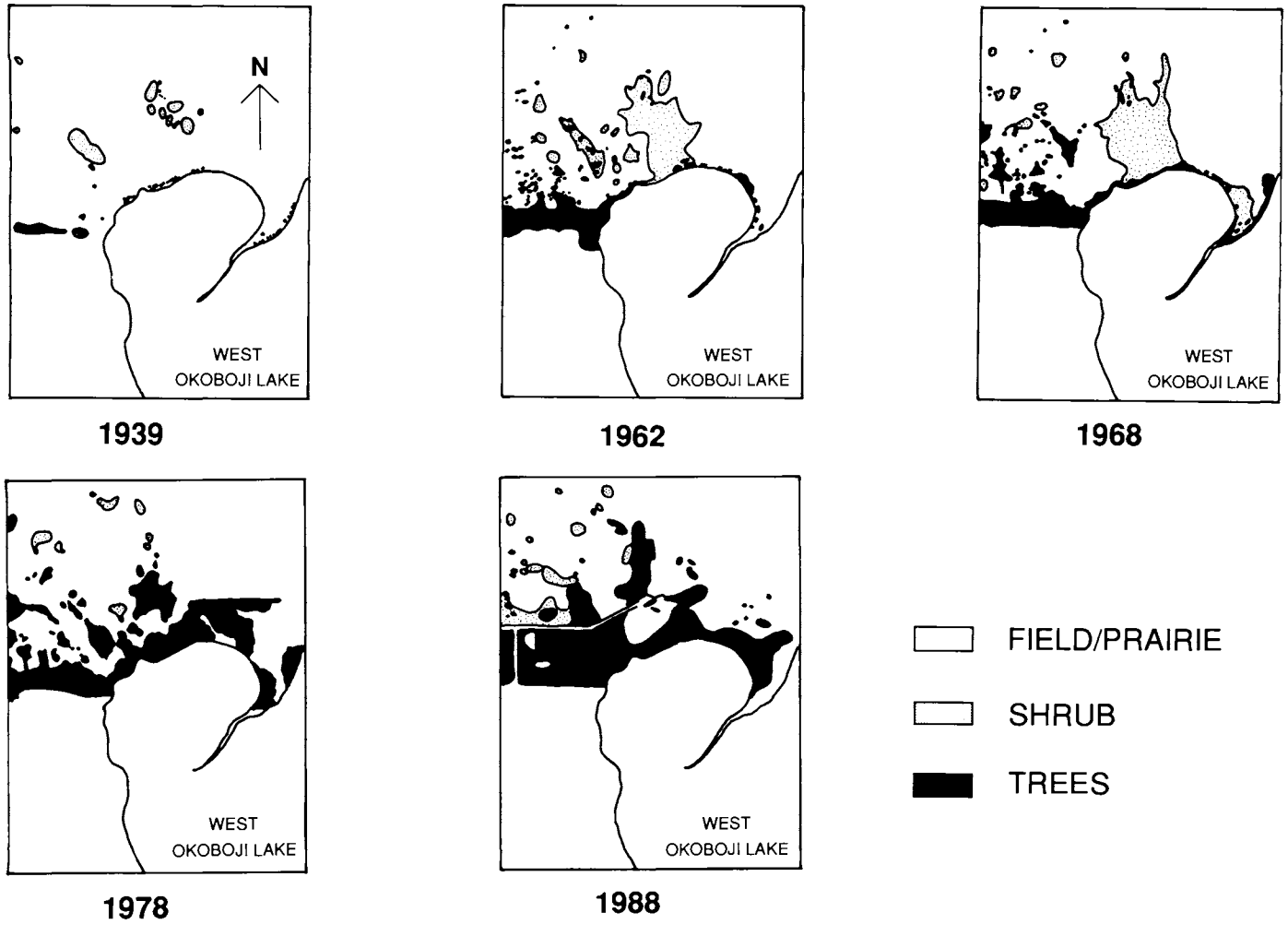

Fig. 1. Woody plant succession on N40, 1939-1988, based on aerial photographs. SW quarter of illustrations are the buildings and campus of Iowa Lakeside Lab.

Fig. 2. Looking north from firebreak road. 2a. 1940 from Kendeigh (1941) showing upland field/prairie with little woody vegetation. 2b. 1989 from present study showing a few changes to upland area from this view, but note recently cut box elders in foreground.

in various years, but detected neither species in mid-June 1988 (Lowther 1989) and only 1 territorial male Western Meadowlark and no Grasshopper Sparrows during his census in early June, 1989 (Lowther 1990). Therefore, a decrease in both of these species was evident before our study, and our failure to detect any individuals of these conspicuous species probably meant that the W. Meadowlark seen by Lowther in 1989 did not remain in the North 40 to breed.

Both W. Meadowlarks and Grasshopper Sparrows are either Blue-listed (possibly becoming threatened) or of Special Concern on the National Audubon Society Blue List (Tate and Tate 1982), and sightings of both species have declined by 62.2% and 57%, respectively, according to the BBS. However, using a subset of the data, Zaletel and Dinsmore (1985) concluded that the Grasshopper Sparrow had remained stable in Iowa.

We also detected declines in the Ring-necked Pheasant, Bobolink, Northern Harrier, American Kestrel, Short-eared Owl, and Eastern Kingbird. Lowther (1983, 1984, 1985, 1986) only detected 1 Ring-necked pheasant in the study area each year, and BBS data indicated a 35.8% decline for Iowa. Failure to see Bobolinks agreed with Lowther, who only noted 1 individual in June, 1983 (Lowther 1984), as well as a 57.4% decline in BBS data. Roosa and Stravers (1989) documented the scarcity of nesting Northern Harriers and Short-eared Owls in Iowa, and Lowther (1983, 1984, 1985, 1986, 1989, 1990) did not detect either species. As recent as 1988, a pair of Northern Harriers did nest in Dickinson Co. and a pair of Short-eared Owls probably nested in neighboring Emmet Co. However, neither species nested in the area in 1989, to the best of our knowledge, and we did not observe either in adjacent lands. While Lowther (1983) saw a single American Kestrel and Zaletel and Dinsmore (1985) noted an increase in sighting along BBS routes, we saw none in or near the study area. Eastern Kingbirds have also increased along Iowa BBS routes (Zaletel and Dinsmore 1985), but show a 16% decline for the whole 20-year data set (unpub. data, BBS, U.S. Fish and Wildl. Serv.). However, Eastern Kingbirds are common throughout Dickinson Co., and while we did not see any in 1989, they probably are present most years. Lowther (1983, 1985, 1986, 1990) saw 1 during June of several years, but usually listed them as visitors. Purple Martins were less common which agreed with BBS data. Other birds not recorded by us, but listed as visitors during past censuses of the upland area included: Gray Partridge (*Peridix perdix*) (Lowther, 1983), Cedar Waxwing (*Bombycilla cedrorum*) (Lowther 1984), Yellow-billed Cuckoo (*Coccyzus americanus*) (Lowther 1985), and the Field Sparrow (*Spizella pusilla*) (Lowther 1985).

It is perplexing that Kendeigh (1941) did not note any Dickcissels. He even stated that Dickcissels were common in the area, but believed that they were more typical of seral stages with sparse vegetation rather than the climax grassland that he studied. However, Dickcissels were well-documented for that specific area at the time of Kendeigh's study (Stephens 1938, King 1944). Our reported increase in Dickcissels differs from the almost 70% decline on Iowa BBS routes, a decline that has been noted nationwide (Fretwell 1977 and 1986, Dinsmore *et al.* 1984).

Our reported decline in grassland birds has also been documented by several authors (e.g., Graber and Graber 1963, Dinsmore 1981, Mayfield 1989). The most obvious reason for the decline in grassland birds was the reduced area of grassland in the study area because of woody succession (Fig. 1). Prairie habitat has also decreased throughout the state (Smith 1981), and, over time, this could have impacted bird populations on the study area by reducing potential breeders from surrounding habitats.

Agricultural land use outside of the study area could also affect the whole region. Graber and Graber (1963) documented that row-crops supported lower densities of birds than pastures, most grain crops, and hay, and Tinker (1914) and Gabrielson (1917) both noted that several of the species in Categories A and B (Table 1) nested in hayfields, pastures, and meadows in the region.

However, the most dramatic difference between Kendeigh's (1941) study and ours was the increase in forest and edge nesting species, especially if we included the Black-and-White Warbler, Rose-breasted Grosbeak, and Wood Thrush. Of the birds in which we noted large increases, BBS data also indicated increases in House Wrens, Gray Catbirds, Com. Yellowthroats, and Song Sparrows. However, BBS data indicated decreases in the Mourning Dove, Yellow Warbler, Red-winged Blackbird, Common Grackle, and the American Goldfinch, all of which were more numerous in our study. Few data are comparable for these species on the study area because Lowther (1983, 1984, 1985, 1986, 1989, 1990) only censused the uplands, and this study not only censused the uplands but also the successional forest. However, D. Cox (student paper, Ia. Lakeside Lab. 1982) found 41 Yellow Warbler territories in the same study area, and Bernstein (unpubl. data) mist netted 12 adult Gray Catbird adults between 20 June - 7 July, 1988, along approximately 18 m of one of the trails through the successional woods.

Correlations between forest succession and increases in bird numbers and diversity have been noted by Dambach (1944), Lanyon (1981), May (1982), and Helle (1985), but forest and edge bird species have declined through much of the state because of loss of habitat (Dinsmore 1981, Zaletel and Dinsmore 1985). The increase in woodland and edge habitat in the study area is atypical for the

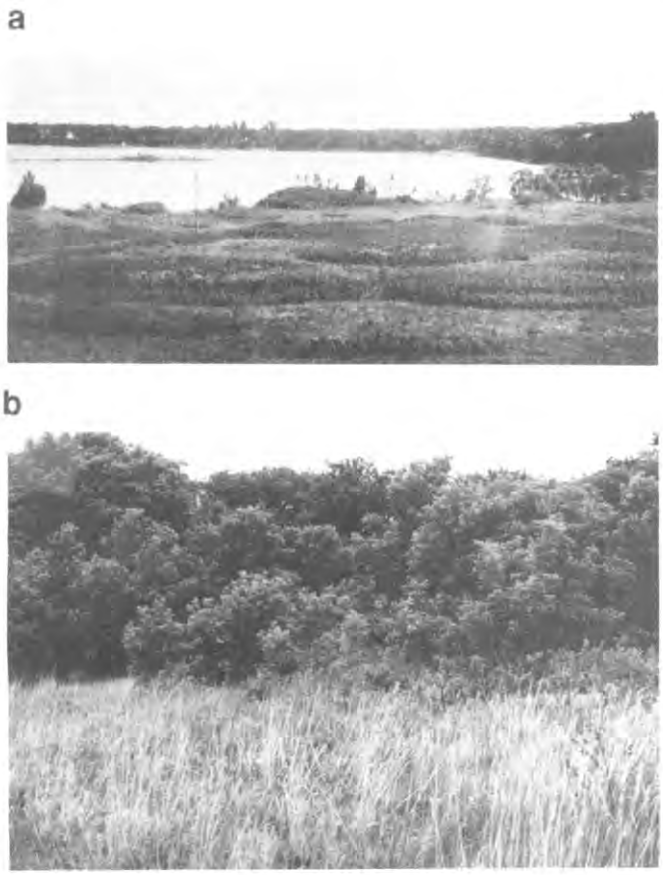

Fig. 3. Looking east from firebreak road. 3a. 1940 from Kendeigh (1941) showing uninterrupted view of the lake. 3b. 1989 from present study showing succesional forest that now blocks view of lake.

county which lost 85% of its woodlands between 1954 and 1974 (Thomson and Hertel 1981).

Additionally, the development of adjacent lands into residential property has turned the study area into a habitat island since 1940, and small, fragmented habitats typically support fewer species (Robbins 1979, Dinsmore 1981, Freemark and Merriam 1986). However, urban habitat favors habitat generalists such as: the Mourning Dove, Gray Catbird, American Robin, Common Grackle, and Song Sparrow (Aldrich and Coffin 1980, Zaletel and Dinsmore 1985), as opposed to more specialized grassland and forest species. Habitat fragmentation also increases edge habitat which could lead to higher predation and brood parasitism rates (Reese and Ratti 1988). Brood parasitism has been listed as a major cause in the decline of Dickcissels (Fretwell 1986), and other species may be similarly affected. However edge habitats can also lead to greater bird diversity, even in an agricultural setting (Best *et al.* 1990).

Along with more people has come more traffic at higher speeds. While this could be a potential disturbance and source of mortality that would further isolate breeding birds on the study area, it is difficult to directly correlate observed changes with this factor.

It is also difficult to directly correlate application of farm chemicals with the changes in breeding birds. Most of the birds observed are at least partially insectivorous through the breeding season, and decreases in insects and soil invertebrates from farm chemicals would negatively impact these species throughout the county and state.

Therefore, we conclude that human impacts, particularly agricultural land usage, have led to a decline in the grassland bird community under study, but this is indicative of a statewide pattern. More unique to this study were the changes in the bird community that were directly correlated with woody plant succession on the unmanaged study area, and this, along with urbanization, has led to an increase in forest and edge species as well as habitat generalists.

ACKNOWLEDGEMENTS

We thank Greg Thorson for help with data collection, the staff of Iowa Lakeside Laboratory for their support, J. Giglierano of the Geological Survey Bureau, Iowa Department of Natural Resources, for use and help with the planimeter program, and the following agencies for assistance: Dickinson County Agriculture Soil Conservation Service, Dickinson County Courthouse, Wahpeton City Hall, Iowa Department of Transportation, Iowa Agricultural Statistics Service of U.S. Department of Agriculture, and Iowa State University Agriculture Exension Office. The study was financially supported, in part, by Mount Mercy College. M. Lannoo undertook the organization of all the papers, and we thank him for his work along with helpful criticisms from J.J. Dinsmore, P.E. Lowther, P.A. Christiansen and R.W. Cruden. Finally, R.V. Bovbjerg brought Kendeigh's paper to Bernstein's attention in 1988. We are especially grateful for his friendship, guidance, and foresight as well as his dedication to Iowa Lakeside Laboratory.

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Fig. 4. Looking south from north border showing invasion of smooth sumac into upland field/prairie community.

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