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Birds on Modified Wetlands in Eastern South Dakota

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BIRDS ON MODIFIED WETLANDS IN EASTERN SOUTH DAKOTA

BY

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EASTERN SOUTH DAKOTA

This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Raymond L. Linder — Thesis Advisor — Date

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Abstract

E. NELL BRADY

To examine the role of bird species (other than Anatidae) in the prairie wetlands ecosystem, 7 wetlands on Waterfowl Production Areas in eastern South Dakota were utilized to measure differences between bird communities in plots with dug brood complexes and non-modified plots. Thirty-eight species of wetland birds were recorded on wetlands during June 1981 and June 1982. The most abundant species included the red-winged blackbird (Agelaius phoeniceus), marsh wren (Cistothorus palustris), and song sparrow (Melospiza melodia). Analysis of variance was used to test between treatment (modified and natural plots on the wetlands) differences for the dependent variables: density, bird species diversity, species richness, and equitability. No significant differences were found between treatments for any of the dependent variables. For 1981-1982, 5 years after excavation of dug brood complexes, the effects of these modifications on wetland bird communities appeared negligible. However, upland cover on the islands of the dug brood complexes provided nesting habitat for some upland nesting species and a possible food source for other upland and marsh-edge species.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Prairie wetlands, once considered wastelands, are a valuable natural resource. One aspect of this valuable natural resource is the habitat wetlands provide for wildlife. Most wetlands management and manipulation have been directed toward game species, particularly waterfowl. However, representatives from many wildlife groups and almost all bird groups use wetlands to some extent and about one-third of the North American bird species rely upon wetlands for some resource (Kroodsma 1978). The role that bird species, other than Anatidae, play in the prairie wetlands ecosystem is poorly understood. Little research has been directed toward these species and how they might be affected by wetland management and manipulation.

There have been many man-made modifications of wetlands in the northern prairie region (Bue et al. 1964). Generally, man-made modifications such as stock ponds and dugouts have been excavated primarily for agricultural use. More recently man-made modifications of natural wetland basins, such as level ditching, blasted potholes, and dug brood complexes, have been created to benefit wildlife. In general, there is a lack of field data on the effects of man-made modifications in natural prairie wetlands (Flake 1979).

The dug brood complex, one of the most recent types of modifications, has been placed in many prairie wetlands. The dug brood complex is a system of channels, ponds, and spoil islands placed in wetlands to benefit waterfowl by providing deep open water and upland nesting areas. The value of these dug brood complexes for wildlife have rarely been evaluated because of cost, manpower, and inadequate experimental study areas (Weller 1978a). If we are to predict how change in habitat structure (i.e. dug brood complexes) would affect a given community, the key environmental features which are necessary for the existence of that community must be known (Kroodsma 1978). The lack of information on birds in wetlands makes the task of predicting change difficult. Adequate assessment before and after management practices could give us a better understanding of the mechanisms that surround changes in habitat and communities.

The intent of this study was to measure effects of modifications on wetland bird communities (other than Anatidae). The study was carried out through the following objectives: (1) identify and count numbers of bird species using modified wetlands during the breeding season, (2) evaluate the effects of dug brood complexes on the numbers and species composition of birds using modified wetlands, and (3) identify species using islands on modified wetlands for nesting.

STUDY AREA

This project was conducted on 7 wetlands in Day and Clark counties on the Coteau des Prairies in eastern South Dakota. In Day County research was conducted on semipermanent wetlands (Class IV according to the classification by Stewart and Kantrud 1971) on Thompson, Cramer, and Schmig Waterfowl Production Areas (WPA). The average basin size for the wetlands studied on the Day County WPAs was 27.13 ha. In Clark County semipermanent wetlands (Class IV, Stewart and Kantrud 1971) studied were on Anderson, Graves, Storbeck, and Kuecker WPAs with an average wetland basin size of 17 ha.

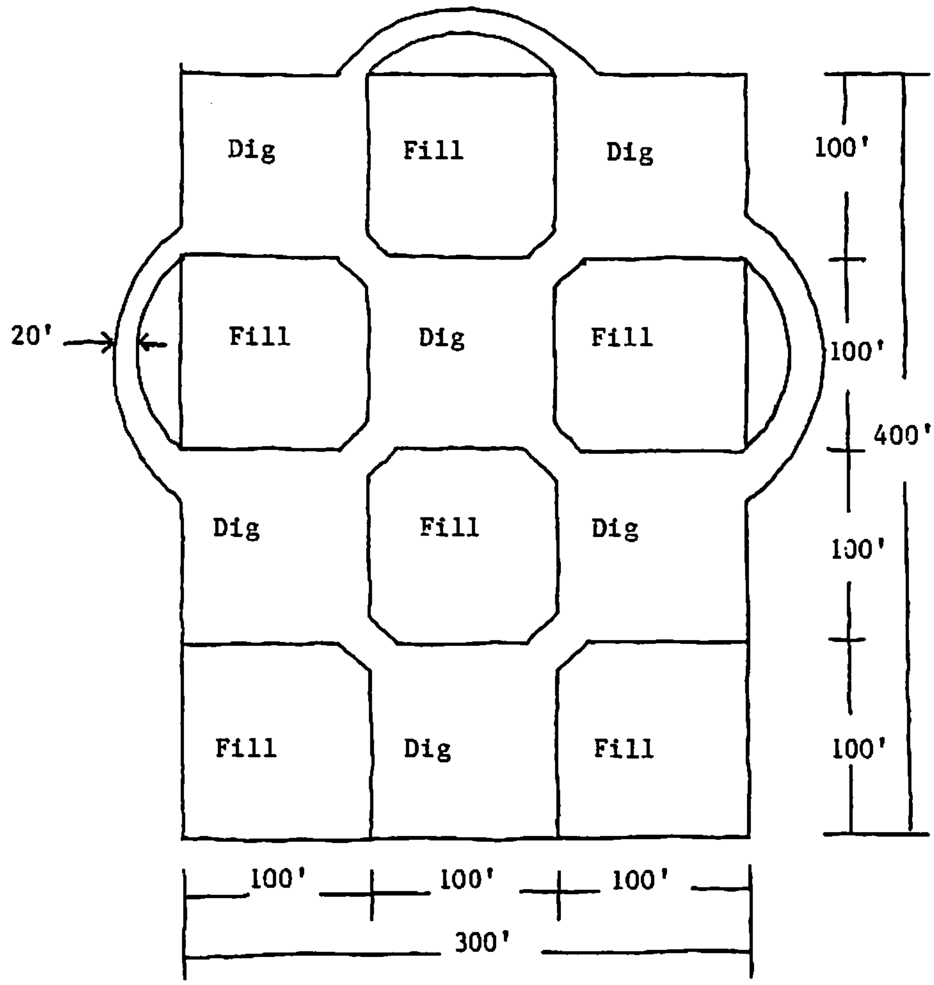
Vegetation characteristics of study wetlands were typical of Class IV semipermanent wetlands (Stewart and Kantrud 1971) with cattail (*Typha* spp.) and bulrush (*Scirpus* spp.) the dominant species. Vegetative cover in the natural wetland basins outside the modification differed by study wetland. Study wetlands on Cramer and Schmig WPAs were in a hemi-marsh condition, i.e., open water and vegetative cover were about equal (Weller and Fredrickson 1974). Water depth on Cramer and Schmig study wetlands ranged from approximately 0.5 to 1 m. The study wetland on Thompson WPA approached hemi-marsh condition with water depth approximately 8 cm. The vegetative cover of the study wetlands on Storbeck, Anderson, Kuecker, and Graves WPAs was characterized by dense emergent vegetation and little open water. Water conditions on these areas were poor with little to no water.

Vegetative cover on the dug brood complexes varied by study wetland. Cattail and bulrush usually surrounded the shoreline of the islands and channels. Vegetation on all of the islands was similar, with a forb-grass combination including Polygonum spp., Zizania sp., members of the Compositae and Verbanaceae, and young trees (Populus deltoides and Salix spp.).

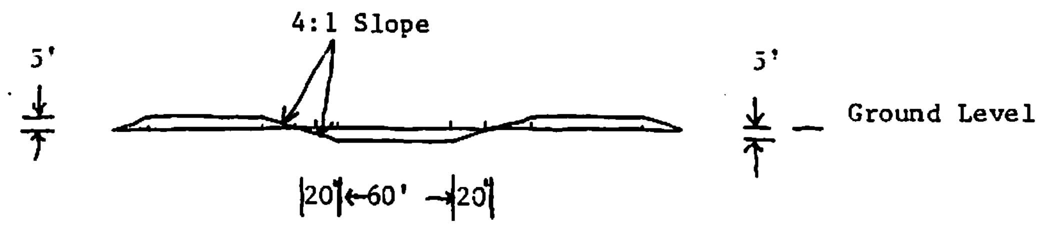
These sites were modified between March 1977 and March 1978. On each area the standard checkerboard type water development plan was used by the U.S. Fish and Wildlife Service in excavation of the modifications (Figure 1, J. W. Koerner pers. comm.). The location of these areas is as follows: in Day County—Cramer WPA Sec 5-8T121NR58W, Schmig WPA Sec 12T121NR57W, and Thompson WPA Sec 21T120NR58W; and in Clark County—Kuecker WPA Sec 1T119NR57W, Graves WPA Sec 29T118NR57W, Storbeck WPA Sec 10T117NR56W, and Anderson WPA Sec 28T115NR57W.

Figure 1. Standard checkerboard type water development plan for the dug brood complex (measurements in feet as in original document).

Top View



End View



METHODS

Seven wetland basins were partitioned into 2 plots. One plot included the dug brood complex and a 50 m area surrounding the modification (modified plot). The other plot (natural plot) was of equal size and similar vegetative composition to the modified plot and was located within the same wetland basin. This natural plot was as far away from the modified plot as possible.

Belt transects (40 m wide) were used to count birds occurring on modified and natural plots during 15-26 June 1981 and 7-16 June 1982. Six transects were run on each of the 7 wetlands, 3 were on the modified plots and 3 on the natural plots of each wetland. All birds observed or heard within the transects were recorded. Transect lengths varied with area. Average length for all transects was 222 m. The transects on the modified plots of each wetland were equal in length to transects on the control section on natural plots. Counts were made between 0600 and 0830 hours (CST) and between 1800 and 2130 hours. Bird counts were not made when winds exceeded 25 km per hour or on rainy days.

Preliminary data from June 1981 showed that the belt transects did not adequately survey for the species of Rallidae. In June 1982 the same transect lines were used to count species of Rallidae using the "playback-response" technique similar to that used by Baird (1974), Glahn (1974), and Tacha (1975). Stations were placed at least 60 m apart to play tape recorded advertising calls of Virginia rails (*Rallus limicola*), soras (*Porzana carolina*), yellow rails

(Coturnicops noveboracensis), and king rails (Rallus elegans). Playbacks per station for each species consisted of 3 groups of 3 rail calls for a total of 9 calls, followed by a listening period of 1 minute between calls. Number of responding rails per station was recorded.

The 42 islands of the 7 dug brood complexes on the 7 areas were searched for nests. Nests were identified by species. Clutch size and distance of the nest from shoreline were recorded.

Counts of birds were based primarily on the number of indicated pairs (Stewart and Kantrud 1972). Nearly all indicated pairs were observed as segregated pairs or as territorial males (Stewart and Kantrud 1972). Segregated pairs and lone females of the Wilson's phalarope (Phalaropus tricolor) were recorded as pairs. In species where sex could not be identified, such as the black tern (Chlidonias niger), the number of indicated pairs was derived by dividing the total number of individuals counted by 2. Species of Rallidae were reported as audibly responding rails per ha wetland basin.

Values of density (pairs/ha wetland basin), species richness, bird species diversity (Tramer 1969), and equitability (Lloyd and Ghelardi 1964) were calculated for each count of each transect. Ecologists use the Shannon Wiener function to measure species diversity (MacArthur and MacArthur 1961, Tramer 1969). The species diversity index is a weighted information index that has two components, species richness and equitability (Lloyd and Gherlardi 1964). Species richness is the number of species in a sample. Equitability is the evenness with which the individuals are apportioned among the species. Conner and Dickson (1980) suggested the use of these variables with analysis of variance (ANOVA) to aid in the determination of the effects of habitat alteration on bird populations. The data for these variables were analyzed using ANOVA to test between area differences.

RESULTS AND DISCUSSION

Thirty-eight species of birds were recorded on the transects (Table 1), 32 species in 1981, and 23 species in 1982. Differences in the number of species for both years can probably be attributed to the differences in climatic conditions for the 2 years. Eastern South Dakota was dry in 1981 and relatively wet in 1982. Precipitation figures were averaged from 2 climatological stations located in the vicinity of the study areas. During September 1980 - June 1981 there were 10.14 inches of precipitation, a -6.10 departure from normal (National Oceanic and Atmospheric Administration 1980, 1981). During September 1981 to July 1982 there were 13.45 inches of precipitation, a -2.79 departure from normal (National Oceanic and Atmospheric Administration 1981, 1982a, 1982b, 1982c, 1982d, 1982e, 1982f). The higher number of species found during 1981 as compared to 1982 is not unusual since upland bird species invade marshes during dry conditions (Weller and Spatcher 1965). The clay-colored sparrow, grasshopper sparrow, vesper sparrow, and Baird's sparrow found on wetlands in 1981 (Table 2) and not in 1982 (Table 3) are usually considered upland bird species. The presence of the swamp sparrow in 1982 may also be due to the wetter conditions that are conducive to swamp sparrow habitat. Swamp sparrows breed in freshwater marshes whereas the song sparrow is more of an aquatic edge species occupying upland areas, although nesting over water is not uncommon (Bent 1968). The song sparrow was present in higher numbers in 1981 than in 1982. The drier conditions in 1981 may have allowed the song sparrow to

Table 1. Thirty-eight bird species were recorded on the wetland study areas during June 1981-1982 surveys in eastern South Dakota. Scientific names according to A.O.U. Checklist of North American Birds (American Ornithologist's Union 1982).

Double-crested cormorant (*Phalacrocorax auritus*)
Ring-billed gull (*Larus delawarensis*)
Franklin's gull (*Larus pipixcan*)
Forster's tern (*Sterna fosteri*)
Black tern (*Chlidonias niger*)
American bittern (*Botaurus lentiginosus*)
Virginia rail (*Rallus limicola*)
Sora (*Porzana carolina*)
American coot (*Fulica americana*)
Killdeer (*Charadrus vociferus*)
Willet (*Catoptrophorus semipalmatus*)
White-rumped sandpiper (*Calidris fuscicollis*)
Wilson's phalarope (*Phalaropus tricolor*)
Ring-necked pheasant (*Phasianus colchicus*)
Northern harrier (*Circus cyaneus*)
Red-tailed hawk (*Buteo jamaicensis*)
Mourning dove (*Zenaida macroura*)
Eastern kingbird (*Tyrannus tyrannus*)
Barn swallow (*Hirundo rustica*)
Tree swallow (*Iridoprocne bicolor*)
Rough-winged swallow (*Stelgidopteryx serripennis*)
Bank swallow (*Riparia riparia*)
Marsh wren (*Cistothorus palustris*)
Sedge wren (*Cistothorus platensis*)
Common yellowthroat (*Geothlypis trichas*)
Red-winged blackbird (*Agelaius phoeniceus*)
Yellow-headed blackbird (*Xanthocephalus xanthocephalus*)
Brown-headed cowbird (*Molothrus ater*)
Common grackle (*Quiscalus quiscula*)
American goldfinch (*Carduelis tristis*)

Table 1. (Continued)

Swamp sparrow (*Melospiza georgiana*)
Clay-colored sparrow (*Spizella pallida*)
Grasshopper sparrow (*Ammodramus savannarum*)
Song sparrow (*Melospiza melodia*)
Vesper sparrow (*Pooecetes gramineus*)
Baird's sparrow (*Ammodramus bairdii*)
Sharp-tailed sparrow (*Ammodramus caudacutus*)
LeConte's sparrow (*Ammospiza leconteii*)

Table 2. Mean density of birds and frequency of occurrence for plots on which birds occurred during June 1981 surveys in eastern South Dakota.

Species	Modified			Natural		
	$\bar{X}$ [a]	SD [b]	F [c]	$\bar{X}$	SD	F
Double-crested cormorant	-	-	-	2.0	4.8	14
Franklin's gull	2.4	6.0	14	2.4	6.0	14
Forster's tern	2.0	4.8	14	2.0	4.8	14
Black tern	18.8	49.6	14	5.6	14.4	14
American bittern	1.6	4.4	14	3.6	6.4	29
Virginia rail	-	-	-	2.0	5.6	14
American coot	-	-	-	2.0	4.8	14
Killdeer	12.8	34.0	29	4.4	7.6	14
Willet	5.6	14.8	14	2.0	4.8	14
White-rumped sandpiper	-	-	-	13.2	34.8	14
Northern harrier	-	-	-	3.6	9.6	14
Red-tailed hawk	-	-	-	2.8	7.6	14
Mourning dove	2.0	5.6	14	-	-	-
Eastern kingbird	6.0	7.6	29	7.2	9.2	43
Rough-winged swallow	3.6	6.4	29	2.0	5.2	14
Bank swallow	2.8	7.6	14	2.0	5.6	14
Marsh wren	10.4	13.6	43	64.0 (2)	159.2	29
Sedge wren	22.4	23.2	57	12.4	28.0	29

Table 2. (Continued)

Species	Modified			Natural		
	$\overline{X}$ [a]	SD [b]	F [c]	$\overline{X}$	SD	F
Common yellowthroat	32.8 (2) [d]	57.6	57	40.8 (3)	34.4	86
Red-winged blackbird	335.2 (1)	144.0	100	410.8 (1)	188.4	100
Yellow-headed blackbird	25.6	36.4	57	39.0	119.2	43
Brown-headed cowbird	2.0	4.8	14	-	-	-
Common grackle	9.2	24.8	14	3.6	10.0	14
American goldfinch	10.0	26.8	14	-	-	-
Swamp sparrow	7.6	10.0	43	8.0	11.2	43
Clay-colored sparrow	4.4	12.0	14	-	-	-
Grasshopper sparrow	-	-	-	7.2	13.2	29
Song sparrow	26.0 (3)	20.8	71	20.8	27.6	57
Vesper sparrow	1.6	4.4	14	-	-	-
Baird's sparrow	2.0	4.8	14	-	-	-
Sharp-tailed sparrow	3.6	6.0	29	2.4	6.4	14
LeConte's sparrow	-	-	-	2.0	4.8	14
Average bird density	22.9	67.1		25.5	80.0	
Total number of species	24.0			26.0		

[a] Mean density/40 ha

[b] Standard deviation

[c] $\text{Frequency (\%)} = \frac{\text{plots on which bird occurred}}{\text{total number of plots}} \times 100$

[d] Ranking

Table 3. Mean density of birds and frequency of occurrence for plots on which birds occurred during June 1982 surveys in eastern South Dakota.

	Modified			Natural		
Species	$\bar{X}$[a]	SD[b]	F[c]	$\bar{X}$	SD	F
Ring-billed gull	7.4	19.5	14	5.4	14.2	14
Franklin's gull	5.5	14.7	14	-	-	-
Black tern	9.4	18.9	29	8.6	22.7	14
American bittern	2.4	6.4	14	-	-	-
Virginia rail	24.8	44.1	29	59.1	59.8	71
Sora	23.5	36.0	43	18.5	24.1	43
American coot	13.9	36.7	14	7.0	17.6	14
Willet	1.9	5.0	14	2.2	5.8	14
Wilson's phalarope	-	-	-	2.6	7.0	14
Ring-necked pheasant	-	-	-	4.8	12.7	14
Mourning dove	2.1	5.6	14	-	-	-
Eastern kingbird	2.3	6.2	14	-	-	-
Barn swallow	17.9	21.4	47	5.9	7.5	43
Tree swallow	1.7	4.5	14	-	-	-
Marsh wren	125.5 (2)[d]	150.0	71	149.4 (2)	162.9	71
Sedge wren	17.3	45.8	14	5.5	10.4	29
Common yellowthroat	109.7 (3)	63.0	100	104.5 (3)	101.4	86
Red-winged blackbird	177.5 (1)	117.9	100	180.8 (1)	131.6	100

Table 3. (Continued)

Species	Modified			Natural		
	$\overline{X}$[a]	SD[b]	F[c]	$\overline{X}$	SD	F
Yellow-headed blackbird	53.9	81.6	57	70.5	130.3	43
Brown-headed cowbird	2.5	6.5	14	6.1	11.2	29
American goldfinch	1.7	4.5	14	-	-	-
Swamp sparrow	2.3	6.1	14	2.5	6.5	14
Song sparrow	13.0	13.7	71	19.4	27.9	43
Average bird density	29.3	48.2		38.4	56.1	
Total number of species	21.0			17.0		

[a]Mean bird density/40 ha

[b]Standard deviation

[c]Frequency (%) = $\frac{\text{plots on which bird occurred}}{\text{total number of plots}}$ X 100

[d]Ranking

attain higher numbers in that year. In June 1981 on 2 dry semipermanent wetlands in eastern South Dakota, Hubbard (1982) observed 9 species that usually nest in a diversity of upland habitats. Hubbard (1982) also found higher numbers of song sparrows than swamp sparrows.

Wetland birds typically observed in prairie pothole wetlands by Provost (1947), Weller and Spatcher (1965), Krapu and Duebbert (1974), Krapu and Green (1978), Weber (1978), Knodel (1979), and Duebbert (1981) were also found in this study. Red-winged blackbirds and yellow-headed blackbirds are commonly found inhabiting marshes. These species generally partition themselves by occupying different portions of the marsh. Yellow-headed blackbirds build nests over water preferably 0.6 to 1.2 m deep (Bent 1965). Red-winged blackbirds will nest in vegetation over shallow water or often in upland areas, sometimes a considerable distance from water (Bent 1965). In 1981 red-winged blackbird densities were 335.2 pairs per 40 ha on modified plots and 410.8 pairs per 40 ha on natural plots. In 1982 there were only 177.54 pairs per 40 ha on modified plots and 180.8 pairs per 40 ha on natural plots. However, in 1981 yellow-headed blackbird densities were 25.6 pairs per 40 ha on modified plots and 39 pairs per 40 ha on natural plots increasing in 1982 to 53.54 pairs per 40 ha and 70.51 pairs per ha on modified and natural plots, respectively. Differences in direction of the bird numbers is possibly a result of the different climatic conditions between the 2 years. Wetter conditions in 1982 allowed more nesting habitat for yellow-headed blackbirds.

Twenty-four species occurred on the modified plot transects (MPT) and 26 species on the natural plot transects (NPT) in 1981.

On MPT the most abundant species, by density, observed in decreasing order were red-winged blackbirds, common yellowthroat, and song sparrow. Frequency of occurrence was 100%, 57%, and 71%, respectively (Table 2). On NPT the most abundant species, by density, observed in decreasing order were red-winged blackbird, marsh wren, and common yellowthroat. Frequency of occurrence was 100%, 29%, and 86%, respectively (Table 2).

In 1982, 20 species occurred on MPT and 18 species on NPT. On MPT red-winged blackbird, marsh wren, and common yellowthroat were the most abundant species by density, with frequency of occurrence of 100%, 71%, and 100%, respectively (Table 3). The most abundant species observed on the NPT were the same as MPT with frequency of occurrence of 100%, 71%, and 81%, respectively (Table 3).

Community Variables

Densities, bird species diversity, species richness, and equitability values were calculated for all birds on modified and natural plots of each wetland area for 1981 (Table 4) and 1982 (Table 5). Mean densities for wetland birds on all areas for both years were 15.87 pairs per ha. Densities on modified plots averaged 14.39 pairs per ha and natural plot densities averaged 17.35 pairs per ha. Bird species diversity values for all areas in both years averaged 1.61. Modified plots and natural plots supported mean species diversity values of 1.68 and 1.54, respectively. Species richness values for all areas in both years averaged 6.5 species. Modified and natural plots averaged 4.69 species and 4.31 species,

Table 4. Mean density, bird species diversity, species richness, and equitability values for birds on 7 modified wetlands in eastern South Dakota, June 1981.

	Area							
	Anderson	Graves	Storbeck	Schmig	Thompson	Kuecker	Cramer	$\bar{X}$
Modified								
Densities[a]	12.65	10.41	13.32	15.93	15.10	15.09	10.90	13.34
Bird Species Diversity[b]	0.20	1.65	1.58	2.32	1.61	0.41	2.16	1.42
Species Richness[c]	1.67	3.67	4.00	7.33	5.33	2.00	5.67	4.24
Equitability[d]	0.16	1.31	0.98	0.95	0.79	0.66	1.02	0.84
Natural								
Densities	16.90	12.94	30.05	21.24	10.94	20.60	11.89	17.95
Bird Species Diversity	1.28	0.82	1.25	2.49	0.97	1.15	1.71	1.38
Species Richness	3.67	2.67	3.33	7.67	2.67	4.33	5.00	4.19
Equitability	0.81	0.72	0.91	1.02	0.83	0.28	0.90	0.78

[a] Density = pairs/ha

[b] Bird species diversity = $H' = -\Sigma P_i \log P_i$

[c] Species richness = number of species

[d] Equitability = $H'/H'_{max} = J'$ (where $H'_{max} = H(s) = -\sum_{r=1}^{s} \pi r \log_2 \pi r$, Lloyd and Ghelardi 1964)

Table 5. Mean density, bird species diversity, species richness, and equitability values for birds on 7 modified wetlands in eastern South Dakota, June 1982.

	Area							
	Anderson	Graves	Storbeck	Schmig	Thompson	Kuecker	Cramer	$\bar{X}$
Modified								
Densities[a]	19.23	7.00	10.09	16.91	20.15	17.32	17.28	15.43
Bird Species Diversity[b]	1.55	1.58	1.65	2.58	2.16	1.39	2.68	1.94
Species Richness[c]	3.67	3.00	3.67	7.33	6.00	4.00	8.33	5.14
Equitability[d]	1.09	1.27	1.07	1.07	1.02	0.84	1.05	1.06
Natural								
Densities	20.91	12.25	23.75	15.56	16.54	9.74	18.49	16.75
Bird Species Diversity	2.03	1.43	1.44	1.67	1.74	0.65	2.95	1.70
Species Richness	5.00	3.33	3.67	4.33	4.00	1.67	9.00	1.10
Equitability	1.07	1.01	1.04	0.93	1.06	0.80	1.10	1.00

[a] Density = Pairs/ha

[b] Bird species diversity = $H' = -\Sigma P_i \log P_i$

[c] Species richness = number of species

[d] Equitability = $H'/H'_{max} = J'$ (where $H'_{max} = H(s) = -\sum_{r=1}^{s} \pi_r \log_2 \pi_r$, Lloyd and Ghelardi 1964)

respectively. Equitability values for all areas in both years averaged 0.92. Values for modified and natural plots averaged 0.95 and 0.89, respectively.

Analysis of variance (ANOVA) was used to test differences between treatments (modified and natural) using the above mentioned values as dependent variables. No significant differences ($P < 0.05$) were found between treatments for any of the dependent variables (Table 6). Since no significant differences were found between modified and natural plots it appears that modifications such as the dug brood complexes have no effects on wetland bird communities that can be attributed to the modifications.

Using ANOVA, significant differences ($P < 0.05$) between areas were found for the dependent variables, bird species diversity, species richness, and equitability (Table 6). A Waller-Duncan K-ratio T test was used for the dependent variables, bird species diversity, species richness, and equitability to group areas with means that were not significantly different.

Areas have been placed into groups for the species richness variable (Table 7). Inspection of the field notes revealed some possible explanations for the groupings. Cramer and Schmig Waterfowl Production Areas were grouped together with the highest means. Water conditions in both of these areas were excellent for 1981 and 1982. The wetland basin surrounding the modifications held water at a depth of approximately 0.5 to 1 m and the area approached hemi-marsh conditions. Weller and Spatcher (1965) and Weller and Fredrickson (1977) found that the numbers of marsh bird species would be at a

Table 6. Analysis of variance using pairs/ha, species richness, bird species diversity, and equitability as dependent variables.

Source	D.F.	Dependent variables (F values)			
		Pairs/ha	Species richness	Bird species diversity	Equitability
Treatment	1	13.50 n.s.[a]	1.49 n.s.	0.77 n.s.	0.00 n.s.
Area	6	1.91 n.s.	34.15 **[b]	41.44 **	9.01 **

[a] n.s. = Non-significant

[b] ** = Significant ($P < 0.05$)

Table 7. Waller-Duncan K-ratio T test for the variables, species richness, equitability, and bird species diversity.

Dependent variable	Group	Area	Mean	N
Species richness	1	Cramer	7.00	12
		Schmig	6.67	12
	2	Thompson	4.50	12
	3	Storbeck	3.67	12
		Anderson	3.50	12
		Graves	3.17	12
		Kuecker	3.00	12
Equitability	1	Graves	1.04	12
		Cramer	1.02	12
		Storbeck	1.00	12
		Schmig	0.99	12
		Thompson	0.93	12
	2	Anderson	0.78	12
		Kuecker	0.67	12
Bird species diversity	1	Cramer	2.38	12
		Schmig	2.26	12
	2	Thompson	1.62	12
	2-3	Storbeck	1.48	12
	3	Graves	1.37	12
		Anderson	1.27	12
	4	Kuecker	0.90	12

maximum during hemi-marsh conditions. Thompson Waterfowl Production Area was grouped alone and approached hemi-marsh conditions with water depth at approximately 8 cm. Weller and Spatcher (1965) and Weller and Fredrickson (1977) found that water regimes during drawdown were not as productive as the hemi-marsh conditions but more productive than dry marshes with dense vegetation. Storbeck, Anderson, Graves, and Kuecker Waterfowl Production Areas, the third grouping and with the lowest number of species, were the areas where the wetland was characterized by dense vegetation with little to no open water.

The groupings for the equitability variable placed the areas, Graves, Thompson, Cramer, Storbeck, and Schmig, in one group and Anderson and Kuecker in another group. Equitability is the evenness with which individuals are distributed among the number of species. In most avian communities the available species partition the breeding space in a characteristic way, and samples from the same or from different localities will yield similar distributions of species abundance (Tramer 1969). The homogeneity of this group probably accounted for the equitability values for Graves, Thompson, Cramer, Storbeck, and Schmig Waterfowl Production Areas. The placement of Anderson and Kuecher in a separate group may be explained by the abundance and type of species observed on those areas. When densities were averaged for both years, red-winged blackbirds accounted for greater than 50% of the samples, 51% and 67% for Anderson and Kuecker, respectively. Gregarious and often polygamous species, like the red-winged blackbird, defend only the immediate area of the nest against others of the same species, and feed largely outside the count area (Horn 1968 and Snelling 1968). This behavior results in high densities of the most abundant species and therefore lower values of equitability (Tramer 1969) as exhibited by Anderson and Kuecker Waterfowl Production Areas.

The grouping for the bird species diversity variable appears to combine the groupings made for the dependent variables, species richness, and equitability. Since species richness and equitability are the 2 components of the bird species diversity index it would seem that the groupings made for the bird species diversity values would follow a combination of the groupings for species richness and equitability (Table 7).

Modified Wetlands

It is difficult to compare values of densities, bird species diversity, species richness, and equitability from this study of modified wetlands to other wetlands studies. Many studies of bird species in wetlands included waterfowl in their counts (Stewart and Kantrud 1972, Krapu and Duebbert 1974, Duebbert 1981, Faanes 1982) which make the data values in this study uncomparable. Weber (1978) reported densities of non-game birds for wetlands but as birds per ha of surface water uncomparable to birds per ha of wetland basin.

As presented earlier, bird species in this study of modified wetlands were similar to bird species found in other wetland studies. It is not known if upland species that were found on the modified wetlands are there because of upland created by the modification (i.e. the islands) or because of food or climatic conditions.

Climatic conditions may explain the differences in some species between 1981 and 1982 but certain upland nesting species were observed in both years and in association with modified section transects.

Species which are usually associated with a diversity of upland habitats such as the song sparrow, American goldfinch, mourning dove, eastern kingbird, and swallows may find the island-pond association compatible to their needs. Song sparrows were seen using young cottonwoods and willows as singing posts on some islands, while American goldfinches were often seen in association with thistle (Circium spp.) growing on the islands. Mourning doves were present in 1981 and 1982 in association with the dug brood complex. Mourning doves, primarily seed eaters (Bent 1963a), may have used species of forbs on the islands as a food source.

The diet of eastern kingbirds and swallows consists primarily of insects that are captured during flight (Bent 1963b). Swallows were seen gleaning insects off and above the surface of the dug brood complex ponds. Many orders of aquatic insects are terrestrial as adults but aquatic as nymphs (Weller 1978a). The nymphs as well as emerging adults could serve as a food source for some birds. Odonata, an aquatic insect, has been reported as a prey item of bank swallows (Bent 1963b). Eastern kingbirds were also seen pursuing prey insects on dug brood complex ponds. Although the eastern kingbird captures most of its food by pursuing flying insects, they have also been reported to pick up suspended larvae from ponds (Bent 1963b).

Data from June 1982 show that red-winged blackbirds, marsh wrens, yellow-headed blackbirds, and common yellowthroats used the islands as nesting sites. Brown-headed cowbirds, usually an upland nester, were seen on modified transects and were found to parasitize red-winged blackbird nests on the islands. Seven of the 9 red-winged blackbird nests with eggs that were found on the islands had been parasitized by brown-headed cowbirds.

Wetland systems are constantly undergoing changes, thus marsh bird species are characterized by a response to water and vegetative substrate near water (Weller and Spatcher 1965). The pioneering ability of various marsh species allows them to adapt to the constant changes of wetland systems. In abandoning unsuitable habitat it is also possible that birds invade newly available or suboptimal areas readily (Weller 1978b). The pioneering ability of species to new habitats is an important component of management strategy (Weller 1978b). In Europe early habitat conditioning seems to occur in the case of marsh-edge passerines which as adults select nest sites comparable to those in which they are reared (Lack 1971). If this were true on modified wetlands then adaptability of most wetland species to modifications such as the dug brood complex should be possible.

CONCLUSIONS

The original intent in the excavation of dug brood ponds was to increase waterfowl production on certain wetlands by providing permanent water to hold pairs, provide brood rearing habitat, prevent forced overland migration of young, provide nesting cover on the islands, and provide deep open water for divers. Five years after construction of dug brood complexes on Waterfowl Production Areas in this study the effects of these modifications on wetland bird communities, other than Anatidae, appeared negligible.

Upland cover on the islands of the dug brood complexes provided nesting habitat for some upland species and a possible food source for other upland and marsh-edge species. The potential of the ponds and waterways of the dug brood complex for invertebrate production could prove to be beneficial for many species of marsh birds.

Although this study found no effects on marsh bird species due to the excavation of dug brood complexes, benefits could be realized by a further understanding of marsh bird communities. Should dug brood complexes be found to increase waterfowl production, then it is important that systems management rather than species management be kept in mind when constructing modifications. The wetlands manager today needs to know that although manipulation of the wetland basin through excavation of dug brood complexes is to increase waterfowl production, that it will not affect other bird communities.

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