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Breeding Bird Populations in Iowa, 1968-1980[1]

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A comparison of Breeding Bird Survey (BBS) data in Iowa between 1968-1970 and 1978-1980 suggests that 19 species have increased in numbers and that 18 have declined over that period. Most species showing increases are associated with agricultural and grassland habitats. Most species showing decreases are associated with agricultural and edge-oldfield habitats. A variety of factors is probably responsible for these declines. BBS results are fairly consistent with the National Audubon Society's Blue List — birds thought to be declining — but show little correlation with that group's list of species of special concern.

The BBS detected at least 68% of the birds known to breed in Iowa, although not all of those were detected each year. About the same number of species were reported from each of five regions in the years considered, although the same species were not seen in all areas. Still, 73 species reported in all five regions dominate the state's avifauna. Some biases related to the species' detectability and observer competence are evident in the data. Overall, BBS data do seem to be meeting their goal of providing quantitative information useful in detecting long-term changes in bird populations.

INDEX DESCRIPTORS: Bird counts, bird census, bird populations, Iowa birds, habitat changes

Starting in 1966, the U. S. Fish and Wildlife Service has conducted a yearly series of Breeding Bird Surveys (BBS) across much of North America. Each BBS route consists of 50 stops at 0.5-mile (0.8 km) intervals along an established road. At each stop, an observer tallies all birds seen or heard within a 3-minute period within 0.25 miles. Counts begin one-half hour before sunrise, run about 4 hours, and are taken on a day without weather extremes in the height of the avian breeding season from late May through early July (see Robbins and Van Velzen 1967 for details). The goal of these counts is to plot distributional patterns, quantify bird numbers, and detect year-to-year changes in abundance of individual species.

There have been a few large-scale analyses of these data (e.g., Dolbeer and Stehn 1979). Analysis at the state level has been attempted for Minnesota (Henderson 1981), Wisconsin (Robbins 1982), Nebraska (Anonymous 1978), and Kansas (Zimmerman 1979) but not for Iowa. This paper compares the number of individuals of selected bird species detected on BBS routes in Iowa in two 3-year periods 10 years apart (1968-1970 and 1978-1980). This spans a time period during which agricultural activity in Iowa generally became increasingly intensive and mechanized with associated losses in wildlife habitat (e.g., larger fields, fewer pastures, fewer fencerows, smaller woodlots, and less of other types of wasteland). Such changes presumably affect bird populations (e.g., Ring-necked Pheasant, Farris et al. 1977).

Specifically we hope to accomplish four objectives. First, we address the question of how effective the BBS is in detecting birds known to breed in Iowa. Second, what species show evidence of increasing or decreasing numbers? Third, what reasons might account for any population changes noted, and are there any general patterns of change? Finally, what information do BBS provide on the abundance patterns of Iowa's birds in different areas of the state?

METHODS

BBS data from Iowa for the 1968-1970 and 1978-1980 were used for this paper. We divided the state into the five regions used by the Iowa Conservation Commission for game bird surveys (Figure 1). The average number of individuals of each bird species seen per route for each region was determined for each 3-year period. The coverage in each of the five regions approximately matched each region's proportion of the state's area (Table 1). Statewide completeness in coverage increased from 77% in 1968-1970 to 91% in 1978-1980 (Table 1). Routes not run in a given year were excluded when averages were figured. A total of 147 species have been reported on BBS routes in Iowa in 1967-1980. Only those 69 species that had an average of at least 1.0 bird per route for at least one of the five regions in either 1968-1970 or 1978-1980 are considered in any detail here.

The various problems inherent in BBS data have been dealt with previously (e.g., Faanes and Bystrak 1981, Robbins 1981a,b). One problem evident to us in analyzing these data was correct identification of certain species (especially meadowlarks). Because problems misidentifying meadowlarks were evident in that data (complete shifts in abundance on a given route from year to year, see Wilson 1983), plus a large component of unidentified meadowlarks, we combined all meadowlark counts. The Eastern Meadowlark is predominant along the Mississippi River in southeastern Iowa and in southern Iowa, whereas the Western Meadowlark is most abundant elsewhere (Dinsmore et al. 1984). It was also evident that some counters detected more species and more individuals per species than others who had surveyed the same route. We assume that, given the volume of data considered here, these problems will not have a great impact on conclusions drawn.

In an attempt to determine whether populations of a species had changed, we compared per-route averages in each region for each of the 3-year periods. An increase or decrease in numbers within a region was defined as at least a 20% change between the 3-year averages. We then tallied the totals of increases and decreases for the five state regions for each species. We defined a statewide population change as having occurred only if there was a plurality of two or more in the regional increases or decreases for that species. For example, Blue Jays decreased by more than 20% in three regions, increased in one region, and showed no change in one region (Figure 6A). This tallies to three decreases and one increase or a plurality of two, and we defined the species as having declined in Iowa.

STUDY REGIONS

Below we give brief descriptions of the five state regions considered here. For a more detailed description of the landforms of Iowa, see Prior (1976), Cooper (1982), and Dinsmore et al. (1984).

Northeast Dairy Region — The northeastern corner of Iowa was largely missed by the most recent glaciation and thus is characterized by a rugged landscape with deeply eroded valleys, limestone outcrop-

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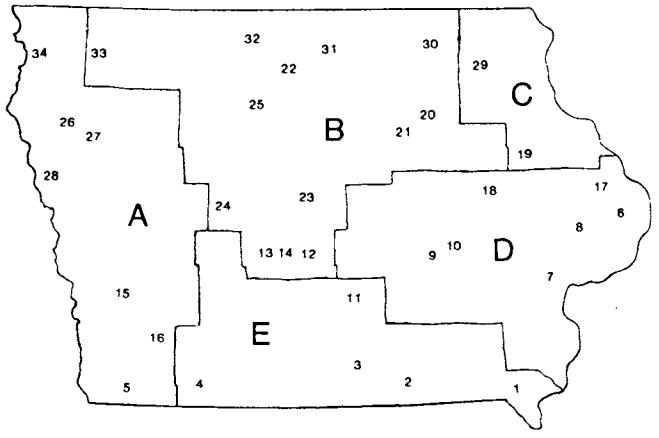

Fig. 1. The location of the 34 Iowa BBS (numbers) and the five state regions used in this analysis of Iowa birds. A = Western Livestock Region, B = Cash Grain Region, C = Northeast Dairy Region, D = Eastern Livestock Region, E = Southern Pasture Region

pings, and the largest contiguous forest area in Iowa. Although some row-crop farming is done, the fields tend to be smaller than elsewhere in Iowa. Dairy farms and pastures are common land uses.

Cash Grain Region — This large section of north-central and central Iowa was largely covered by the most recent glaciation some 11,000 years ago and has a flat to gently rolling landscape. Because of the recentness of the glaciation, relatively few major drainages have developed, and few rivers cross the region. Before settlement, this area was tall grass prairie, with thousands of small wetlands in shallow depressions. Most of Iowa's remaining native wetlands are found here. By and large, though, the current scene is one of very intensive agriculture, with the land largely devoted to row crops, especially corn and soybeans. Historically, this area was largely treeless, but now groves around farmsteads are numerous and probably have attracted birds that previously were absent from the region except along wooded watercourses.

Southern Pasture Region — The southern third of Iowa is generally of rolling to hilly relief. Although agriculture is intensive, with much land in row crops, this region contains abundant pasture land. In western Iowa, the region is largely treeless, but as one moves east, the amount in forest gradually increases so that in southeastern Iowa there are some large wooded areas. Several fairly large wooded river valleys cut across the region, draining either to the Mississippi or Missouri rivers.

Eastern Livestock Region — The eastern part of Iowa has fairly steep rolling relief, with numerous well-defined drainages and woodlands along them. Although row crops are common, the field size is somewhat limited by the topography, and much of the grain is fed to livestock. Like the Northeast Dairy Region, numerous species typical of deciduous forests are found here.

Western Livestock Region — Like the Eastern Livestock Region, this region has fairly steep relief, especially along the river valleys and in the loess hills along the Missouri River. Again, row crops are common, and much of the grain is fed to livestock in large feedlot operations. The major difference between this region and the Eastern Livestock Region is the scarcity of trees except in the river valleys, around farmsteads, and in the loess hills.

Table 1. Summary of BBS coverage in Iowa, 1968-1970 and 1978-1980.

Region	Number of BBS routes (%)	Number of times route run in period (% of max. possible) 1968-1970	1978-1980	% of state area
Cash Grain	13(38)	22 (56)	33 (85)	32
Western Livestock	7(21)	21(100)	19 (90)	23
Eastern Livestock	7(21)	21(100)	21(100)	20
Southern Pasture	5(15)	9 (60)	14 (93)	18
Northeast Dairy	2 (6)	6(100)	6(100)	7
Totals	34	79 (77)	93 (91)	

Table 2. Comparison of agricultural land use in Iowa, 1968-1970 and 1978-1980.

Crop type	Mean acres planted 1968-1970	1978-1980	percentage change
Corn	10,488,000	13,783,000	+31
Soybeans	5,639,000	8,033,000	+42
Oats	2,878,000	1,533,000	−47
Hay	2,552,000	2,310,000	−9

From U.S. Dept. Agriculture, 1971, 1981

RESULTS AND DISCUSSION

Land use in Iowa

Iowa is an agricultural state, with much of its land devoted to raising two major crops, corn and soybeans; lesser amounts are devoted to pasture, oats, and other crops. Much of the publicly owned park land consists of lowland forests along rivers and streams (greenbelts), some lakes, and hunting areas, often associated with a marsh of some type. These publicly owned lands, because of their small size and scattered distribution, have little impact on the birds reported on BBS. Indicative of this is the rarity of the Yellow-headed Blackbird on BBS, even though it is common to abundant in wetlands in the Cash Grain Region. An extensive road system, with roads usually at 1-mile (1.6 km) intervals, provides considerable roadside habitat in Iowa. In heavily farmed areas, this is a major seminatural habitat available for birds. Thus, most birds reported on BBS are those found on farmland, farmsteads, roadsides, or in the greenbelts where the BBS routes cross such habitats. The acreages of four major crops in Iowa changed for the time periods compared here (Table 2). Especially striking are the increases in corn and soybean acreages and the decline in oats. Parts of that change may be attributed to the loss in the late 1960s of several government agricultural support programs that had encouraged taking land out of production and leaving it "idle." Such land was shifted to cropland during the 1970's (Farris et al. 1977, p. 77). In many areas, livestock farming changed from feeding the animals (mainly cows and pigs) on pastures to maintaining them in feedlots or in confinement buildings, leading to a decrease in pastureland. Although data on pastureland are not available for all the years considered here, cropland use for pasture and grazing declined steadily from 4,007,000 acres in 1969 to 2,500,000 acres in 1982 (U. S. Dept. Commerce 1984), a 38% decline. In addition, other marginal lands (wetlands, woodlots, edges of farmsteads, etc.) also were converted to cropland and cultivated. The net result has been a reduction in the diversity of habitats available in Iowa, especially of those that traditonally have been considered richest in their avifauna.

Iowa nesting birds and the BBS

A total of 187 bird species have been authentically reported nesting in Iowa (Dinsmore et al. 1984). From 1967 through 1980, 147 species were reported on BBS in Iowa. The Common Raven (*Corvus corax*) reported in 1971 is deleted as misidentified. Correcting for duplications, these two lists total 203 species. Of these, 21 have nested in Iowa but not during 1967-1980 and thus would not be

expected to have been reported in the period covered here (Appendix A). Another 16 species were reported on BBS but have never been known to nest in Iowa (Appendix B). These include some late migrants, nonbreeding summer residents, and at least two that probably nest in Iowa but for which there are no authentic nesting records. Thirty-nine species known to nest in Iowa have never been reported on BBS (Appendix C). These include numerous birds of wetlands or forests, habitats that seem to be poorly sampled by Iowa BBS. This leaves 127 species known to nest in Iowa that have been reported on at least one BBS in Iowa in 1967-1980. Thus, the BBS was successful in detecting at least 68% of the known Iowa breeding avifauna over the 1967-1980 period. Omitting the 21 species that have not nested recently in Iowa, the detection rate is 77%. Of the nesting species not reported on BBS (Appendix C), at least two-thirds of them are either aquatic or forest species. This suggests either that those habitats are undersampled on Iowa BBS or that those species have a very scattered distribution in Iowa. Most likely, both factors are involved. Such bias, in which birds of wetlands and forest are easily missed while roadside birds are perhaps oversampled, must be recognized in analyses of Iowa BBS.

Of the 127 nesting species detected on BBS, 58 (46%) were found so few times that we have not analyzed their numbers here (Appendix D, see Methods). This leaves 69 species (Table 3) for which we believe there are sufficient data to look for population changes as indicated by the BBS. With the two meadowlarks combined, 68 "species" are discussed. Maps comparing the numbers of individuals seen per route, by region, are presented for these 68 in Figures 2-10.

Population Decreases

The 18 species showing population declines represent a broad array of taxonomic and habitat groups (Table 4). Some of these species are considered to have declined elsewhere (e.g., Loggerhead Shrike, Graber et al. 1973; Dickcissel, Fretwell 1977; and Eastern Bluebird, Tate and Tate 1982). These decliners also include some species whose

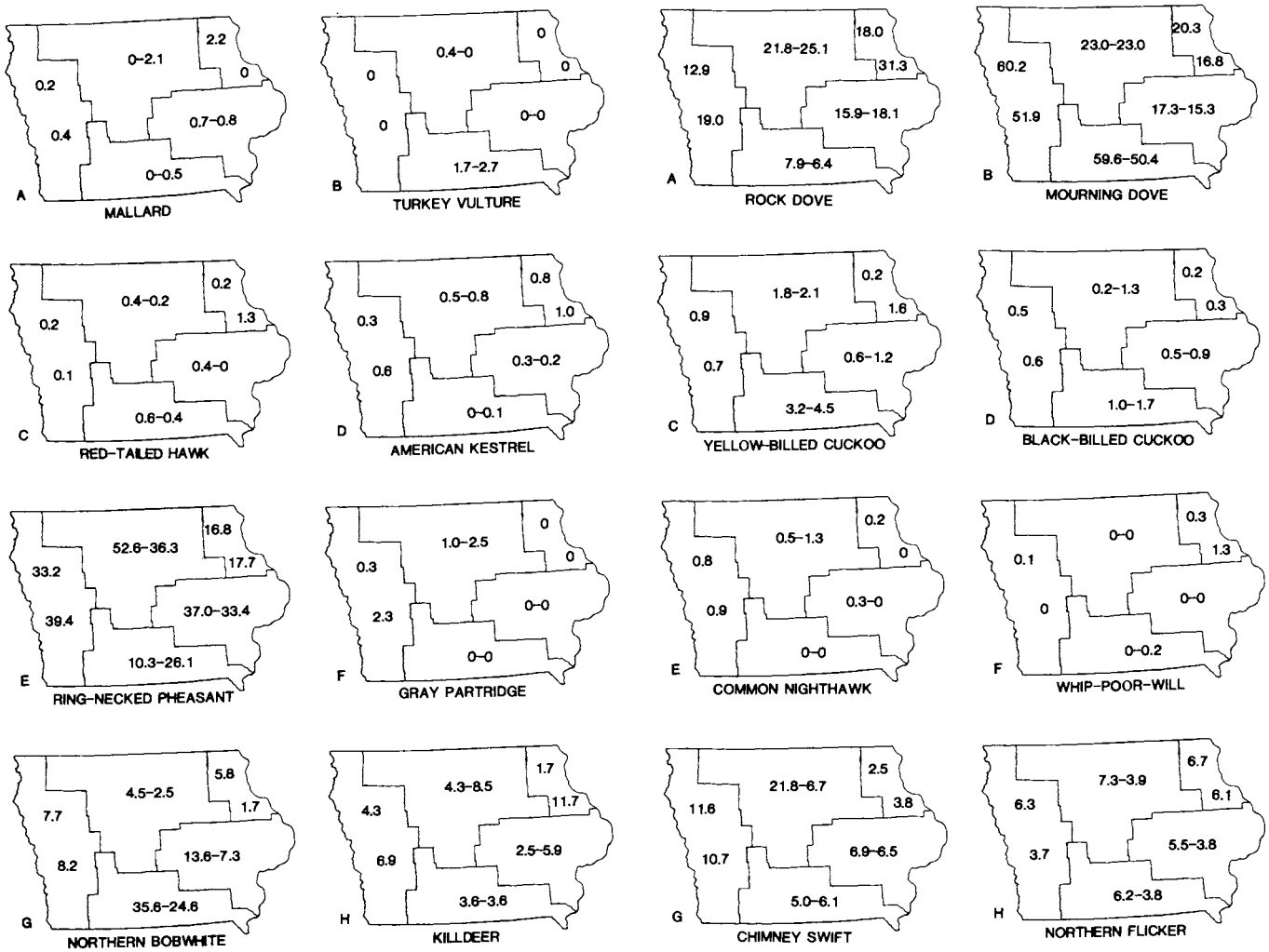

Fig. 2. Average number of birds seen per BBS in each of five regions of Iowa. For each region, the first number is the average for 1968-1970, and the second number is the average for 1978-1980.

A. Mallard
B. Turkey Vulture
C. Red-tailed Hawk
D. American Kestrel
E. Ring-necked Pheasant
F. Gray Partridge
G. Northern Bobwhite
H. Killdeer

Fig. 3. Average number of birds seen per BBS in each of five regions of Iowa. For each region, the first number is the average for 1968-1970, and the second number is the average for 1978-1980.

A. Rock Dove
B. Mourning Dove
C. Yellow-billed Cuckoo
D. Black-billed Cuckoo
E. Common Nighthawk
F. Whip-poor-will
G. Chimney Swift
H. Northern Flicker

Table 3. Species to be analyzed in this report. For each species, the major habitat type(s) used during the time of the BBS is(are) indicated. Ag = agricultural-cropland; Aq = aquatic-marshes-riparian; Ed = edge-old field; Gr = grassland-pasture-hayfield; Ur = Urban-residential; W = woodland.

	Ag	Aq	Ed	Gr	Ur	W
Mallard (*Anas platyrhynchos*)		x		x		
Turkey Vulture (*Cathartes aura*)						x
Red-tailed Hawk (*Buteo jamaicensis*)			x			x
American Kestrel (*Falco sparverius*)			x			
Ring-necked Pheasant (*Phasianus colchicus*)	x			x		
Gray Partridge (*Perdix perdix*)	x					
Northern Bobwhite (*Colinus virginianus*)	x		x			
Killdeer (*Charadrius vociferus*)	x					
Rock Dove (*Columba livia*)					x	
Mourning Dove (*Zenaida macroura*)			x		x	x
Yellow-billed Cuckoo (*Coccyzus americanus*)						x
Black-billed Cuckoo (*Coccyzus erythropthalmus*)						x
Common Nighthawk (*Chordeiles minor*)					x	
Whip-poor-will (*Caprimulgus vociferus*)						x
Chimney Swift (*Chaetura pelagica*)					x	
Common Flicker (*Colaptes auratus*)			x			x
Red-headed Woodpecker (*Melanerpes erythrocephalus*)			x		x	x
Red-bellied Woodpecker (*Melanerpes carolinus*)						x
Downy Woodpecker (*Picoides pubescens*)						x
Great Crested Flycatcher (*Myiarchus crinitus*)						x
Willow Flycatcher (*Empidonax traillii*)			x			
Eastern Phoebe (*Sayornis phoebe*)			x			x
Eastern Wood-Pewee (*Contopus virens*)						x
Eastern Kingbird (*Tyrannus tyrannus*)			x			
Western Kingbird (*Tyrannus verticalis*)			x			
Horned Lark (*Eremophila alpestris*)	x					
Bank Swallow (*Riparia riparia*)		x				
Northern Rough-winged Swallow (*Stelgidopteryx serripennis*)		x				
Tree Swallow (*Tachycineta bicolor*)		x	x			
Barn Swallow (*Hirundo rustica*)					x	
Cliff Swallow (*Hirundo pyrrhonota*)					x	
Purple Martin (*Progne subis*)					x	
Blue Jay (*Cyanocitta cristata*)			x			x
American Crow (*Corvus brachyrhynchos*)	x				x	
Black-capped Chickadee (*Parus atricapillus*)						x
Tufted Titmouse (*Parus bicolor*)						x
White-breasted Nuthatch (*Sitta carolinensis*)						x
House Wren (*Troglodytes aedon*)			x			x
Eastern Bluebird (*Sialia sialis*)			x			
American Robin (*Turdus migratorius*)			x		x	
Gray Catbird (*Dumetella carolinensis*)			x		x	x
Brown Thrasher (*Toxostoma rufum*)			x			x
Cedar Waxwing (*Bombycilla cedrorum*)						x
Loggerhead Shrike (*Lanius ludovicianus*)			x			
European Starling (*Sturnus vulgaris*)					x	
Yellow-throated Vireo (*Vireo flavifrons*)						x
Warbling Vireo (*Vireo gilvus*)			x			
Common Yellowthroat (*Geothlypis trichas*)		x	x			
Northern Cardinal (*Cardinalis cardinalis*)			x		x	x
Rose-breasted Grosbeak (*Pheucticus ludovicianus*)						x
Indigo Bunting (*Passerina cyanea*)			x			
Dickcissel (*Spiza americana*)	x		x	x		
Rufous-sided Towhee (*Pipilo erythrophthalmus*)						x
Chipping Sparrow (*Spizella passerina*)			x		x	
Field Sparrow (*Spizella pusilla*)			x			
Vesper Sparrow (*Pooecetes gramineus*)	x			x		
Savannah Sparrow (*Passerculus sandwichensis*)				x		
Grasshopper Sparrow (*Ammodramus savannarum*)				x		
Song Sparrow (*Melospiza melodia*)			x			
Bobolink (*Dolichonyx oryzivorus*)				x		
Red-winged Blackbird (*Agelaius phoeniceus*)		x	x			
Eastern Meadowlark (*Sturnella magna*)				x		
Western Meadowlark (*Sturnella neglecta*)				x		
Common Grackle (*Quiscalus quiscula*)			x		x	
Brown-headed Cowbird (*Molothrus ater*)	x		x	x	x	x
Northern Oriole (*Icterus galbula*)			x		x	x
Orchard Oriole (*Icterus spurius*)			x			x
American Goldfinch (*Carduelis tristis*)			x	x		
House Sparrow (*Passer domesticus*)					x	

numbers are generally thought to be stable (e.g., Northern Flicker, Blue Jay, and American Goldfinch). Only six species (Eastern Phoebe, Dickcissel, Field Sparrow, meadowlark, Common Grackle, American Goldfinch) declined in all five regions, with the Dickcissel and meadowlark showing the most precipitous declines. Nine species

Table 4. Species showing population changes (see Methods) from 1968-1970 to 1978-1980.

Increased	Decreased
Mallard	Red-tailed Hawk
American Kestrel	Northern Bobwhite
Gray Patridge	Northern Flicker
Killdeer	Eastern Phoebe
Rock Dove	Bank Swallow
Yellow-billed Cuckoo	Blue Jay
Black-billed Cuckoo	American Crow
Great Crested Flycatcher	Tufted Titmouse
Eastern Wood-Pewee	Eastern Bluebird
Eastern Kingbird	Cedar Waxwing
Northern Rough-winged Swallow	Loggerhead Shrike
Barn Swallow	Dickcissel
Cliff Swallow	Rufous-sided Towhee
Indigo Bunting	Field Sparrow
Chipping Sparrow	Meadowlark sp.
Vesper Sparrow	Common Grackle
Savannah Sparrow	Orchard Oriole
Brown-headed Cowbird	American Goldfinch
House Sparrow	

declined in four of the five regions (Red-tailed Hawk, Northern Bobwhite, Northern Flicker, Bank Swallow, Tufted Titmouse, Eastern Bluebird, Loggerhead Shrike, Rufous-sided Towhee, Orchard Oriole).

With the exceptions of the Red-tailed Hawk and Loggerhead Shrike, declining species do not belong to those raptorial/fish-eating groups whose populations have declined in the past because of pesticide contamination. Agricultural chemicals are applied in large quantities to Iowa farmland, but we have no evidence of their possible effect on the birds discussed here.

Iowa periodically has weather extremes that influence bird populations. Extended heavy snow cover and extremely cold weather combined with strong winds (blizzards) are especially harmful to winter residents (Klonglan 1971). A severe blizzard in northwestern Iowa in January 1975 severely reduced the Ring-necked Pheasant population there (Farris et al. 1977). Northern Iowa is at the northern limit of the Northern Bobwhite's range, and bobwhite numbers commonly decline drastically during severe winters with heavy snow cover (Stempel 1962). The winter of 1978-79 was unusually severe, with extended deep snow cover in southeastern Iowa, the heart of this species' range in Iowa, and bobwhite numbers were reduced in the following years (George et al. 1983). Fewer Northern Bobwhite and comparable declines in Tufted Titmice in 1978-1980 may be attributed to severe winters.

Associated with the increase in Brown-headed Cowbirds in Iowa (Fig. 9H), might be a decline in the numbers of the common cowbird nest hosts. Four species (Eastern Phoebe, Rufous-sided Towhee, meadowlark, Dickcissel) are common cowbird hosts and have declined. These are all acceptor species (Rothstein 1975) and would be under heavy cowbird pressure. Two other common hosts (Chipping Sparrow, Vesper Sparrow) increased in numbers, however.

Recently, considerable concern has been shown over the decline of numerous forest interior, neotropical migrants, presumably because of the loss of habitat on the wintering grounds (Keast and Morton 1980)

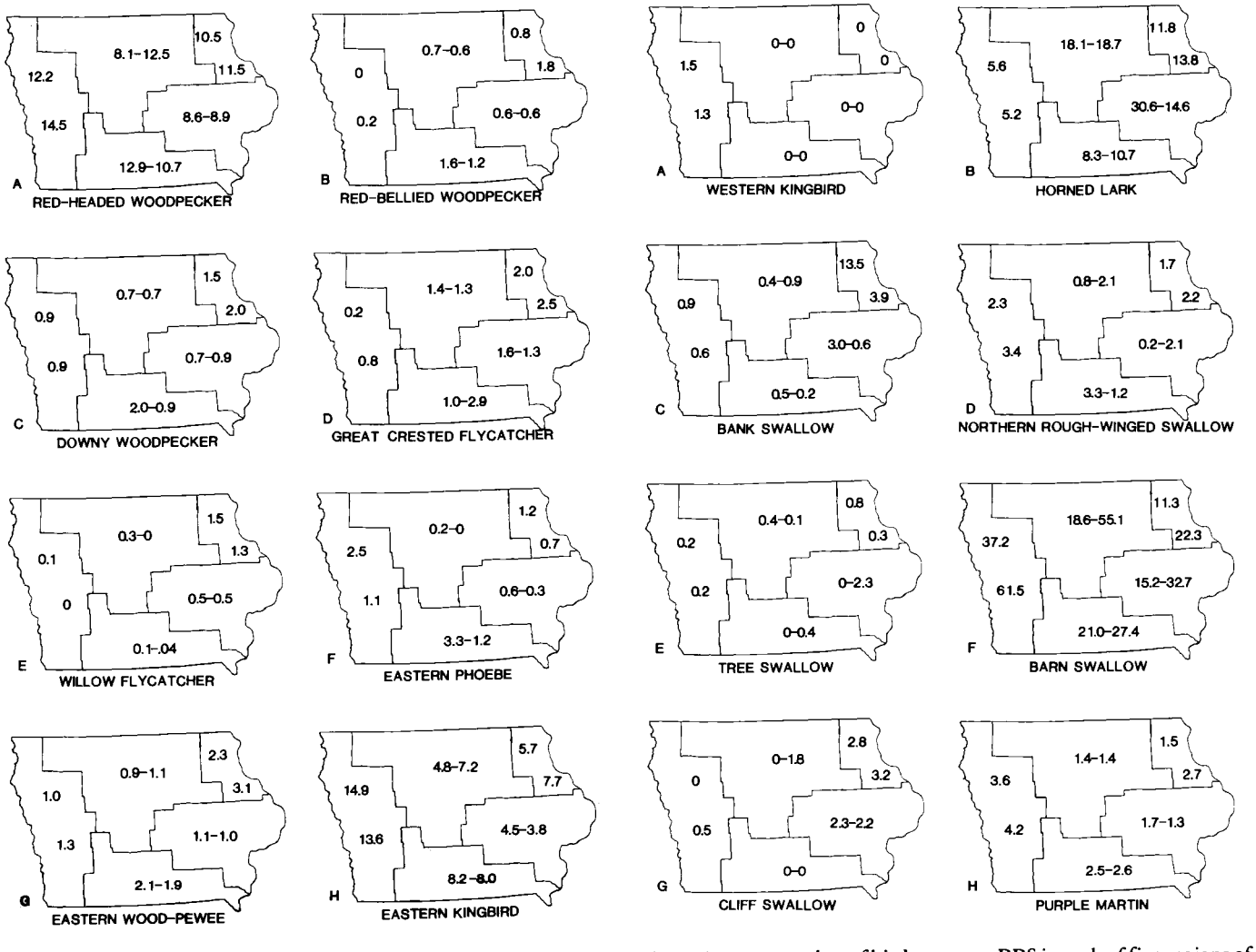

Fig. 4. Average number of birds seen per BBS in each of five regions of Iowa. For each region, the first number is the average for 1968-1970, and the second number is the average for 1978-1980.

A. Red-headed Woodpecker
B. Red-bellied Woodpecker
C. Downy Woodpecker
D. Great Crested Flycatcher
E. Willow Flycatcher
F. Eastern Phoebe
G. Eastern Wood-Pewee
H. Eastern Kingbird

Fig. 5. Average number of birds seen per BBS in each of five regions of Iowa. For each region, the first number is the average for 1968-1970, and the second number is the average for 1978-1980.

A. Western Kingbird
B. Horned Lark
C. Bank Swallow
D. Northern Rough-winged Swallow
E. Tree Swallow
F. Barn Swallow
G. Cliff Swallow
H. Purple Martin

and habitat fragmentation on the breeding grounds (Robbins 1979, Whitcomb et al. 1981). Of the species in Table 4, only the Rufous-sided Towhee might be affected by forest fragmentation. The Dickcissel, Bank Swallow, and Orchard Oriole are neotropical migrants whose numbers could be affected by wintering ground conditions. Indeed, most of the typical forest interior species (e.g., warblers, vireos, flycatchers) were found too infrequently on Iowa BBS to be considered here.

Fretwell (1977) thought that factors away from the breeding grounds were responsible for the Dickcissel's population decline. Given the small change in Dickcissel habitat in Iowa (Table 2), this view is probably correct. The 38% decline in pastureland noted earlier probably is responsible for much of the decline in meadowlark numbers.

Somewhat puzzling is the rather marked decline noted in Common Grackles. Dolbeer and Stehn (1979) noted no declines in BBS data from any of the states adjacent to Iowa and reported increases in both Wisconsin and Minnesota. We cannot explain the decline found in Iowa. Eight species that we found declining in Iowa (flicker, phoebe, bluebird, waxwing, towhee, Field Sparrow, meadowlark, and goldfinch) declined also in Wisconsin over a comparable period (Robbins 1982), suggesting a regional decline in their numbers.

Population Increases

The 19 species showing population increases represent several taxonomic and habitat groups, with the cuckoos, swallows, and sparrows being represented most (Table 4). Only the Black-billed Cuckoo and Barn Swallow increased in all five regions of the state. The American Kestrel, Killdeer, Northern Rough-winged Swallow, Indigo Bunting, Chipping Sparrow, Vesper Sparrow, Savannah Sparrow, and Brown-headed Cowbird all increased in four of the five regions. Because of the broad array of species showing increases, we cannot discuss all the factors that may be involved. Also, factors affecting populations on the wintering grounds or during migration, not considered here, may be important to some of the species showing increases.

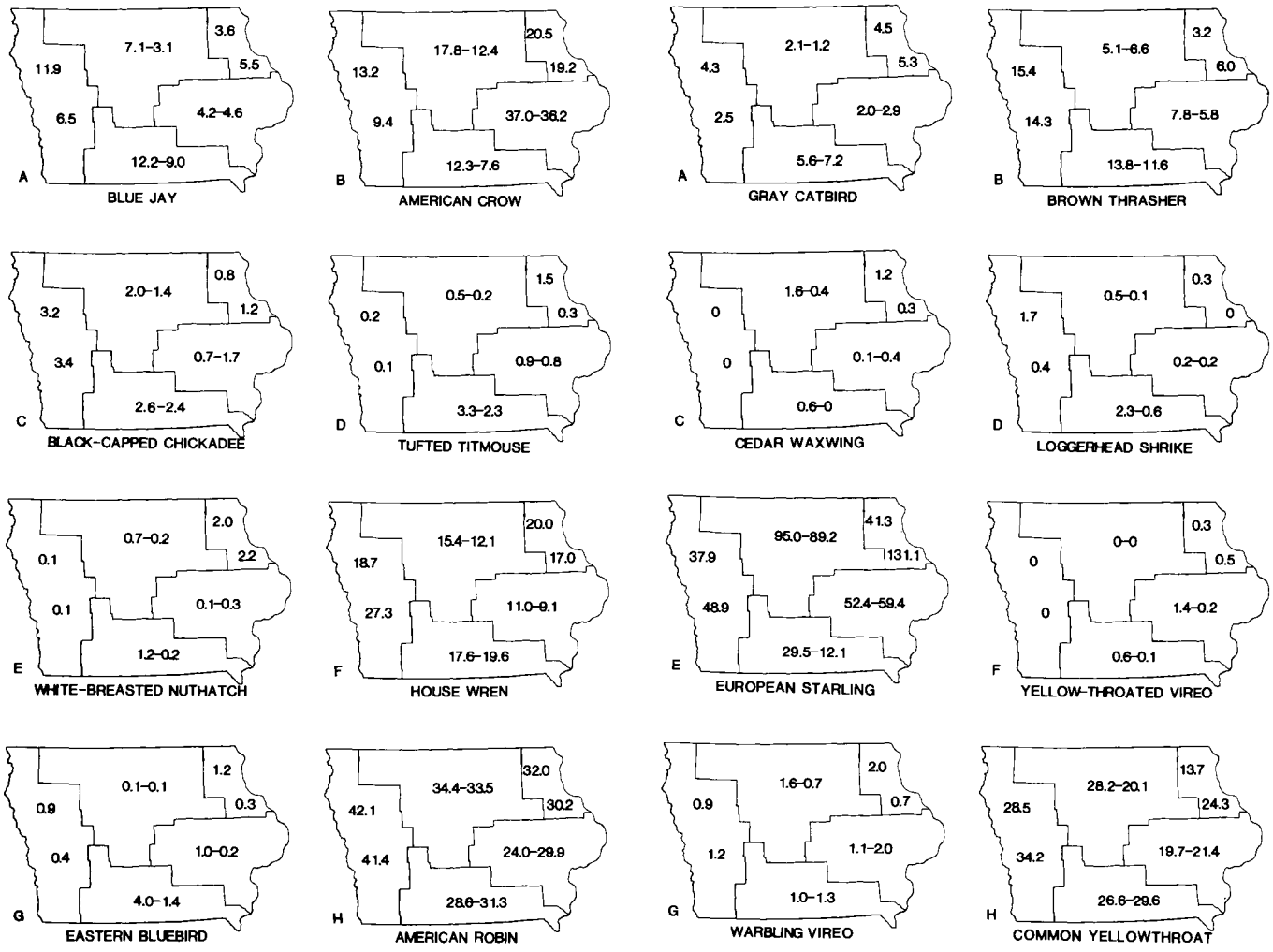

Fig. 6. Average number of birds seen per BBS in each of five regions of Iowa. For each region, the first number is the average for 1968-1970, and the second number is the average for 1978-1980.
A. Blue Jay
B. American Crow
C. Black-capped Chickadee
D. Tufted Titmouse
E. White-breasted Nuthatch
F. House Wren
G. Eastern Bluebird
H. American Robin

Fig. 7. Average number of birds seen per BBS in each of five regions of Iowa. For each region, the first number is the average for 1968-1970, and the second number is the average for 1978-1980.
A. Gray Catbird
B. Brown Thrasher
C. Cedar Waxwing
D. Loggerhead Shrike
E. European Starling
F. Yellow-throated Vireo
G. Warbling Vireo
H. Common Yellowthroat

Although the American Kestrel generally has been thought to be declining, the increase found here matches that noted by Tate and Tate (1982). Perhaps this increase indicates a recovery from the effects of pesticide contamination that has been implicated in declines of kestrel populations elsewhere (Porter and Wiemeyer 1969, Henny 1977). The somewhat cyclic nature of cuckoo populations may account for their increases. It is harder to understand increases by Barn Swallows and House Sparrows, species already abundant in 1968-1970. These species generally are found near farm buildings, but the number of farms in Iowa has declined 16% from 1970 to 1980 (U. S. Dept. Agriculture 1971, 1981). The replacement of many old bridges with concrete bridges has provided nest sites readily used by both Cliff and Barn swallows and may contribute to their increases. However, Eastern Phoebes, another species nesting on bridges, have declined. Likewise, Rock Doves frequently nest under bridges, but increases in nesting sites on bridges would be offset by losses of sites on farmsteads where they also commonly nest. The increase in Mallards seems contrary to the continuing loss of their wetland habitats (Bishop 1981).

Two open farmland species, the Killdeer and Gray Partridge, have shown increases that match the increase in open farmland (Table 2), their preferred habitat. Population increases of another farmland species, the Brown-headed Cowbird, are not confined to Iowa. In adjacent states, cowbirds have increased on BBS in Minnesota, Missouri, and South Dakota but not in Illinois, Wisconsin, or Nebraska in the period 1966-1976 (Dolbeer and Stehn 1979).

For some species, the supposed increases may be due to differences in observer's skills. One that hints of this is illustrated by Savannah Sparrow counts, where a tremendeous increase was noted for the Northeast Dairy Region (see Figure 9A). With only 2 routes in that region, changes in observer skills could have a marked effect on route averages, but this would have limited effect on our assessment of statewide population changes.

For all species for which we show increases or decreases, we must caution the reader that our suggested reasons for the changes are speculations and do not represent cause and effect explanations. We

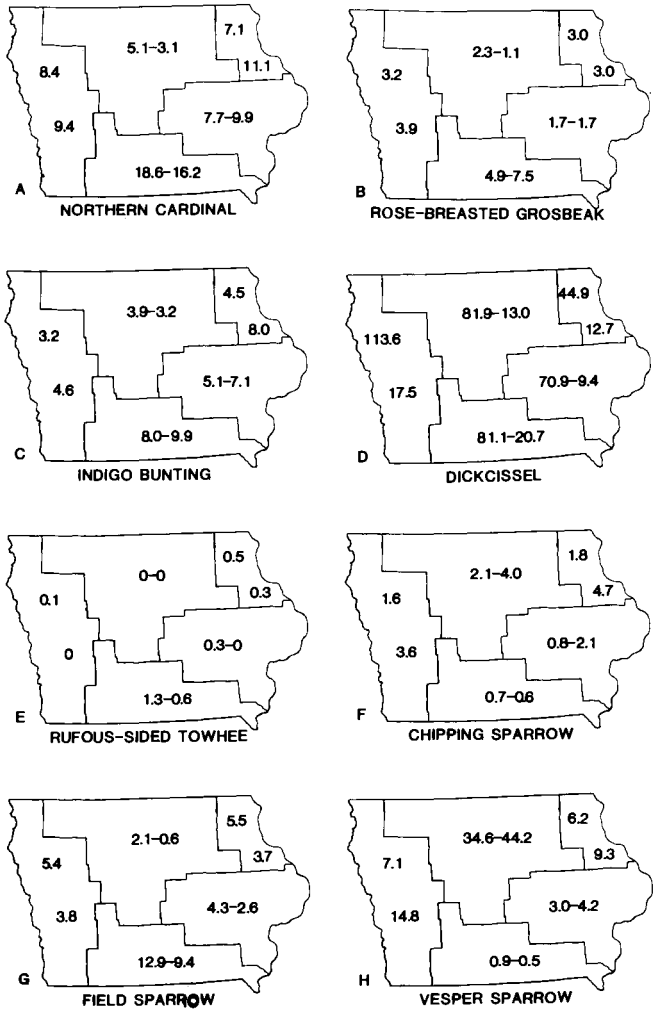

Fig. 8. Average number of birds seen per BBS in each of five regions of Iowa. For each region, the first number is the average for 1968-1970, and the second number is the average for 1978-1980.

A. Northern Cardinal
B. Rose-breasted Grosbeak
C. Indigo Bunting
D. Dickcissel
E. Rufous-sided Towhee
F. Chipping Sparrow
G. Field Sparrow
H. Vesper Sparrow

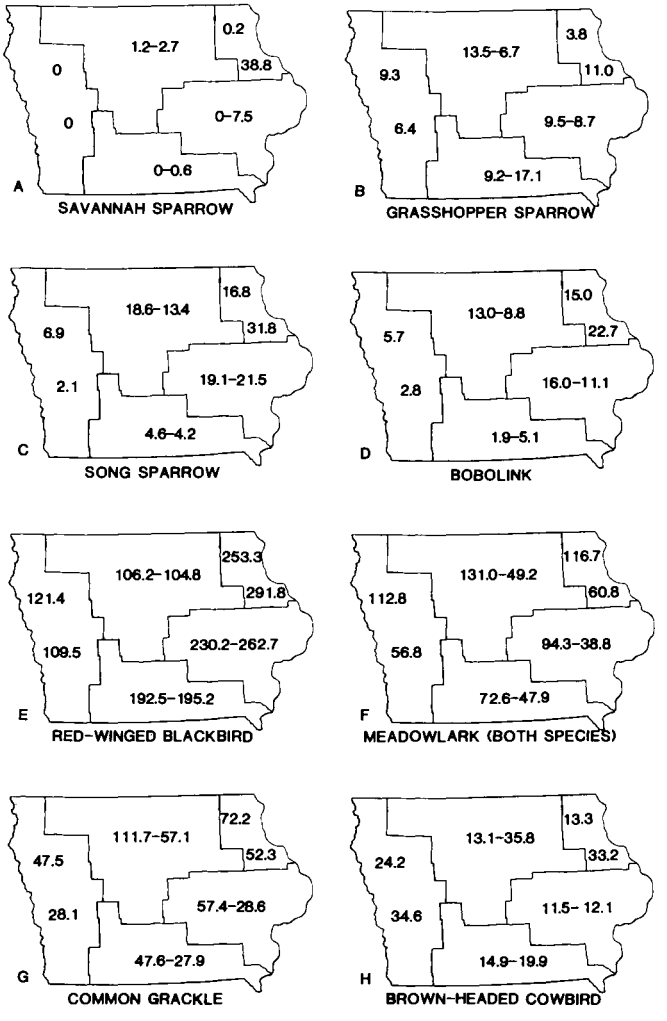

Fig. 9. Average number of birds seen per BBS in each of five regions of Iowa. For each region, the first number is the average for 1968-1970, and the second number is the average for 1978-1980.

A. Savannah Sparrow
B. Grasshopper Sparrow
C. Song Sparrow
D. Bobolink
E. Red-winged Blackbird
F. Meadowlark (Eastern and Western meadowlarks combined)
G. Common Grackle
H. Brown-headed Cowbird

express these speculations here in the hope that others will examine these or other factors more closely and provide more solid information for the various species.

Population changes in relation to habitat

We looked for general patterns of population changes in relation to habitat types. We assigned each species to one or more of six major habitat types (Table 3) which reflect the habitats used during the time when BBS are run. Then, for each habitat, the number of species showing increases, decreases, or no change was determined. Permitting a species to be counted in more than one habitat (the cowbird used five), there were 26 increases, 29 decreases, and 48 with no change noted (Table 5). On this basis, the habitats with the greatest percentage of birds increasing were agricultural-cropland and grassland-pasture. The former is not surprising because of the general increase in cropland in Iowa during this time interval (Table 2). That several grassland species increased is surprising as this habitat has declined greatly in Iowa. Birds of edge or forest habitats had relatively few increases. This indicates a continuing decline in forests, hedgerows, and associated edge communities as more land was converted to cropland (Best et al. 1978, Thomson 1980) and as the average crop field increased in size. Habitats with the most declines were edge, woodland, agricultural land, and grassland. With the increase in corn and soybean acreage and a corresponding decline in hay and oats (Table 2) and pastureland, we expected that such changes would have led to more drastic declines by more species. Indeed, two of the species with the greatest decline were grassland (and hayfield) species (Dickcissel, meadowlarks) and fit this pattern. That others such as the Vesper, Savannah, and Grasshopper sparrows and the Bobolink have not followed a similar pattern (the first two have increased) is puzzling. The Vesper Sparrow utilizes fencerows and cropland but is most successful if minimum tillage is practiced (Rodenhouse and Best 1983). Increasing popularity of this type of agriculture in Iowa (mimeo report, Soil Conservation Service, Des Moines, IA, 1983) may help it increase. The other three species also make use of alfalfa fields, one of the few grassland types that has almost held its own in Iowa (see hay in Table 2) and thus may have maintained their numbers by this habitat shift. It is possible that the stability or increase shown by the three sparrows may be due to improved identification skills by BBS cooperators; all three species have songs that are often hard to hear.

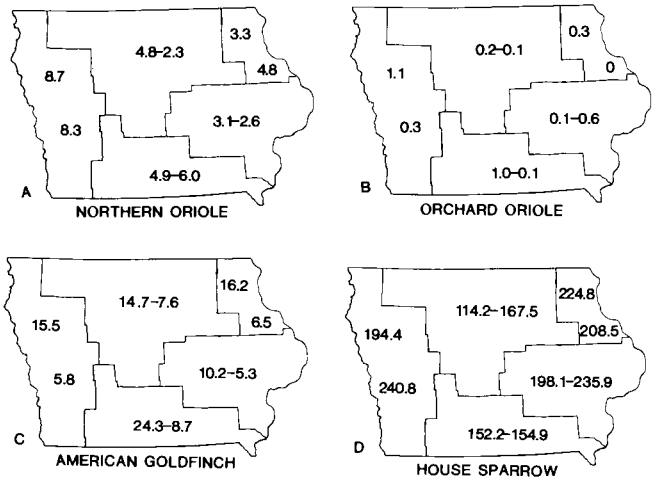

Fig. 10. Average number of birds seen per BBS in each of five regions of Iowa. For each region, the first number is the average for 1968-1970, and the second number is the average for 1978-1980.
A. Northern Oriole
B. Orchard Oriole
C. American Goldfinch
D. House Sparrow

Table 5. Number of species in each habitat showing population changes or no change. Numbers in parentheses are percentages.

Habitat type	Increase	Decrease	No change	No. of. species found in habitat
Agricultural-cropland	4(44)	3(33)	2(22)	9
Aquatic-riparian	2(33)	1(17)	3(50)	6
Edge-old field	5(16)	12(37)	15(47)	32
Grassland-pasture-hayfield	4(40)	3(30)	3(30)	10
Urban-residential	6(33)	2(11)	10(56)	18
Woodland	5(18)	8(29)	15(54)	28
Totals	26	29	48	103
Number of species	19	18	31	68

Endangered and Special Concern Species

Given the general survey nature of the BBS, we considered no state or federally endangered species. Only the Loggerhead Shrike has threatened status on the Iowa state list (Roosa 1977) and declined on BBS (see Figure 7D).

Nineteen species are either Blue-listed (possibly becoming threatened) or of Special Concern on the latest National Audubon Society Blue List (Tate and Tate 1982). Of the six Blue-listed species, two stayed stable in Iowa (Willow Flycatcher, Grasshopper Sparrow) and four declined (Eastern Bluebird, Loggerhead Shrike, Dickcissel, meadowlark). The 13 species of Special Concern are more confusing to consider. Four increased in Iowa (American Kestrel, Yellow-billed Cuckoo, Cliff Swallow, Savannah Sparrow), five seemed to be stable (Turkey Vulture, Whip-poor-will, Common Nighthawk, Red-headed Woodpecker, Purple Martin), and only four declined (Northern Bobwhite, Eastern Phoebe, Bank Swallow, Orchard Oriole). Tate and Tate (1982) also listed a number of "local problem" species. They mention seven species that might be affected in Iowa; we have data for six. These include one that has increased (Chipping Sparrow), one that has decreased (Tufted Titmouse), and four that seem stable (Chimney Swift, House Wren, Yellow-throated Vireo, Warbling Vireo). Thus, the Blue List seems fairly consistent with Iowa BBS data, but the Special Concern and local problem lists seem less reliable for Iowa. Only 9 of the 18 declining species we list are considered on the Tates' lists (Table 4). Nine are not mentioned at all, including three (Field Sparrow, Common Grackle, American Goldfinch) that declined in all five regions of Iowa.

Geographical distribution

All breeding species reported on at least one BBS in the years 1967-1980 (Appendix D, Table 3) were considered by the region of the state where they were reported. Of those 126 species, 73 (58%) were reported from all five regions (including 62 of the 68 that we analyzed in detail). Notable is the similarity in the total number of species reported on BBS for the different regions of Iowa, the range being only 92-107 (Table 6). The 73 species reported from all five regions constitute a large block of species that are essentially statewide in distribution and dominate the avifauna. Another 15 species were reported from four regions, and only 20 of the 126 were reported from just one region (Table 6).

Comparisons with other data

A major question that remains is how valid are these data and the population trends that they suggest? Few other data sets are available

Table 6. Regional patterns of birds reported on Iowa BBS, 1967-1980.

Region	No. species reported	No. reported only from this region
Cash Grain	107	11
Western Livestock	101	3
Eastern Livestock	97	1
Southern Pasture	94	3
Northeast Dairy	92	2

for comparison. Christmas Bird Counts and late summer roadside counts of game birds are available but are not comparable because they cover different time periods. The former includes winter residents and excludes summer residents, whereas the latter includes offspring from the most recent breeding season.

The only comparable data that we could find was that collected by the Iowa Conservation Commission on three long-term studies of Northern Bobwhite and Ring-necked Pheasants (George et al. 1983). The Northern Bobwhite data were collected near the Iowa-Missouri border in the Southern Pasture Region. This population exhibited a 25% population decline from 1968-1970 to 1978-1980, similar to the 31% found in the BBS in the Southern Pasture Region over the same years (Figure 2G). Thus, the trends in the BBS data and those of the Iowa Conservation Commission are similar.

Data for the Ring-necked Pheasant are available from two areas, one on the Iowa-Minnesota border in the Cash Grain Region and, the other, in southern Iowa near the western edge of the Southern Pasture Region. The data from the northern Iowa area show the Ring-necked Pheasant declining almost 100% (George et al. 1983) whereas the BBS data from the Cash Grain Region show a decline of only 31% (Figure 2E). Unfortunately, the individual BBS routes closest to this study area were not run from 1968-1970 so it is not possible to see if those routes matched the decline found on the long-term study area. It is possible that the decline found throughout the Cash Grain Region was not nearly as severe as that found in extreme northern Iowa. The long-term data from southern Iowa showed a 10% decline (George et al. 1983). This compares with a 153% increase in pheasant numbers in the Southern Pasture Region on the BBS over the same time period (Figure 2E). However, the five individual BBS routes that were closest to this area (two routes each in the Cash Grain and Western Livestock regions and one in the Southern Pasture region) showed a 16% decline in pheasant numbers, very similar to the 10% decline noted in the long-term study. Thus, it seems that for pheasants, the BBS data, if used selectively, do show trends similar to those detected by other survey methods.

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APPENDIX A.

Species with nesting records for Iowa but none in 1967-1980 and that thus would not be expected on BBS analyzed here. S = strays reported on one or more BBS; E = extinct species.

Common Loon (*Gavia immer*); Western Grebe (*Aechmophorus occidentalis*); Double-crested Cormorant (*Phalacrocorax auritus*); Trumpeter Swan (*Cygnus buccinator*); Bufflehead (*Bucephala albeola*); Sharp-shinned Hawk (*Accipiter striatus*), S; American Swallow-tailed Kite (*Elanoides forficatus*); Merlin (*Falco columbarius*); Peregrine Falcon (*Falco peregrinus*), S; Greater Prairie-Chicken (*Tympanuchus cupido*), reintroduced into Iowa in 1980 and 1982; Sandhill Crane (*Grus canadensis*), S; Whooping Crane (*Grus americana*); Long-billed Curlew (*Numenius americanus*); Marbled Godwit (*Limosa fedoa*); Franklin's Gull (*Larus pipixcan*), S; Passenger Pigeon (*Ectopistes migratorius*), E; Black-billed Magpie (*Pica pica*); Red-breasted Nuthatch (*Sitta canadensis*); Rock Wren (*Salpinctes obsoletus*); Golden-winged Warbler (*Vermivora chrysoptera*), S; Clay-colored Sparrow (*Spizella pallida*).

APPENDIX B.

Species reported on one or more BBS in Iowa from 1967 through 1980 but with no authentic nest record from Iowa. V = vagrant, S = nonbreeding summering, M = late migrant, N = possibly nesting.

American White Pelican (*Pelecanus erythrorhynchos*), S; Osprey (*Pandion haliaetus*), V; Rough-legged Hawk (*Buteo lagopus*), V; Lesser Yellowlegs (*Tringa flavipes*), M; Baird's Sandpiper, (*Calidris bairdii*), M; Ring-billed Gull, (*Larus delawarensis*), S; Common Tern, (*Sterna hirundo*), S; Alder Flycatcher (*Empidonax alnorum*), M; Hermit Thrush (*Catharus guttatus*), M; Tennessee Warbler (*Vermivora peregrina*), M; Northern Parula (*Parula americana*), N; Mourning Warbler (*Oporornis philadelphia*), M; Lazuli Bunting (*Passerina amoena*), V; Lark Bunting (*Calamospiza melanocorys*), V; Henslow's Sparrow (*Ammodramus henslowii*), N; Brewer's Blackbird (*Euphagus cyanocephalus*), V, N.

APPENDIX C.

Species known to nest in Iowa but never reported on an Iowa BBS.

American Bittern (*Botaurus lentiginosus*); Least Bittern (*Ixobrychus exilis*); Yellow-crowned Night Heron (*Nycticorax violaceus*); American Black Duck (*Anas rubripes*); Gadwall (*Anas strepera*); American Wigeon (*Anas americana*); Canvasback (*Aythya valisineria*); Ring-necked Duck (*Aythya collaris*); Hooded Merganser (*Lophodytes cucullatus*); Ruddy Duck (*Oxyura jamaicensis*); Bald Eagle (*Haliaeetus leucocephalus*); Red-shouldered Hawk (*Buteo lineatus*); Swainson's Hawk (*Buteo swainsoni*); King Rail (*Rallus elegans*); Virginia Rail (*Rallus limicola*); Common Moorhen (*Gallinula chloropus*); Piping Plover (*Charadrius melodus*); American Woodcock (*Scolopax minor*); Forster's Tern (*Sterna forsteri*); Least Tern (*Sterna antillarum*); Common Barn-Owl (*Tyto alba*); Long-eared Owl (*Asio otus*); Chuck-will's Widow (*Caprimulgus carolinensis*); Yellow-bellied Sapsucker (*Sphyrapicus varius*); Say's Phoebe (*Sayornis saya*); Brown Creeper (*Certhia americana*); Winter Wren (*Troglodytes troglodytes*); Bewick's Wren (*Thryomanes bewickii*); Veery (*Catharus fuscescens*); White-eyed Vireo (*Vireo griseus*); Chestnut-sided Warbler (*Dendroica pensylvanica*); Yellow-throated Warbler (*Dendroica dominica*); Cerulean Warbler (*Dendroica cerulea*); Black-and-white Warbler (*Mniotilta varia*); Prothonotary Warbler (*Protonotaria citrea*); Louisiana Waterthrush (*Seiurus motacilla*); Hooded Warbler (*Wilsonia citrina*); Summer Tanager (*Piranga rubra*); Pine Siskin (*Carduelis pinus*).

APPENDIX D.

Species known to nest in Iowa but reported on Iowa BBS too few times to analyze.

Pied-billed Grebe (*Podilymbus podiceps*); Eared Grebe (*Podiceps nigricollis*); Great Blue Heron (*Ardea herodias*); Great Egret (*Casmerodius albus*); Green-backed Heron (*Butorides striatus*); Black-crowned Night Heron (*Nycticorax nycticorax*); Canada Goose (*Branta canadensis*); Wood Duck (*Aix sponsa*); Green-winged Teal (*Anas crecca*); Northern Pintail (*Anas acuta*); Blue-winged Teal (*Anas discors*); Northern Shoveler (*Anas clypeata*); Redhead (*Aythya americana*); Lesser Scaup (*Aythya affinis*); Northern Harrier (*Circus cyaneus*); Cooper's Hawk (*Accipiter cooperi*); Broad-winged Hawk (*Buteo platypterus*); Ruffed Grouse (*Bonasa umbellus*); Wild Turkey (*Meleagris gallopavo*); Sora (*Porzana carolina*); American Coot (*Fulica americana*); Spotted Sandpiper (*Actitis macularia*); Upland Sandpiper (*Bartramia longicauda*); Common Snipe (*Gallinago gallinago*); Wilson's Phalarope (*Phalaropus tricolor*); Black Tern (*Chlidonias niger*); Eastern Screech-Owl (*Otus asio*); Great Horned Owl (*Bubo virginianus*); Burrowing Owl (*Athene cunicularia*); Barred Owl (*Strix varia*); Short-eared Owl (*Asio flammeus*); Ruby-throated Hummingbird (*Archilochus colubris*); Belted Kingfisher (*Ceryle alcyon*); Hairy Woodpecker (*Picoides villosus*); Pileated Woodpecker (*Dryocopus pileatus*); Acadian Flycatcher (*Empidonax virescens*); Least Flycatcher (*Empidonax minimus*); Scissor-tailed Flycatcher (*Tyrannus forficatus*); Carolina Wren (*Thryothorus ludovicianus*); Sedge Wren (*Cistothorus platensis*); Marsh Wren (*Cistothorus palustris*); Blue-gray Gnatcatcher (*Polioptila caerulea*); Wood Thrush (*Hylocichla mustelina*); Northern Mockingbird (*Mimus polyglottos*); Bell's Vireo (*Vireo bellii*); Red-eyed Vireo (*Vireo olivaceus*); Blue-winged Warbler (*Vermivora pinus*); Yellow Warbler (*Dendroica petechia*); American Redstart (*Setophaga ruticilla*); Worm-eating Warbler (*Helmitheros vermivorus*); Ovenbird (*Seiurus aurocapillus*); Kentucky Warbler (*Oporornis formosus*); Yellow-breasted Chat (*Icteria virens*); Scarlet Tanager (*Piranga olivacea*); Blue Grosbeak (*Guiraca caerulea*); Lark Sparrow (*Chondestes grammacus*); Swamp Sparrow (*Melospiza georgiana*); Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*).