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Distribution and Importance of Stockdams, Dugouts, and Natural Wetlands To Breeding Waterfowl In South Dakota

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DISTRIBUTION AND IMPORTANCE OF STOCKDAMS, DUGOUTS, AND NATURAL WETLANDS TO BREEDING WATERFOWL IN SOUTH DAKOTA

By

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This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable as meeting the thesis requirements for this degree, but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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DISTRIBUTION AND IMPORTANCE OF STOCKDAMS, DUGOUTS, AND NATURAL WETLANDS TO BREEDING WATERFOWL IN SOUTH DAKOTA

Abstract

James J. Ruwaldt Jr.

Wetland distribution and utilization by breeding waterfowl of stockdams, dugouts, and natural wetlands were investigated in South Dakota during 1973 and 1974.

Wetlands in South Dakota were estimated to encompass 590,499 ha and to total 631,557 basins. Natural ponds and lakes comprised 74.7 percent of the wetland area and 46.0 percent of the total number. Stockdams composed 13.9 percent of the wetland area and 14.0 percent of the number, and dugouts 0.3 percent and 8.1 percent of the state's wetland area and number respectively. Ninety-one percent of the ponds and lakes were found east of the Missouri River and 86.7 percent of the stockdams were found west of the Missouri River.

Higher numbers of indicated breeding waterfowl pairs per wet basin and per hectare of surface water, for a given wetland class, were generally found east of the Missouri River (East River) in the state as compared with west of the Missouri River (West River). Densities of breeding waterfowl were generally highest on class III and IV ponds, stockdams, and dugouts. Dugouts associated with other wetlands had higher waterfowl use in most cases than dugouts which were not associated with other wetlands.

Drought conditions during 1974 caused a reduction in breeding pair numbers from 1973 on all wetland classes except class V lakes, and a reduction in wet basins and surface water on most wetland classes.

Class III and IV ponds and stockdams were used by a large segment of most waterfowl populations throughout the study. Mallard (Anas platyrhynchos) and American wigeon (Anas crecca) populations in 1973 and mallard, pintail (Anas acuta), American wigeon, and northern shoveler (Anas clypeata) populations in 1974 used stockdams extensively. Blue-winged teal (Anas discors), gadwall (Anas strepera), green-winged teal (Anas carolinensis), wood duck (Aix sponsa), canvasback (Aythya valisneria), redhead (Aythya americana), lesser scaup (Aythya affinis), and ringneck (Aythya collaris) were most often associated with class III and IV ponds in 1973 and 1974. Stockdams were used by a larger segment of all populations in 1974 than in 1973, while the proportion of ducks using natural ponds and lakes decreased from 1973 to 1974. Stockdams were used by diving ducks only during the drought year of 1974.

Federally funded wetland drainage in South Dakota for 1936 to 1974 was estimated to encompass 98,306 ha. Records of privately funded drainage are wanting and an estimate of the total land area drained is not available.

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INTRODUCTION

Drainage of wetlands has been identified as a major factor responsible for the declining populations of North American waterfowl (Burwell and Sugden 1964, Sanderson and Bellrose 1969). Drainage within the prairie pothole region of the United States has been heavy. Schrader (1955) estimated that only about half of the original 74 million acres of wetlands remained in the prairie pothole region of the United States. The Reuss Amendment to the Agriculture Appropriations Act of 1963 has reduced the role of the Federal Government in drainage of wetlands. Numerous privately organized and funded drainage projects have continued; however, and the Soil Conservation Service is still involved with drainage through its small watershed program (PL-566). The Duck Stamp Act of 1934 was amended in 1958 in an effort to reduce loss of wetlands by drainage. The amendment stipulated that funds collected were to be spent for purchase or easements to preserve wetlands in major waterfowl producing states including South Dakota. In addition, in South Dakota, the Department of Game, Fish, and Parks has been purchasing wetlands and adjacent upland acreages under their game production area program. These programs; however, are designed to preserve existing wetlands only and do not replace wetlands that have already been drained.

The prairie pothole region of South Dakota still contains an abundance of wetlands; but the semi-arid, unglaciated prairie west of the Missouri River is generally lacking in natural wetlands and those present are often of a temporary nature. Because of uneven distribution,

regional scarcity, and temporary nature of wetlands in South Dakota, large numbers of stock watering ponds (stockdams and dugouts) have been constructed by farmers and ranchers. Many of these stockdams and some of the dugouts offer potentially attractive sites to breeding waterfowl (Smith 1958).

Duebbert (1972) feels that stockdams can act as replacements for wetlands which have been destroyed by drainage; however, Sanderson and Bellrose (1969) believe that stockdams are not as productive of waterfowl on a regional basis as are natural wetlands. Kruse (1972) in a study of stockdams in North Dakota found both use by breeding waterfowl pairs and broods to exceed that occurring on natural wetlands.

The objectives of this study were to: 1) determine the number, area, and regional distribution of natural wetlands in South Dakota, 2) determine the number and hectares of stockdams and dugouts which have been constructed and are still functioning in South Dakota, 3) determine the density of breeding waterfowl pairs found on stockdams, dugouts, and natural wetlands and the proportion of populations using these classes of wetlands, 4) determine the number and hectares of wetlands which have been drained using federal funds in South Dakota since 1936 and, 5) determine to what degree waterfowl production from stockdams and dugouts has compensated for the loss of waterfowl production from federally funded drainage of wetlands.

STUDY AREA

Precipitation

Annual precipitation decreases from southeast to northwest across the state. Precipitation averages 63.12 cm at Vermillion in the extreme southeastern corner and 34.82 cm at Camp Crook in the northwestern corner. (Spuhler et al 1971). Approximately 75 percent of the moisture falls from April to September. Amount of precipitation can fluctuate widely, and drought such as occurred in the 1930's and 1950's may occur periodically. Snowfall averages 63 to 114 cm except in the Black Hills where it averages 254 cm per year.

Vegetation and General Land Use

South Dakota lies within the grassland biome of North America (Knight 1970). Tall grasses such as big bluestem (Andropogon gerardii), little bluestem (Andropogon scoparius), indiangrass (Sorghastrum nutans), and switchgrass (Panicum virgatum) along with numerous forbs were the dominant native plants east of the James River (Weaver and Albertson 1956). Tall grasses gradually gave way to a mid-tall grassland community adjacent to the James River. Western wheatgrass (Agropyron smithii), big bluestem, and porcupine grass (Stipa spartea) were common grasses in this region.

Most of the native prairie of eastern South Dakota has been plowed. Row crops, particularly corn and soybeans, are predominant in the southeast and the James River Valley. Further west and north, small grains are more often grown and a higher proportion of the land is in pasture and wild hay.

The western two-thirds of the state (excluding the Black Hills) is primarily mixed grass prairie, although many localized areas are dominated by shortgrasses due to persistent overgrazing by livestock (Johnson and Nichols 1970). Common plant species of the mixed grass prairie are western wheatgrass, blue grama (Bouteloua gracilis), and needleandthread (Stipa comata). Western South Dakota and the area on either side of the Missouri River are still predominately rangeland although in some areas a large portion of the land has been broken and is in small grains (Westin et al 1967).

The vegetation of the Black Hills consists of nearly pure stands of ponderosa pine (Pinus ponderosa). Native stands of northern river bottom hardwoods are still found along the Big Sioux, James, Cheyenne and other major river systems of the state. The once extensive stands of hardwoods along the Missouri River have been lost, following the completion of the mainstem reservoir system in the 1960's.

Physiography

The Missouri River generally marks the western extent of glaciation in South Dakota and divides the state approximately into eastern (East River) and western (West River) halves. A series of glaciers moved across the state in a northeastern to southwestern direction. The soil and landforms east of the Missouri River are of relatively recent origin because of the glaciation. Natural drainage systems are poorly developed, and potholes and lakes are abundant. The landforms and natural drainage systems west of the Missouri River are older and

more developed than those east of the river. Few natural wetlands occur west of the river, and most of the available waterfowl habitat occurs as stockdams.

Physiographic Strata

The state has been divided into eight major physiographic regions (strata) by Westin et al. (1967) (Fig. 1). Strata in the East River area are further subdivided into several substrata.

The Minnesota-Red River Lowland (Stratum I) is a broad, gently rolling to a level valley. Elevation ranges from 275 to 335 m above sea level. Density of wetlands is low when compared with the Coteau des Prairies to the west.

The Coteau des Prairies or Prairie Hills (Stratum II) covers an area approximately 65 km wide from the North Dakota border on the north to the Missouri River on the south. This highland region slopes downward to the James River Lowland on the west and the Minnesota-Red River Lowland on the east. Substratum IIA is the northeastern escarpment of the Coteau des Prairies. Within this substratum the Coteau des Prairies drops nearly 300 m to the Minnesota-Red River Lowland. Portions of the escarpment are sharply eroded. The many draws and gullies are often heavily wooded with bur oak (Quercus macrocarpa) and shrubs. Wetlands within this substratum are less numerous than in substratum IIC1; however, they are more numerous than in much of the rest of stratum II.

Substratum IIB encompasses much of the area drained by the Big Sioux River. In contrast to the rest of stratum II, the natural surface drainage is good and wetlands are not generally abundant. The Big

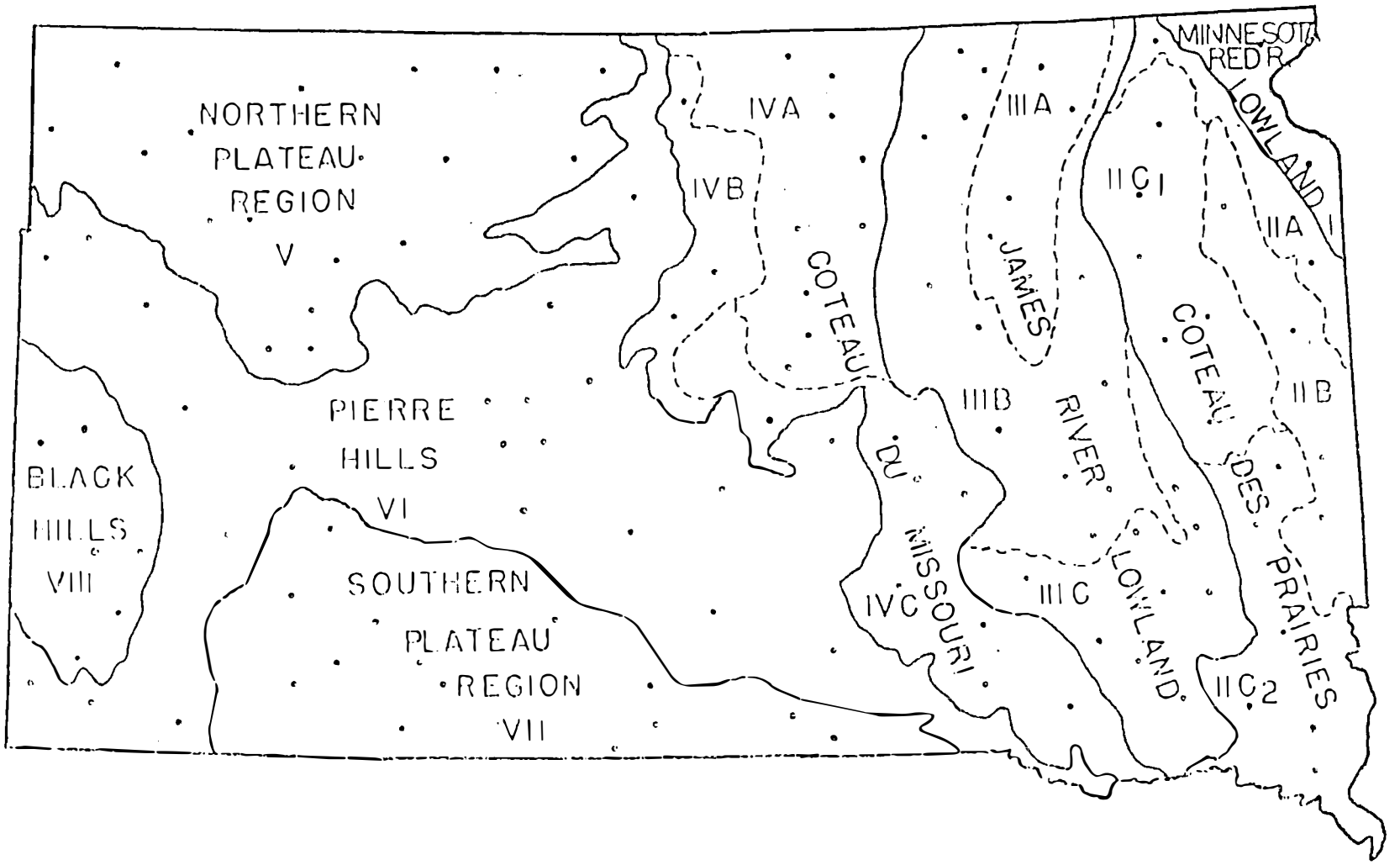

Fig. 1. Major physiographic regions, strata, and substrata within South Dakota and the location of 125 randomly selected cluster samples, 1973-74.

Sioux River and its associated drainage ways are the primary wetlands in this substratum.

The remaining portions of stratum II occur between the James River on the west and the Big Sioux River on the east. This region has a poor natural drainage system, and numerous wetlands are found here particularly in the north. Some of the highest densities of wetlands in the state occur in the northern portion of substratum IIC1. The topography of substratum IIC1 varies from rolling to gently undulating with the greatest relief occurring in the northern section. Soils in both substratum IIC1 and IIC2 are similar; however, soils in substratum IIC2 developed in a generally warmer climate and the accumulation of organic matter was less than in substratum IIC1. Although the density of wetlands in substratum IIC2 was never as high as the density of wetlands in substratum IIC1, more agricultural drainage has occurred in this substratum. Thus a great disparity of wetland numbers occurs between these two substrata.

The James River Lowland (Stratum III) is a broad, gently undulating plain lying between the Coteau du Missouri on the west and the Coteau des Prairies on the east. Density of natural wetlands is low compared with the previous two strata, and stockdams and dugouts are of greater importance. A greater proportion of wetlands in this strata are of a temporary nature than in most other areas of the state (Wheeler 1972). Substratum IIIA delineates the bed of ancient Lake Dakota. The former lake bed is nearly level and has few natural wetlands. The James River and dugouts comprise the major surface water in the substratum.

Substratum IIIB is similar to substratum IIIA in type and numbers of wetlands present and in general land use. Substratum IIIC is also similar to the rest of stratum III; however, there are local areas of higher wetland density and permanence than generally occur in the rest of stratum III.

The Coteau du Missouri (Stratum IV) or the Missouri Hills is the western most stratum in the glaciated prairie region. This, like the Coteau des Prairies, is a highland region. The eastern edge slopes downward to the James River Lowland. The Missouri River marks the western edge of the Coteau. The northeastern portion of the stratum (substratum IVA) is rolling to undulating, poorly drained, and has a relatively high density of wetlands. Substratum IVB has a mature drainage pattern and contains few natural wetlands when compared with the remainder of the glaciated prairie in South Dakota. The topography is similar to much of the West River area with alternating draws and ridges. Stockdams and dugouts form a major portion of the surface water. Substratum IVC is gently rolling to level and contains few natural wetlands. Stockdams and dugouts are numerous and provide a large proportion of the available surface water.

The Northern Plateau Region (Stratum V) is an area of level to rolling topography with elevated plateaus and buttes. The Pierre Hills (Stratum VI) is a more rolling area than the Northern Plateau Region. Like the Northern Plateau Region, the Southern Plateau Region is also an area of elevated plateaus and buttes. The Badlands are found in the northwestern corner of this stratum. South and east of the Badlands is the Pine Ridge country, an area of steep to rolling topography with

ponderosa pine in the draws and on the ridge tops. A portion of the Nebraska Sand Hills extends into the extreme southern fringe of this stratum.

Percentage distribution of the total area found in the eight major strata is as follows: Minnesota-Red River Lowland (I) 1.54; Coteau des Prairies (II) 12.74; James River Lowland (III) 15.64; Coteau du Missouri (IV) 14.03; Northern Plateaus (V) 15.08; Pierre Hills (VI) 26.47; Southern Plateaus (VII) 10.43; and Black Hills (VIII) 4.07. The total East River area (strata I-IV) accounts for 43.95 percent of the state, and the West River area, excluding the Black Hills (stratum VIII), accounts for 51.98 percent of the state.

METHODS

Five hundred quarter section plots were selected across South Dakota using a stratified random sampling technique similar to that used by Stewart and Kantrud (1972). The quarter section was selected as the sampling unit because boundaries of quarter sections are often marked by roads, trails, or fencelines or are readily identified by differences in land use. The area of a quarter section (64.8 ha) is also sufficiently small to allow censusing by one or two observers. Duplicate counts of ducks are reduced or avoided on quarter section areas because flushed waterfowl can be watched until they land, and visual and voice contact can be maintained between observers.

The number of sample plots selected for each physiographic area was in proportion to the size of the area (Brewster 1975). Two-stage, cluster sampling techniques were used to reduce the amount of time required for driving between sample plots and to increase sample size. One hundred and twenty-five township corners representing the center points of clusters were randomly drawn and a circle, 3 miles in diameter, drawn around each point. Each cluster was divided into quadrants, and one quarter section was randomly selected from each quadrant. Aerial photographs of all quarter sections were obtained from the Agricultural Stabilization and Conservation Service (ASCS) in Huron, South Dakota. Enlargements were made (8x8 inches) and photocopies produced for field use.

Two breeding pair counts were made during both 1973 and 1974. The first count in each year was directed toward the early nesting

species: mallard, pintail, wood duck, and canvasback. The second count each year was directed toward the mid and late nesting species: blue-winged teal, gadwall, green-winged teal, American wigeon, northern shoveler, redhead, lesser scaup, ringneck duck, and ruddy duck (Oxyura jamaicensis).

Counts of breeding pairs in 1973 were conducted from 10 May to 1 June and from 3 to 21 June. In 1974, counts were conducted from 13 to 27 May and from 10 to 20 June. Due to the inaccessibility of the plots and general lack of waterfowl habitat, the Black Hills (stratum VIII) was dropped from the study in 1974 reducing sample plots from 500 to 476.

Indicated breeding pairs were tabulated according to Hammond (1969) as segregated pairs, lone males, and mixed-group females. Excess lone females were also recorded as indicated pairs after Stewart and Kantrud (1972). Field data were collected by two teams of two men each. Each team utilized binoculars and a spotting scope. East and West River regions were censused simultaneously in a general south to north direction.

Many wetlands in the West River area occur as stockdams, dugouts, and intermittent streams. Ducks on these wetland classes are highly visible and can often be censused from a vehicle. Natural wetlands in the East River region were usually censused by the walk-wade method. Small, relatively open wetlands were censused by one man walking the shoreline while the other observer censused another plot or other wetlands on the same plot. Both observers waded larger or more heavily vegetated wetlands. An attempt was made to avoid flushing ducks when

visibility was high, however, we attempted to flush ducks on heavily vegetated wetlands where ducks were difficult to observe. Flushed waterfowl were watched until they landed to avoid duplicate counts. Ducks on upland areas within a plot were recorded and tabulated as being associated with the nearest wetland on the plot. Only ducks within sample plots were recorded on ponds which extended outside the plot.

Natural ponds and lakes with residual vegetation were classified according to the system developed by Stewart and Kantrud (1971). We further classified man-made wetlands (stockdams and dugouts), tillage ponds, and heavily grazed basins devoid of wetland vegetation. Dugouts were divided into: 1) dugouts which were found in a wetland basin which contained water or within 50 m of such a basin, 2) dugouts which were found in a wetland basin that was dry or within 50 m of such a basin, and 3) dugouts which were not associated with other wetland basins. The perimeter of each wetland basin was outlined on a copy of the appropriate aerial photograph, and the basin area was determined later by planimeter. Hectares of surface water were determined for each basin by multiplying the estimated percentage of the basin containing water by the hectares of the basin.

All data collected and calculated were coded by ponds and key-punched on standard 80 column IBM cards.

RESULTS AND DISCUSSION

Wetland Inventory

Expansion of the data yielded an estimate of 631,557 wetland basins encompassing 590,499 ha in South Dakota (Table 1). Of this, 74.7 percent of the basin area and 46.0 percent of the basin numbers were class I (ephemeral), II (temporary), III (seasonal), IV (semipermanent), or V (permanent) natural wetlands (Stewart and Kantrud 1971). Stockdams composed 13.9 percent of the area and 14.0 percent of the basins, and dugouts composed 0.3 percent of the area and 8.1 percent of the basins (Table 2). The remaining 10.6 percent of the wetland area and 31.9 percent of the basins were classified as miscellaneous wetlands. Miscellaneous wetlands included intermittent streams, permanent streams and rivers, and roadside ditches.

A wetland inventory, conducted by the U.S. Fish and Wildlife Service in 1964 and updated in 1975 to include all natural ponds and lakes, indicated an estimated 534,222 ha of natural ponds and lakes in South Dakota, as compared to the 441,227 ha of natural ponds and lakes estimated from data obtained in this study.

In South Dakota, the East River region contained the largest proportion of both total wetlands, 80.0 percent of the area and 67.5 percent of the basins, and natural ponds and lakes, 96.0 percent of the area and 91.6 percent of the number (Table 3). Class IV and V wetlands comprised the majority of the wetland area in the Minnesota-Red River Lowland and the Coteau des Prairies, while less permanent wetlands comprised most of the wetland area in the James River Lowland

Table 1. Estimated hectares of wetland basins (in parentheses) and numbers of wetland basins in the major physiographic regions of South Dakota.

Wetland class	Minnesota River-Red River Lowland I	Coteau des Prairies II	James River Lowland III	Coteau du Missouri IV	Total East River	Northern Plateaus V	Pierre Hills VI	Southern Plateaus VII	Total West River	State Total
I	(60.05) 594	(4371.40) 8272	(30769.71) 15545	(31150.42) 21596	(74351.57) 46007	(4592.68) 4519	(1876.87) 887	(3853.90) 2870	(10323.46) 8276	(84675.03) 54283
II		(7432.38) 23292	(17221.85) 21346	(41395.29) 45919	(66049.51) 90357	(169.81) 646	(147.13) 2660	(46.46) 574	(363.40) 3880	(66412.91) 94237
III	(1409.91) 2374	(16071.26) 26525	(19273.43) 23410	(35320.39) 20541	(72574.99) 72850	(5751.71) 1291	(197.38) 887	(18.58) 574	(5947.67) 2752	(78522.66) 75602
IV	(9578.74) 2374	(129638.12) 26260	(21834.87) 10882	(25571.45) 13555	(186623.18) 53071	(308.27) 5810	(739.27) 4547		(1047.54) 9357	(187670.72) 62428
V		(18093.83) 2265	(5851.95) 1437		(23945.78) 3702					(23945.78) 3702
Total	(11048.70) 5342	(175606.99) 86614	(103451.80) 72420	(133437.55) 101611	(423545.03) 265987	(10802.47) 12265	(2960.65) 7981	(3918.94) 4018	(17682.07) 24264	(441227.10) 290252
Dugouts		(750.53) 9851	(2191.58) 23990	(1249.10) 10889	(4191.01) 44730	(175.03) 1291	(351.69) 3547	(153.32) 1722	(680.04) 6560	(4871.05) 51290
Stockdams		(283.19) 2682		(13320.96) 9117	(13604.15) 11799	(10196.39) 16138	(49039.15) 51432	(8948.30) 9184	(68183.84) 76754	(81787.99) 88553
Miscellaneous	(420.33) 2374	(5937.76) 28355	(20460.50) 47956	(4473.35) 21783	(31527.94) 103478	(12309.86) 50352	(15782.97) 26264	(3191.84) 18368	(31284.67) 94984	(62812.61) 201462
Grand Total	(11469.03) 7716	(182614.47) 127512	(126103.68) 144366	(152430.96) 146400	(472668.13) 425994	(33483.75) 80046	(68134.46) 89224	(16212.40) 33292	(117830.62) 202562	(590498.75) 631557

Table 3. Percentage of wetland basins and basin hectares (in parentheses) in South Dakota by major physiographic strata.

Wetland class	Minnesota River-Red River Lowland I	Coteau des Prairies II	James River Lowland III	Coteau du Missouri IV	Total East River	Northern Plateaus V	Pierre Hills VI	Southern Plateaus VII	Total West River
I	1.1 (t)	15.2 (5.2)	28.6 (45.8)	39.8 (36.8)	84.7 (87.8)	8.3 (5.4)	1.6 (2.2)	5.4 (4.6)	15.3 (12.2)
II	3.1 (1.8)	24.7 (11.2)	22.4 (25.9)	45.7 (60.6)	95.9 (99.5)	0.7 (0.3)	2.8 (0.2)	0.6 (t)	4.1 (0.5)
III	3.1 (1.8)	35.1 (20.5)	31.0 (25.2)	27.2 (45.0)	96.4 (92.4)	1.7 (7.5)	1.2 (0.3)	0.8 (t)	3.6 (7.6)
IV	3.8 (5.1)	42.1 (69.1)	17.4 (11.6)	21.7 (13.6)	85.0 (99.4)	9.3 (0.2)	5.7 (0.4)		15.0 (0.6)
V		61.2 (75.6)	38.8 (24.4)		100.0 (100.0)				
Total	1.8 (2.6)	29.8 (39.8)	25.0 (23.4)	35.0 (30.2)	91.6 (96.0)	4.2 (2.4)	2.7 (0.7)	1.5 (0.9)	8.4 (4.0)
Dugouts		19.3 (15.4)	46.5 (45.0)	21.3 (25.6)	87.1 (86.0)	2.5 (3.6)	6.9 (7.2)	3.5 (3.1)	12.9 (14.0)
Stockdams		3.0 (0.3)		10.3 (15.3)	13.3 (16.6)	18.2 (12.5)	58.1 (60.0)	10.4 (10.9)	86.7 (83.4)
Miscellaneous	1.2 (0.7)	14.1 (9.5)	23.8 (32.7)	12.3 (7.1)	51.4 (50.0)	25.0 (19.7)	13.0 (25.2)	10.6 (5.1)	47.1 (50.0)
Grand Total	1.2 (1.9)	20.2 (30.9)	22.9 (21.4)	23.2 (25.8)	67.5 (80.0)	12.7 (5.7)	14.1 (11.5)	5.7 (2.7)	32.5 (20.0)

and the Coteau du Missouri. Over the entire East River region, class IV ponds comprised the largest proportion of the area of natural ponds and lake basins (39.5 percent), and class II basins were the most numerous (21.2 percent) (Table 2).

Miscellaneous wetlands were the second most important in terms of hectares and number of wetlands in the East River region (Table 2). The James River Lowland contained the highest proportion of both miscellaneous wetland areas and numbers. The miscellaneous wetlands were primarily roadside ditches. The remaining three strata had approximately equal distributions of miscellaneous wetland area (Table 1).

Eighty-six percent of the dugouts within the state occurred in the East River region (Table 3); however, dugouts and stockdams were the least important wetland classes in the East River region in terms of basin area and number (Table 1). Only 3.8 percent and 13.2 percent of the total East River wetland area and number, respectively, were comprised of dugouts and stockdams combined (Table 2). The James River Lowland contained the largest number and area of dugouts of any strata in the state (Table 1). Dugouts were absent in the sample obtained in the Minnesota-Red River Lowland. Stockdams occurred only in the sample obtained in the Coteau du Missouri and Coteau des Prairies strata. Stockdams were most numerous in the Coteau du Missouri, yet accounted for only 8.7 percent of the wetland area and 6.2 percent of the wetland numbers in that stratum (Table 2).

Natural ponds and lakes in the West River region account for only 4.0 percent of the total area of natural ponds and lakes and 8.4 percent of the total numbers of wetlands in the state (Table 3). Stockdams constituted 57.9 percent of the area and 37.9 percent of total wetland numbers in the West River strata (Table 2). The greatest basin area and number of stockdams were found in the Pierre Hills stratum where 60.0 percent of the total surface area of water in stockdams and 58.1 percent of the total numbers of stockdams in the state were found (Table 3). Approximately equal areas of stockdams were found in the Northern Plateaus and Southern Plateaus strata.

Numbers and hectares of miscellaneous wetlands were similar in both East River and West River regions. Roadside ditches accounted for the greatest number of wetlands in this classification in the East River region, and intermittent streams constituted the largest segment in the West River region. The miscellaneous wetland classification accounted for a greater proportion of total West River wetlands because fewer total wetlands occur in the West River region (Table 2).

Available Waterfowl Habitat

The proportions of the total number of basins and total area of basins containing water and thus available to waterfowl are presented in table 4 as obtained during each of the four pair counts conducted. A gradual loss of both numbers of wet basins and surface area of water occurred throughout the 2 years. Percentage of natural basin area containing surface water ranged from 52.3 during the early pair count in 1973 to 26.7 during the late pair count in 1974.

Table 4. Percentage of wetland hectares and wetland basins containing water in South Dakota during pair counts conducted in May and June of 1973 and 1974.

Wetland class	1973 May Pair Count		1973 June Pair Count		1974 May Pair Count		1974 June Pair Count	
	Area	No.	Area	No.	Area	No.	Area	No.
I	1.0	11.9	0.7	4.8	2.6	15.1	0.7	4.0
II	16.6	45.5	19.1	30.4	19.5	41.3	10.3	23.6
III	50.5	38.2	38.5	32.2	33.0	27.6	19.3	16.8
IV	82.9	96.0	75.5	86.8	47.0	80.5	41.0	71.0
V	99.8	100.0	100.0	100.0	92.7	100.0	95.3	100.0
Total	52.3	46.8	47.2	37.7	34.3	39.1	27.6	26.7
Dugouts	75.5	91.9	76.6	94.7	78.0	94.7	82.2	96.0
Stockdams	80.8	87.1	77.8	87.6	60.5	72.4	67.1	70.4
Miscellaneous	65.6	66.7	57.8	63.6	52.9	55.2	46.6	47.4
Grand Total	57.9	60.9	52.9	55.6	40.3	51.9	35.6	43.2

Stockdams and dugouts exhibited more permanency than natural wetlands. Surface water in dugouts was never less than 75 percent of the available dugout basin area, and surface water in stockdams was never less than 60 percent of the available stockdam basin area. Permanent lakes (class V) had the most stable water levels among all wetland classes.

Densities of Breeding Pairs of Waterfowl

Densities of breeding pairs of waterfowl were calculated by wetland class for each of the seven censused strata, the East River area, the West River area, and the entire state for 1973 and 1974. Breeding pairs were classified as either early nesting species (mallard, pintail, canvasback, and wood duck) or late nesting species (blue-winged teal, gadwall, American wigeon, northern shoveler, green-winged teal, late nesting diving ducks, and ruddy duck). Late nesting diving ducks included redhead, ringneck duck, and lesser scaup. Densities of breeding pairs and percentage of populations using the various wetland classes were calculated for species on a statewide basis during both 1973 and 1974.

During 1973, densities of breeding pairs were consistently greater for all wetland classes in the East River region as compared with the West River region except where the small sample size of natural ponds and lakes in the West River area produced inflated values. The greater frequency of wetlands in the East River region probably accounted for the generally higher waterfowl densities found on wetlands in that region. Densities of breeding pairs per hectare of surface water for

the entire state were highest for class I, II, and III wetlands and on stockdams and dugouts (Table 5) in 1973. Densities found on dugouts are particularly high due to their small mean size ($\bar{x}$ = .10 hectare). Association with natural wetlands was an important influence on densities of breeding pairs observed on dugouts. Dugouts located in or within 50 m of a wet basin generally had higher densities per wet basin and higher densities per hectare of surface water throughout the study (Tables 5 and 6). Cooch (1950) and Smith (1958) also reported that greatest use of dugouts occurred on those dugouts associated with natural wetland basins. High densities observed on dugouts associated with dry wetlands may be due to several factors: 1) the surrounding wetland basin may have contained water earlier in the year which made the dugout more attractive to waterfowl, 2) hens may have homed to their natal wetland (Mckinney 1964, Sowls 1955) or to wetlands used in previous years as nesting sites and which are now dry, 3) vegetation in the dry wetland basin may provide attractive nesting cover near the associated dugout.

Highest numbers of early breeding pairs per wet basin were recorded on stockdams and class IV ponds (Table 5). Pairs per wet basin on dugouts was greatest for dugouts associated with wet wetland basins, intermediate for those associated with dry basins, and least for those not associated with any wetland.

Late nesting pairs utilized natural ponds and lakes to a greater degree than did early nesting pairs in 1973. Class I ponds had the highest density of late nesting pairs per surface water hectare followed

Table 5. Densities of early and late breeding waterfowl pairs per wet basin (WB) and per hectare of surface water (SW) in South Dakota, 1973.

Wetland class	Early Pairs						Late Pairs					
	East River		West River		Statewide		East River		West River		Statewide	
	(WB)	(SW)	(WB)	(SW)	(WB)	(SW)	(WB)	(SW)	(WB)	(SW)	(WB)	(SW)
I	0.33	4.72	0.20	1.09	0.27	2.10	1.06	42.38			1.06	42.38
II	0.53	1.95			0.49	1.90	0.60	3.95	0.47	0.79	1.58	3.56
III	1.02	1.61			0.98	1.30	2.30	3.61			2.27	3.51
IV	1.82	0.59	0.29	6.75	1.60	0.62	6.11	1.98	0.08	1.33	5.15	1.98
V	0.62	0.10			0.62	0.10	2.62	0.42			2.62	0.42
Total	1.13	0.77	0.18	0.44	1.04	0.77	3.62	2.22	0.16	0.67	3.24	2.13
Dugouts	0.90	11.49	0.41	4.87	0.84	10.60	1.08	14.16	0.10	0.44	0.96	12.33
1[a]	1.09	14.16	0.25	3.45	1.02	13.30	1.49	19.21	0.25	5.26	1.37	16.53
2[b]	0.65	9.82			0.65	9.82	0.90	13.61			0.90	13.61
3[c]	0.54	5.91			0.50	5.56	0.71	8.29			0.54	5.81
Stockdams	2.69	3.85	1.22	1.38	1.41	1.63	4.61	5.83	1.21	1.46	1.66	2.03
Miscellaneous	0.37	1.06	0.41	1.51	0.39	1.23	0.40	1.31	0.17	0.64	0.26	0.94

[a]Dugouts located in or within 50 meters of a wetland basin containing water.

[b]Dugouts located in or within 50 meters of a dry wetland basin.

[c]Dugouts not in or within 50 meters of a wetland basin.

Table 6. Densities of early and late breeding waterfowl pairs per wet basin (WB) and per hectare of surface water (SW) in South Dakota, 1974.

Wetland class	Early Pairs						Late Pairs					
	East River		West River		Statewide		East River		West River		Statewide	
	(WB)	(SW)	(WB)	(SW)	(WB)	(SW)	(WB)	(SW)	(WB)	(SW)	(WB)	(SW)
I	0.14	0.54			0.14	0.54						
II	0.11	0.35			0.11	0.35	0.22	0.64			0.20	0.64
III	0.27	0.42			0.27	0.42	0.45	0.69	0.53	3.98	0.46	0.74
IV	1.14	0.54	0.08	1.43	0.96	0.54	3.51	1.61	0.09	1.26	2.78	1.61
V	0.73	0.12			0.73	0.12	2.92	0.47			2.92	0.47
Total	0.50	0.44	0.07	1.16	0.47	0.30	1.75	1.21	0.12	1.88	1.53	1.21
Dugouts	0.24	3.05	0.71	8.10	0.27	3.57	0.45	6.33	0.10	1.09	0.40	4.84
1[a]	0.26	3.04			0.25	2.91	0.77	8.13			0.73	7.44
2[b]	0.26	3.39			0.25	3.22	0.18	2.92	0.50	7.69	0.22	3.26
3[c]	0.41	5.96	1.00	12.20	0.33	4.69	0.27	2.14			0.27	1.94
Stockdams	1.23	2.08	1.03	1.26	1.06	1.36	1.89	2.40	0.84	0.94	0.99	1.11
Miscellaneous	0.11	0.32	0.38	1.51	0.23	0.73	0.44	1.06	0.18	0.94	0.31	1.04

[a]Dugouts located in or within 50 meters of a wetland basin containing water.

[b]Dugouts located in or within 50 meters of a dry wetland basin.

[c]Dugouts not in or within 50 meters of a wetland basin.

by dugouts associated with wet wetland basins, dugouts associated with dry wetland basins, dugouts not associated with other wetlands, class II ponds, and class III ponds. Numbers of late nesting pairs per dugout were lower than all classes of natural ponds and lakes. Late pairs per wet basin on stockdams were higher than numbers recorded on class I and class II ponds, but lower than the mean number found on class III, IV, and V wetlands.

The substantial reduction in numbers of breeding pairs in 1974 (Brewster 1975) resulted in decreased densities of early nesting pairs on all wetland classes except class V lakes (Table 6). Densities of early nesting pairs per hectare surface water were higher on dugouts and stockdams than on any other wetland class. Highest numbers of early nesting pairs per wet basin were found on stockdams followed by class IV ponds and class V lakes. In contrast with use by breeding pairs during the rest of the study, dugouts which were not associated with other wetlands had the highest density of pairs per hectare of surface water and per wet basin followed by dugouts associated with dry wetland basins and dugouts associated with wet wetland basins. Highest densities of late nesting pairs were found on dugouts associated with wet wetlands followed by dugouts associated with dry wetlands and dugouts not associated with other wetlands. Late nesting pairs per surface water hectare of stockdam was higher than all natural ponds and lakes except class IV ponds.

Distribution of Breeding Pairs and Water

A further measure of the relative importance of various classes of wetlands to breeding waterfowl can be made by comparing the proportion of the pairs occurring on a wetland class with the proportion of the total surface water area of wetland and the number of wet basins occurring as that particular kind of wetland (Table 7).

During the early pair count of 1973, class IV ponds accounted for the largest percentage of surface water while miscellaneous wetlands were the largest source of wet basins (Table 7). Stockdams accounted for the largest proportion of early pairs (28.9 percent), followed by class IV ponds (25.2 percent). Dugouts accounted for only 1.1 percent of the total area of surface water while 10.6 percent of the early nesting pairs were found on dugouts. The greatest proportion of these were found on dugouts closely associated with wetland basins containing water.

Distribution of water during the late pair count in 1973 was similar to that found during the early count of that year (Table 7). Late nesting pairs used natural ponds and lakes more extensively than did the early nesting pairs. Over 67 percent of the late nesting pairs were found on natural ponds and lakes which comprised 66 percent of the total surface water in the state. Class IV ponds accounted for the largest proportion of both late pairs (42.4 percent) and ponds (45.1 percent). Stockdams ranked second in both percentage of pairs and percentage of surface water (19.7 and 20.5 percent, respectively).

Table 7. Percentage of wet basins, surface water, and breeding pairs in South Dakota during pair counts conducted in May 1973 and 1974 and June 1973 and 1974.

Wetland class	1973 May			1974 May			1973 June			1974 June		
	Wet basin	Surface water	Pairs	Wet basin	Surface water	Pairs	Wet basin	Surface water	Pairs	Wet basin	Surface water	Pairs
I	1.5	0.2	0.4	2.2	0.9	0.7	0.7	<0.1	0.4	0.7	0.3	
II	10.1	3.3	5.6	10.7	5.5	2.5	7.4	4.1	7.0	7.3	3.3	1.7
III	13.2	11.8	14.7	11.2	11.1	6.2	12.2	9.9	16.6	8.2	7.3	4.4
IV	13.8	45.3	25.2	13.6	36.9	27.4	13.7	45.1	42.4	14.4	36.4	47.0
V	1.0	6.9	0.7	1.0	9.2	1.5	1.0	7.6	1.5	1.3	10.7	4.1
Total	39.6	67.5	46.6	38.7	63.6	38.3	35.0	66.7	67.9	31.9	58.0	57.1
Dugouts	11.1	1.1	10.6	13.4	1.6	8.0	12.5	1.2	7.2	16.3	2.0	7.6
1[a]	5.8	0.6	6.8	5.9	0.8	3.2	6.1	0.6	4.4	6.3	0.8	5.0
2[b]	2.0	0.2	1.6	3.5	0.4	1.9	2.9	0.2	1.7	5.5	0.5	1.3
3[c]	3.3	0.3	2.2	4.0	0.4	2.9	3.5	0.4	1.2	4.5	0.7	1.3
Stockdams	18.0	19.5	28.9	17.6	21.0	38.9	19.8	20.5	19.7	20.5	26.3	23.7
Miscellaneous	31.3	11.9	13.9	30.3	13.8	14.8	32.7	11.5	5.1	31.3	13.7	11.5
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a]Dugouts located in or within 50 meters of a wetland basin containing water.

[b]Dugouts located in or within 50 meters of a dry wetland basin.

[c]Dugouts not in or within 50 meters of a wetland basin.

Wetland composition and proportion of surface water changed slightly from the early count of 1973 to the early count of 1974 (Table 7). Class IV ponds still represented the major areas of surface water in the state; however, a smaller percentage of the total surface water area occurred as class IV ponds and total ponds and lakes while stockdams and dugouts increased slightly in proportion to the state's surface water area.

The distribution of early nesting pairs shifted from May of 1973 to May of 1974 to favor the more permanent wetlands (Table 7). Stockdams, class IV ponds, and class V lakes showed increases in the proportion of total early nesting pairs found on those wetland classes. The largest proportion of early nesting pairs in 1974 was found on stockdams (38.9 percent) followed by class IV ponds (27.4 percent). The percentage of early nesting pairs found on stockdams was greater than the total percentage of early nesting pairs found on all natural ponds and lakes combined, even though natural ponds and lakes accounted for 63.6 percent of the total surface water versus only 21.0 percent in stockdams.

As the drought intensified during 1974, the more permanent lakes, dugouts, and stockdams increased in proportion to the state's total surface water (Table 7). The proportion of late nesting pairs using class IV ponds and class V lakes increased, although the proportion of late pairs found on natural ponds and lakes declined from 1973 as did the total percentage of surface water occurring as natural ponds and lakes (Table 7). Consistent with the distribution of late nesting species in 1973, natural ponds and lakes were still able to account for

nearly two times the number of late nesting pairs that stockdams and dugouts combined were able to account for in 1974.

Numbers of early nesting pairs declined during 1974 on all wetland classes except class V lakes which showed a 2.3 percent increase from 1973 to 1974 (Table 8). Similar changes in wetland use by ducks during periods of drought have been noted in North Dakota (Stewart and Kantrud 1964) and Saskatchewan (Stoudt 1971). Smith (1971), in his study near Lousana, Alberta, noted that during the drought year of 1959 many paired ducks spent the breeding season on larger lakes in the area and apparently did not attempt to nest.

Greatest changes in numbers of early pairs between 1973 and 1974 occurred with class II and class III ponds and dugouts (Table 8). A high loss of pairs on dugouts even though there was a slight increase in the surface water area of dugouts was probably due to the reduction in water in natural pond and lake basins surrounding many dugouts. Stoudt (1971), in Saskatchewan, has concluded that dugouts are of little value to waterfowl except when surrounded by another basin containing water. Relatively smaller decreases in numbers of breeding pairs occurred on stockdams and class I ponds (37.6 and 34.5 percent, respectively). Class III and IV ponds declined in both numbers of wet basins and surface water area. The increase in basin number and area noted in the class I and class II ponds and dugouts was due to localized heavy spring rains during 1974 in the case of the natural ponds, and the construction of new dugouts during the summer of 1973 in the case of dugouts. Overall, stockdams decreased relatively less than natural ponds and lakes in numbers of wet basins, area of surface water, and

Table 8. Percentage change in numbers of wet basins, hectares of surface water, and breeding pairs between the early pair counts of 1973 and 1974 and the late pair counts of 1973 and 1974.

Wetland class	Change between early pair counts			Change between late pair counts		
	Wet basins	Surface water	Pairs	Wet basins	Surface water	Pairs
I	+27.4	+159.9	-34.5	-17.1	+780.7	-100.0
II	-9.3	+17.5	-79.2	-22.6	-46.1	-90.4
III	-27.6	-34.7	-80.3	-47.9	-50.0	-89.5
IV	-16.1	-43.2	-49.8	-18.3	-45.7	-55.9
V	-14.1	-7.1	+2.3	-5.2	-5.5	+5.4
Total	-16.5	-34.4	-62.0	-29.1	-41.5	-66.5
Dugouts	+3.0	+3.3	-65.4	+1.3	+7.3	-57.9
Stockdams	-16.9	-25.1	-37.6	-19.6	-13.8	-52.2
Miscellaneous	-17.3	-19.3	-50.9	-25.5	-19.3	-11.2
Grand Total	-6.5	-29.3	-54.0	-20.8	-31.9	-61.0

numbers of breeding pairs. Dugouts increased in numbers of wet basins and hectares of surface water, but decreased in pair use at a rate similar to that exhibited by natural ponds and lakes.

Drying of wetlands continued through the remainder of the 1974 breeding season. Class I ponds and dugouts were the only wetland classes showing net gains in surface water between the late pair count of 1973 and the late pair count of 1974 (Table 8). Stockdams, with a 13.8 percent decline in surface water area during the period, showed a relatively smaller loss in surface water than occurred between the early pair counts of 1973 and 1974. The relative permanence of stockdams and dugouts when compared with natural ponds and lakes was illustrated by the considerably smaller loss of numbers of wet basins and surface water area for stockdams and dugouts, and the larger average decrease in wet basins and surface water area for natural ponds and lakes.

Numbers of late nesting pairs declined an average of 61.0 percent between 1973 and 1974 on all wetland classes (Table 8). Only class V lakes held more pairs during 1974 than 1973, a 5.4 percent increase. Largest decreases occurred on class I, II, and III ponds with smaller losses on class IV ponds, dugouts, stockdams, and miscellaneous wetland classes. Late nesting pairs decreased 52.2 percent between 1973 and 1974 on stockdams, 57.9 percent on dugouts, and 66.5 percent on natural ponds and lakes during the interval.

Total early and late nesting pairs declined on all wetland classes except class V lakes (Table 9). Losses on stockdams were lower (45.5 percent) than reductions in total pairs using natural ponds and lakes (65.2 percent) while dugouts lost approximately the same

Table 9. Percentage change in total breeding pairs in South Dakota between 1973 and 1974.

Wetland class	Total Pairs
I	-74.6
II	-86.9
III	-86.3
IV	-54.3
V	+4.8
Total	-65.2
Dugouts	-61.3
Stockdams	-45.5
Miscellaneous	-35.4

proportion of total pairs as did natural ponds and lakes. This similar loss of breeding pairs on dugouts and natural ponds is indicative of the strong dependence of dugouts on surrounding wetlands. Dugouts are most suitable for waterfowl only when they are a part of a larger wetland community. Stockdams; however, simulate the natural wetland habitat more closely and are able to fulfill the habitat requirements of many waterfowl species.

Species Distribution and Densities

Blue-winged teal, mallard, pintail, and gadwall accounted for a large majority of breeding waterfowl pairs during both 1973 and 1974 (Brewster 1975). Densities of mallards and pintails were relatively high on both stockdams and dugouts during both years (Tables 10 and 11). The largest proportion of mallard pairs on a single wetland class were found on stockdams during both 1973 and 1974 (Tables 12 and 13) when 33.7 percent and 35.1 percent, respectively, of all mallard pairs occurred on stockdams. Mallards, with their relatively large home ranges (Dzubin 1955), are particularly well suited to using the widespread stockdams west of the Missouri River. Lokemoen (1973) in western North Dakota found that as distance between stockdams and other surface water increased, pair use by all species except mallards decreased.

The proportion of pintail pairs found on stockdams increased substantially from 22.1 percent of the total in 1973 to 51.5 percent in 1974 (Tables 12 and 13). However, the proportion of pintail pairs using dugouts declined from 13.4 percent in 1973 to 6.2 percent in 1974. Densities of blue-winged teal were highest on class I, II, III, and IV

Table 10. Densities of breeding pairs of major waterfowl species per wet basin (WB) and per hectare of surface water (SW) in South Dakota during 1973.

Wetland class	Mallard		Pintail		Blue-winged teal		Gadwall		American wigeon		Green-winged teal	
	WB	SW	WB	SW	WB	SW	WB	SW	WB	SW	WB	SW
I	0.27	2.10			0.84	33.66						
II	0.21	0.79	0.25	0.96	1.24	2.79	0.07	0.17			0.08	0.20
III	0.53	0.74	0.44	0.62	1.65	2.57	0.31	0.47	0.02	0.02	0.04	0.07
IV	0.86	0.32	0.68	0.27	3.49	1.33	0.59	0.22	0.04	0.02	0.13	0.05
V	0.37	0.07	0.11	0.02	2.07	0.35	0.14	0.02				
Total	0.55	0.42	0.45	0.32	2.29	1.51	0.36	0.25	0.02	0.02	0.09	0.05
Dugouts	0.44	5.54	0.39	4.97	0.70	8.97	0.18	2.25	0.01	0.12	0.02	0.27
Stockdams	1.01	1.19	0.40	0.47	1.11	1.36	0.21	0.27	0.12	0.15	0.07	0.07
Miscellaneous	0.29	0.96	0.39	0.27	0.20	0.72	0.03	0.10	0.01	0.02	0.01	0.05

Table 11. Densities of breeding pairs of major waterfowl species per wet basin (WB) and per hectare of surface water (SW) in South Dakota during 1974.

Wetland class	Mallard		Pintail		Blue-winged teal		Gadwall		American wigeon		Green-winged teal	
	WB	SW	WB	SW	WB	SW	WB	SW	WB	SW	WB	SW
I	0.14	0.54										
II	0.11	0.35			0.17	0.54	0.02	0.07				
III	0.23	0.35	0.04	0.05	0.28	0.44	0.18	0.30				
IV	0.70	0.40	0.22	0.12	1.62	0.94	0.64	0.37	0.02	0.02	0.01	<0.01
V	0.28	0.05			1.77	0.30	0.73	0.12	0.27	0.05		
Total	0.36	0.22	0.09	0.05	0.91	0.72	0.37	0.30	0.02	0.02	0.01	<0.01
Dugouts	0.23	2.94	0.05	0.62	0.26	3.16	0.10	1.16			0.03	0.40
Stockdams	0.74	0.96	0.31	0.40	0.55	0.62	0.23	0.27	0.08	0.07	0.02	0.02
Miscellaneous	0.20	0.67	0.02	0.07	0.21	0.69	0.04	0.12	0.02	0.07	0.01	0.02

Table 12. Percentage of breeding pairs by species found on various wetlands in South Dakota, 1973.

Wetland class	Mallard	Pintail	Canvasback	Wood duck	Blue-winged teal	Gadwall	American wigeon	Northern shoveler	Green-winged teal	Late diver	Ruddy duck
I	0.7				0.9			1.4			
II	3.8	7.6		27.0	8.0	2.7		12.5	12.0		
III	12.9	17.8	21.0		16.9	18.4	7.5	14.7	10.5	13.0	10.8
IV	22.2	29.0	58.9	25.0	40.2	39.7	15.6	35.1	34.7	87.2	69.7
V	0.7	1.0	20.1		2.0	0.7					8.8
Total	40.3	55.4	100.0	52.0	68.0	61.5	23.1	63.7	57.2	100.0	89.3
Dugouts	9.2	13.4		8.0	7.4	10.9	3.4	6.8	5.2		
Stockdams	33.7	22.1			18.5	21.0	65.3	22.9	27.3		10.7
Miscellaneous	16.8	9.1		40.0	6.1	6.6	8.2	6.6	10.3		
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 13. Percentage of breeding pairs by species found on various wetlands in South Dakota, 1974.

Wetland class	Mallard	Pintail	Canvasback	Wood duck	Blue-winged teal	Gadwall	American wigeon	Northern shoveler	Green-winged teal	Late diver	Ruddy duck
I	0.9										
II	3.3				2.5	1.0					
III	6.9	4.2			4.5	7.6					
IV	26.0	28.0	19.9	45.0	45.8	47.9	12.0	19.2	13.1	84.0	72.5
V	0.8		59.5		4.1	4.6	10.7			2.8	
Total	37.9	32.2	79.4	45.0	56.9	61.1	24.0	19.2	13.1	86.7	72.5
Dugouts	8.5	6.2			8.3	8.2		11.1	38.3		
Stockdams	35.1	51.5	20.8		22.1	25.0	51.9	37.9	27.3	13.3	
Miscellaneous	18.5	10.1		55.0	12.7	5.7	25.7	31.8	21.3		27.5
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

ponds, dugouts, and stockdams in 1973 and class IV ponds, stockdams, and dugouts in 1974. However, the largest proportion of blue-winged teal numbers were found on class III and IV ponds and stockdams in 1973 and class IV ponds and stockdams in 1974 (Tables 12 and 13). A large segment of the American wigeon population also occurred on stockdams during both years. Northern shoveler used stockdams extensively in 1974, and green-winged teal used both stockdams and dugouts heavily during 1974. No canvasback or those classified as late diving ducks (lesser scaup, ringneck, and redhead) were recorded on stockdams or dugouts in 1973, but 20.6 percent and 13.3 percent, respectively, of their populations were found on stockdams in 1974. In all cases, except green-winged teal in 1974, larger proportions of the total numbers of each species were found on stockdams than on dugouts.

Drainage

Drainage of wetlands for agriculture in the prairie pothole region of North America is generally conceded to be the single most important limiting factor to continental waterfowl populations (Burwell and Sugden 1964, Sanderson and Bellrose 1969). Drainage of wetlands in South Dakota, as in the rest of the pothole region, has been extensive and is continuing in significant amounts east of the Missouri River in the glaciated prairie.

Data on hectares of wetlands drained in South Dakota was supplied by the Agricultural Stabilization and Conservation Service in Huron, South Dakota for 1936 to 1974 (ASCS 1964) and the South Dakota-Nebraska

Area Office of the U.S. Fish and Wildlife Service (personal letter, Maurice Anderson, U.S. Fish and Wildlife Service, Pierre, South Dakota) for 1964 to 1974.

Data on wetland drainage presented in this thesis includes only the period 1936 to 1974. Earlier drainage projects, although probably extensive, were mainly privately funded (Allen and Leedy 1970), and records of the projects are difficult to obtain.

The ASCS has maintained records of federally assisted agricultural drainage in the U.S. since inception of the federal program in 1936. This method of recording was to list drainage of wetlands under the category "acres benefitted by drainage." In this recording system a 100 ha block of land on which 10 ha of wetland were drained could possibly be recorded as 100 ha benefitted by drainage. The U.S. Fish and Wildlife Service has determined that approximately 25 percent of the hectares reported as benefitted by drainage by the ASCS represent significant wetland losses to waterfowl (Allen and Leedy 1970, U.S. Fish and Wildlife Service, Minneapolis, Minnesota, unpublished data). From 1936 to 1964 the ASCS reported that 314,043 ha of land had been benefitted by drainage in South Dakota. Applying the .25 factor, approximately 78,511 wetland ha were drained with federal assistance.

Privately funded and organized drainage may have been extensive during the 1936-1964 period. Erickson (1975) reported that of 201 ha of wetland drained between 1952 and 1960 in the Wild Rice Creek Watershed of North and South Dakota, 136 ha did not involve federal assistance. The stimulus to drain in this case was the proposed channelization of

portions of Wild Rice Creek which provided a good channel for previously infeasible wetland drainage. Privately funded drainage continued at an even higher rate following completion of the channel. Choate (1972) reported that privately assisted drainage increased following stream channelization in the Hawk Creek Watershed of Minnesota.

The U.S. Fish and Wildlife Service has conducted an annual survey of wetland drainage in North Dakota, Minnesota, and South Dakota since 1964. Originally, the inventory included only types 3, 4, and 5 wetlands (Martin et al 1953), but a correction factor was applied in 1975 to allow the inclusion of type 1 wetlands. Drainage reported from this survey totals 19,795 ha (U.S. Fish and Wildlife Service, Pierre, South Dakota, unpublished data). Total hectares of wetland drained with federal assistance from 1936 to 1974 therefore equals 78,511 ha + 19,785 ha or 98,296 ha.

Composition of the drained wetlands in South Dakota by class of wetland is difficult to determine. ASCS drainage reports did not differentiate drainage by wetland class or type, and the proportion of drainage that occurred on the various types of wetlands prior to 1964 could not be determined accurately. Schrader (1955) reported that the wetlands most easily drained were the first to be drained. Temporary wetlands (types 1 and 3) may have been easier to drain than more permanent types (4 and 5), thus more permanent wetlands may have been least affected by drainage.

Drainage estimates computed by the U.S. Fish and Wildlife Service are categorized by wetland types, but are limited to types 3, 4, and 5. Data compiled during 1964 to 1968 (U.S. Fish and Wildlife Service, Pierre,

South Dakota, unpublished data) shows 80.0 percent of the wetlands drained were type 3, 16.7 percent were type 4, and 2.3 percent were type 5 wetlands. These data support the assumption that drainage was most concentrated on less permanent ponds, but, the extent of drainage on type 1 ponds is unknown.

CONCLUSIONS

Stockdams were shown to contain high densities of breeding waterfowl pairs and in some cases to be used by a large segment of certain waterfowl populations in South Dakota. Dugouts also held high densities of certain species although density is a particularly misleading measure of waterfowl use on dugouts due to their small mean size. Dugouts are most often used by breeding pairs of waterfowl when they are associated with other wetland basins.

The species composition of waterfowl on stockdams and dugouts is different from that on natural wetlands. Breeding pairs of mallards, pintails, and American wigeons commonly use stockdams while natural wetlands are used by all species of dabbling and diving ducks. The relative proportion of most populations using stockdams increases during drought.

Diving ducks avoid stockdams and dugouts except when water conditions on natural wetlands become so poor that the man-made ponds become the only habitat available. Considering the lack of emergent vegetation on most stockdams and dugouts, it is doubtful that any production of young from diving duck pairs occurs when they are forced to use stockdams and dugouts.

Mallards and pintails, which have relatively large home ranges, are the best adapted species to use the widespread stockdams west of the Missouri River. It is possible, however, that with further construction of stockdams in the West River area the resulting reduction in

distances between dams may allow other shorter ranging species to utilize stockdams in this area to a greater extent.

This study has shown that other wetlands near dugouts influence dugout use by breeding pairs, but it is also possible that dugouts also influence the use of surrounding wetlands. The greatest value of dugouts may be in providing loafing sites and open water areas in conjunction with existing natural wetlands. Additional studies of waterfowl use of stockdams and dugouts should examine the factors influencing the selection of ponds by breeding pairs. Factors such as age of the pond, grazing intensity, season of use, proximity to other wetlands, and water chemistry need further consideration.

An accurate estimate of the extent of drainage that has taken place in South Dakota could not be determined. Therefore, it was not possible to evaluate the degree that waterfowl production from stockdams and dugouts has compensated for production lost through wetland drainage.

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