A study of waterfowl production on two rest rotation grazing units in northcentral Montana
by Frank Mathew Gjersing

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE in Fish and Wildlife Management
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Abstract:
A study of waterfowl production on reservoirs in two rest-rotation grazing systems was conducted in Phillips County, Montana from 1968-1970. Five reservoirs, subjected to normal grazing, were selected as controls outside of each area. Pair populations increased during the years of census with the greatest increase between years occurring on the south area in pasture 4 which was rested the previous year. A decrease on this area occurred in pasture 5 which was grazed in the fall of the previous year. Increases in breeding pairs on the north area occurred in those pastures which were grazed during the fall of two consecutive seasons. Brood production increased over the three year period on the rest-rotation areas but controls remained fairly constant on the south area and increased on the north area. Largest increases in brood production between years occurred in pasture 4 of the south area from 1969-70. Average brood size was less on controls than on the rest-rotation pastures. With an average of 6 ducks per brood, about 9 ducks per acre of water were produced to flying stage. Data were obtained relative to waterfowl use and pond type, depth and age. Quantitative and qualitative measurements of shoreline and upland vegetation were made. Increases in canopy coverage of three shrub types and of numbers of "key" grasses were found to occur on the south area.

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FRANK MATHEW GJERSING

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree

of

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Approved:

Head, Major Department

Chairman, Examining Committee

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ABSTRACT

A study of waterfowl production on reservoirs in two rest-rotation grazing systems was conducted in Phillips County, Montana from 1968-1970. Five reservoirs, subjected to normal grazing, were selected as controls outside of each area. Pair populations increased during the years of census with the greatest increase between years occurring on the south area in pasture 4 which was rested the previous year. A decrease on this area occurred in pasture 5 which was grazed in the fall of the previous year. Increases in breeding pairs on the north area occurred in those pastures which were grazed during the fall of two consecutive seasons. Brood production increased over the three year period on the rest-rotation areas but controls remained fairly constant on the south area and increased on the north area. Largest increases in brood production between years occurred in pasture 4 of the south area from 1969-70. Average brood size was less on controls than on the rest-rotation pastures. With an average of 6 ducks per brood, about 9 ducks per acre of water were produced to flying stage. Data were obtained relative to waterfowl use and pond type, depth and age. Quantitative and qualitative measurements of shoreline and upland vegetation were made. Increases in canopy coverage of three shrub types and of numbers of "key" grasses were found to occur on the south area.

INTRODUCTION

In an attempt to improve watersheds and increase forage production for livestock on western ranges, rest rotation grazing systems (Hormay, 1961) are becoming increasingly popular with land managers. Each of these systems requires that certain pastures within the system receive periodic seasonal rest from grazing. Frequently there is a need for the construction of additional stock ponds.

Previous studies, although not directly concerned with rest rotation systems, have shown the effects of grazing on waterfowl production (Bue *et al.* 1965, Drewien 1968, and Kirsh 1969). The purpose of this study was to determine the effects of certain rest rotation systems on waterfowl production in northcentral Montana.

DESCRIPTION OF THE AREA

Two study areas were located in Phillips County in northcentral Montana, one 12 miles south (Milk River Association Pasture) and one 50 miles north (Liebel-Math Pasture) of Malta (Figure 1). These areas included 20,650 and 4,320 acres respectively. Gieseker (1926) describes the physiography of the area as rolling plains dissected by deeply intrenched streams and coulees. Rough, broken land is found along most of the streams and in the more feebly glaciated areas.

The climate is semiarid, characterized by low rainfall, great temperature extremes, and a large number of sunny days (Gieseker *op. cit.*). The mean annual precipitation is 11.84 inches and the mean annual temperature is 42.8°F. Respective precipitation for 1968 and 1969 was 1.14 and .48 inches below average. In 1970, precipitation was 1.75 inches above normal. Average temperatures for the period April through July for 1968, 69, and 70 were 59.1, 57.3, and 58.7°F respectively.

Fifty six reservoirs were located on the two study areas, 33 on the south area and 23 on the north. The reservoirs were of two types: pit type or "dugouts" and retention dams (Figure 2).

The vegetation is mainly a grassland community. Crested wheatgrass *(Agropyron cristatum)*, bluestem *(Agropyron smithii)*, needleleaf sedge *(Carex eleocharis)*, blue grama *(Bouteloua gracilis)*, junegrass *(Koeleria cristata)*, sandberg bluegrass *(Poa secunda)* and needle-and-

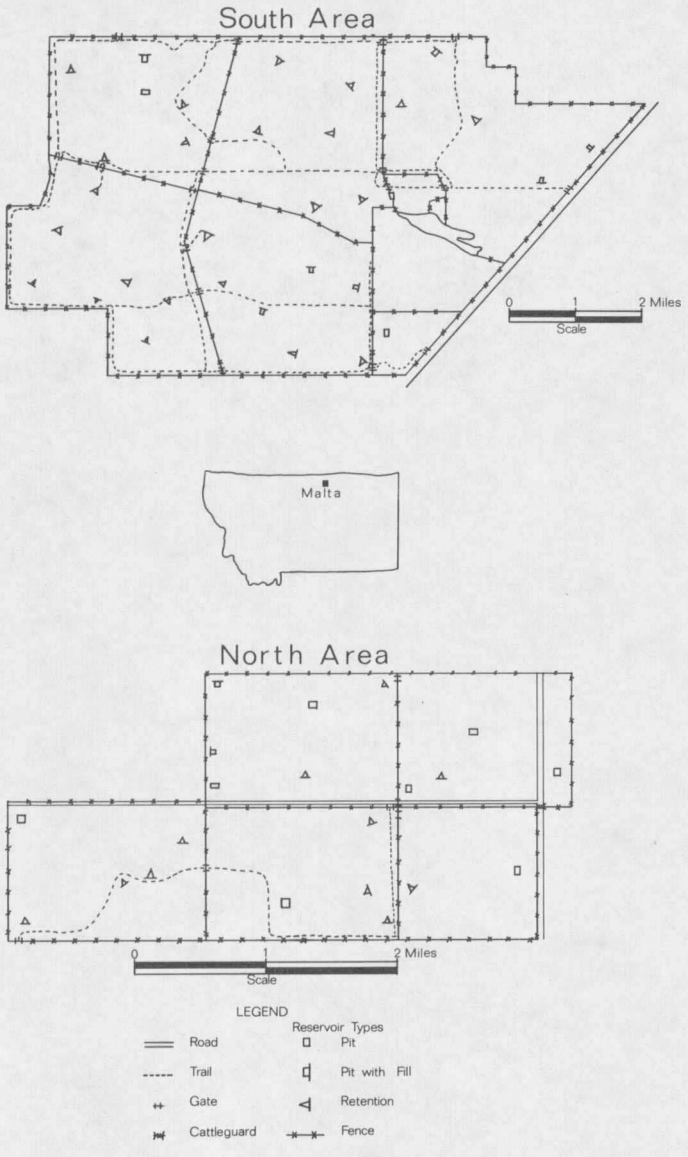
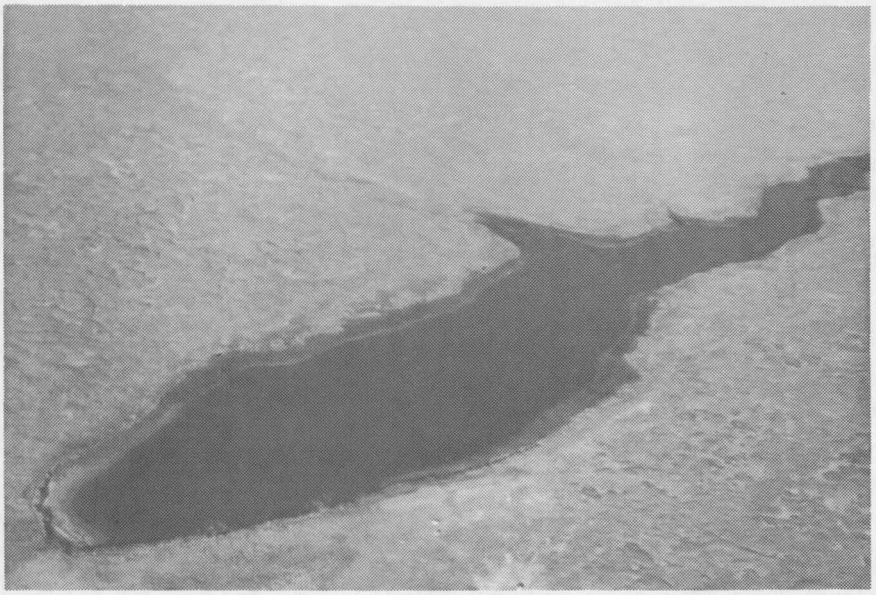


Figure 1. Map of the south and north study areas.



A



B

Figure 2. Aerial views of (A) pit type, and (B) retention type reservoirs.

thread *(Stipa comata)* are the dominant grasses and grass-like plants. Dominant forbs included yarrow *(Achillea millefolium)*, fringed sagewort *(Artemisia frigida)*, saltbrush *(Atriplex nuttalii)* and plantain *(Plantago* spp.*)*. Shoreline vegetation consisted mainly of spike-sedge *(Eleocharis* spp.*)*, and Foxtail barley *(Hordeum jubatum)*. Emergent vegetation included American water plaintain *(Alisma plantago-aquatica)* and arrowleaf *(Sagittaria cuneata)*. Sago pondweed *(Potamogeton pectinatus)*, Milfoil *(Myriophyllum exalbescens)*, and aquatic buttercup *(Ranunculus aquaticus)* are the principle submergents.

METHODS

The division of the south and north areas into five pastures each was completed in the fall of 1966 and 1967 respectively. The general grazing plan essentially followed that of Hormay (1961).

In June of 1968 five reservoirs were selected outside of each experimental study area for controls to compare waterfowl production on reservoirs in pastures under normal grazing with those under rest rotation grazing.

Observations of pairs, lone drakes, and/or combinations indicating pairs were used to estimate the breeding population (Hammond 1959). One census of the north area was made each year of the study, in May of 1968 and 1969 and early April of 1970. One census of the majority of reservoirs on the south study area was made during May of 1969 and early April of 1970. Counts in early June of each year supplemented the previous counts.

Brood counts were made each summer from both areas at approximately 10 day intervals from early June to September 15. The census method employed was designed to keep waterfowl disturbance at a minimum. Each reservoir was approached by vehicle to within a few hundred yards of the base of the dam. I then walked to the dam and counted the birds with the aid of binoculars (7x35) and a spotting scope (15x60 variable) while remaining partially concealed. All broods were recorded as to species, age class, date observed, and number of young.

Broods observed only once on a specific pond were considered "transient" (Berg 1956). Calculation of brood production followed that of Gollop and Marshall (1954).

A permanent 100 foot line transect (Canfield 1941) was established on each of three shrub types on the south study area. The canopy intercept of shrubs along the entire line was measured and the numbers of individual plants of key species of shrubs and grasses in square foot frame placed at 10 foot intervals along the line were counted in 1968 and 1970.

Canopy coverages of "upland" and shoreline vegetation were determined on each of the five pastures in the south area and on two of the pastures in the north area. The method was a modification of Daubenmire (1959). Twenty 2x5 decimeter plots were placed along a 100 foot tape at 5 foot intervals. Within these plots, the percent canopy coverage of each taxon was visually determined and recorded into classes. These were: Class 1 = 0-5; class 2 = 5-25; class 3 = 25-50; class 4 = 50-75; class 5 = 75-95; and class 6 = 95-100 percent. Midpoints of each class were used in data tabulations. The vegetation occurring within the plots was also recorded into one or more of 5 height classes for each category of canopy coverage. Classes were: Class 1 = 0-3; class 2 = 3-6; class 3 = 6-9; class 4 = 9-12; and class 5 = 12+ inches. The amount of bare ground, moss, lichen, rock, and litter was recorded. The point intercept of each of the four legs of the plot frame with

bare ground, litter, rock, or living vegetation was recorded.

Utilization of vegetation in each pasture by cattle was determined by the Key Forage Plant Method (Physical Resource Studies 4412.22B1). In each pasture a point was selected as an initial station. From this point, the pasture was gridded at .3 mile intervals. Each point on the grid was numbered and located on an aerial photo. Utilization at each station was recorded into one of five utilization classes. These classes were: Slight = 0-20 percent utilization; light = 21-40 percent; moderate - 41-60 percent; heavy = 61-80 percent; severe = 81-100 percent. Stations were later located on an acetate overlay of a map of the area and utilization patterns were sketched in. The acreages of each use pattern were determined by dot gridding. The percentage of the area in a certain use class was multiplied by the degree of use resulting in a weighted utilization. The weighted utilization for each class was summed, giving the total degree of use for each pasture.

A general description of the height and density of vegetation around each reservoir was made from 1968 through 1970. Photographs were taken once a month of most reservoirs from photo stations established during the summer of 1968. Each year, during the first two weeks of July, aerial photographs of all ponds were taken.

To determine water level fluctuations, steel fence posts marked at two-inch intervals were placed in each of 10 reservoirs. The water

level was recorded at least twice a month.

Shoreline length was obtained during the fall of 1970. A calibrated wheel was pushed around each reservoir at the high and low water line for that year.

The slope of the shoreline of each pond was determined with the aid of a surveyor's compass and placed into one or more of four classes; steep slope = 45°+; medium slope = 10-45°; gentle slope = less than 10° where water did not "feather" onto the shore; feather edge = "feathering" of the shore by water. The percent composition for each class was visually estimated. Depth of all reservoirs was determined by sounding.

No intensive nest searches were made, but for nests found, the following information was recorded: distance to water, species of duck and fate.

RESULTS

Pair Populations

Pair populations were composed principally of dabbling ducks, although redheads *(Athya americana)*, ruddy *(Oxyura jamaicensis)*, ringneck *(Nyroca collaris)*, canvasback *(Nyroca valisineria)*, and lesser scaup *(Nyroca affinis)*, were seen as spring migrants. Lesser scaup and canvasback pairs comprised the diver populations after June 10.

The estimated number of pairs on the south and north study areas is shown in Tables 1 and 2 respectively. Pair populations increased on both areas during the years of census. Blue-winged teal *(Anas discors)* and lesser scaup showed the greatest increase on the south while no single species showed great increases on the north.

The maximum number of breeding pairs per acre of water occurred in 1970 when there was 1.18 and 1.83 for the south and north areas respectively. Comparable data for the controls for the two study areas during the same period were 3.1 and 3.28. The higher pair density occurring on the controls may have been due to selections of control ponds being largely retention type, whereas those ponds on the study areas were all inclusive within a unit area and thus included a higher percent of dugouts.

Retention type ponds held the highest density of breeding pairs. The average number of pairs for both years on retention type and

Table 1. ESTIMATED NUMBER OF PAIRS OF DUCKS ON SOUTH STUDY AREA, 1969-70.

Species	Pairs of Ducks			Percent Composition		
	1969	1970	Av.	1969	1970	Av.
Baldpate	17	19	18	24	21	23
Pintail	18	18	18	25	14	20
B.W. Teal	6	17	12	9	21	15
Mallard	11	13	12	16	14	15
Shovelor	11	10	11	16	10	13
Gadwall	7	8	8	10	10	10
L. Scaup	1	8	5	1	10	6
Total Pairs	71	93	84			
Controls	18	24	21			

Table 2. ESTIMATED NUMBER OF PAIRS OF DUCKS ON NORTH STUDY AREA, 1968-70.

Species	Pairs of Ducks				Percent Composition			
	1968	1969	1970	Av.	1968	1969	1970	Av.
Pintail	11	14	16	14	28	30	33	30
Baldpate	7	9	9	8	18	19	18	18
Shoveler	6	10	5	7	15	21	10	15
Mallard	7	4	6	6	18	9	12	13
B.W. Teal	4	5	6	5	10	11	12	11
Gadwell	4	3	4	4	10	6	8	8
L. Scaup	0	2	3	2		4	6	3
Canvasback			1	1				1
Total Pairs	39	47	49	45				
Controls		16	21	19				

dugouts was 3.2 and 0.9 respectively. Pairs per 1000 feet of shoreline on these same types averaged 2.3 and 1.2 (Table 3).

A strong relationship was found between water level and the use of dugouts by ducks. Pair use increased as the water level approached full and was highest when the water was flowing into the surrounding vegetation (Table 3). Similar findings were reported by Shearer (1960) and Uhlig (1963).

Breeding pair fluctuations for pastures in relation to grazing treatments are shown in Figure 3.

The greatest increase in breeding pairs on the south area from 1969-70 occurred in pasture four. This pasture was rested during 1969 and grazed from May 1 to July 20 during 1970. The only decrease on this area occurred in pasture 5 which was grazed in the fall of 1969 and rested during 1970.

The greatest increase in breeding pairs on the north area occurred in those pastures which were grazed during the fall of two consecutive seasons; namely, pastures five and two. No relationship between decreases in breeding pairs and grazing treatments was observed in this area.

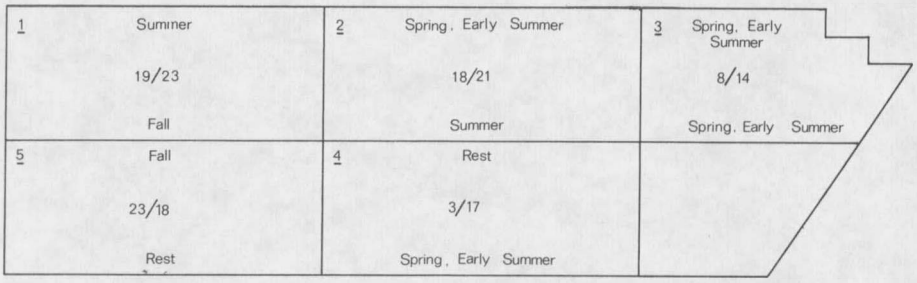
Brood Populations

Brood production on the south and north study areas for 1968, 69, and 70 is shown in Tables 4 and 5 respectively. Production on the two areas increased over the three year period with pintails and blue-winged

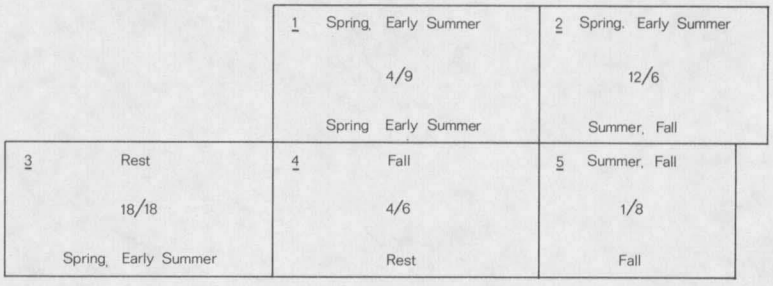
Table 3. COMPARISON OF PAIR USE ON RETENTION AND DUGOUT PONDS, 1969-1970.

Type	Total Ponds	Total Pairs		Pairs/Pond		Pairs/1000' Shoreline	
		1969	1970	1969	1970	1969	1970
Retention	49	141	169	2.9	3.4	2.0	2.5
Dugouts	17	11	18	.6	1.1	.9	1.5
Water level below capacity							
0 ft.		8	15				
1 ft.		2	3				
2+ ft.		1	0				

South Area 1969/70



North Area 1968/69



North Area 1969/70

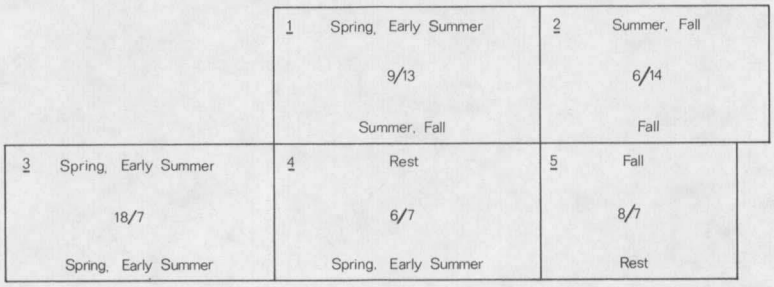


Figure 3. Changes in breeding pair numbers in relation to grazing treatments[1]

[1]Grazing treatments for the first year indicated is given at the top of each pasture; second year at the bottom.

Table 4. BROOD PRODUCTION ON THE SOUTH STUDY AREA, 1968-1970.

Species	Number of Broods				Percent Composition				Average Brood Size[2]			
	1968	1969	1970	Av.	1968	1969	1970	Av.	1968	1969	1970	Av.
Pintail	4(2)[1]	13(3)	17(2)	11	11	27	22	20	3	4.5	5.6	4.4
Mallard	6	13(3)	11(2)	10	17	27	14	19	5	6.1	5.5	5.5
Baldpate	6	9(2)	15(1)	10	17	19	19	18	5.8	6.3	5.5	5.9
Shoveler	6(1)	6(2)	11(1)	8	17	13	14	15	5.8	9.3	9.8	8.3
B.W. Teal	4(2)	2	16(5)	7	11	4	21	13	5.3	3	7.1	5.1
Gadwall	9(2)	4	6	6	26	8	8	12	4.8	6.8	7.3	6.3
L. Scaup		1	1	1		2	1	1		10	9	9.5
Totals	35(7)	48(10)	77(11)	53					5.1	6.1	6.7	6.2
Controls	12	11	13	12					5.4	5.8	5.9	5.7

[1]Number of transient broods is shown in parentheses.

[2]Average brood size given is Class 11c - 111a.

Table 5. BROOD PRODUCTION ON THE NORTH STUDY AREA, 1968-1970.

Species	Number of Broods				Percent Composition				Average Brood Size[2]			
	1968	1969	1970	Av.	1968	1969	1970	Av.	1968	1969	1970	Av.
Pintail	4(2)[1]	11(5)	9(1)	8	18	31	23	24	3.3	4.8	3.9	4.0
Baldpate	6(1)	7	8(2)	7	27	20	21	23	5.2	7.3	6.9	6.5
Shoveler	4	10(1)	5	6	18	29	13	20	6.3	7.4	4.4	6.0
Mallard	4	3(3)	5(1)	4	18	9	13	13	5.7	4.0	6.0	5.2
Gadwall	4(1)	1	4	3	18	3	10	10	6.0	5.0	7.3	6.1
B.W. Teal		2	7	3		6	18	8		6.5	9.0	7.8
L. Scaup		1	1	1		3	3	2		9.0	2.0	5.5
Totals	22(4)	35(9)	39(5)	32				Averages	5.2	6.3	6.1	5.9
Controls	4	9	11	8					3.7	5.7	5.3	5.3

[1]Number of transient broods is shown in parentheses.

[2]Average brood size given is Class 11c - 111a.

teal showing the greatest increase on both. Brood production for the same period on controls remained fairly constant on the south area and increased on the north area.

Average brood size was less on controls than on the rest rotation pastures. The greatest decrease in size of broods occurred within two weeks after hatching. During this period an average loss of 1.8 ducklings/brood in 1969 and 1.4 during 1970 was recorded. After this time the loss dropped to less than .2 ducklings/brood. Similar findings were reported by Low (1945), Earl (1950), Keith (1961), and Miller and Collins (1954).

The maximum number of broods per acre of water (transient broods excluded) occurred in 1970 when there was 1.2 and 2.1 for the south and north areas respectively. Comparable data for the controls of the two study areas during the same period were 1.9 and 2.3. With an average of 6 ducks per brood, about 9 ducks per acre of water were produced to flying stage. Two new reservoirs in pasture five on the south area which were built during the fall of 1968 were excluded from these figures. These reservoirs totaled 13.4 acres but produced no broods during 1970.

A relationship was found between the age of ponds and production/acre of water. Three retention type ponds that were less than three years old by 1970 produced only one brood per 15.5 acres of water. These new ponds were fairly turbid and had little shoreline vegetation.

Pond depths appeared to influence brood use on reservoirs (Table 6). Brood use was least in ponds which had 0 to 10 percent of their area less than two feet in depth. Brood numbers per pond increased as the amount of area in this depth class increased and reached a maximum at 50-75 percent.

Although shoreline slope is related to these percentage classes (Table 7), I feel that the difference in broods per pond is due to the amount of feeding area (i.e. that area less than 2' in depth) and not the shoreline slope. Pit type reservoirs were included in class one. Only two broods were produced on this type which accounts partially for the low number of broods per pond observed on this type.

Changes between years in numbers of broods produced in relation to grazing treatments are shown in Figures 4 and 5. The greatest increases in brood numbers on the south area from 1968-69 occurred in pastures one and two. These pastures were both grazed from May 1 to July 20 during 1968. Pasture two was grazed during the same period in 1969 and pasture one was grazed during the late summer. The greatest decrease occurred in pasture four which was grazed in the fall of 1968 and rested during 1969.

The greatest increase on the south area from 1969-70 occurred in pasture four. This pasture was rested during 1969 and grazed from May 1 to July 20 during 1970. An increase of seven broods occurred in pasture five which was grazed during the fall of 1969 and rested during

Table 6. RELATIONSHIP BETWEEN BROODS AND PERCENT OF POND SURFACE AREA LESS THAN 2' IN DEPTH.

South Area

Percent of Surface Area less than 2' in Depth	No. of Ponds	Broods/1000' of Shoreline				Broods/Pond			
		1968	1969	1970	Av.	1968	1969	1970	Av.
0- 10	5	.6	0	.6	.4	.6	0	.6	.4
10- 25	7	1.1	.7	1.6	1.1	1.9	1.1	2.7	2.0
25- 50	3	.7	3.9	4.5	3.0	.7	4.0	3.0	3.1
50- 75	3	.7	2.0	2.7	1.8	.8	4.0	5.3	3.7
75-100	3	1.4	1.4	1.8	1.6	2.7	2.7	3.3	2.9
North Area									
0- 10	9	0	.6	1.2	.6	0	.2	.4	.2
10- 25	2	3.41	3.9	2.9	3.4	3.5	4.0	3.0	3.5
25- 50	5	2.7	4.3	5.3	4.1	2.6	4.2	5.2	4.0
50- 75	-	---	---	---	---	---	---	---	---
75-100	3	0	1.2	0	.4	0	.3	0	.1

Table 7. RELATIONSHIP BETWEEN PERCENT OF SURFACE AREA LESS THAN 2' IN DEPTH AND SHORELINE SLOPE.

Percent of Surface Area less than 2' in Depth	Percentage of Shore in Four Slope Classes			
	Feather	Nearly Flat	Medium	Steep
0- 10	4	28	36	33
10- 25	34	16	39	11
25- 50	39	35	18	8
50- 75	47	38	12	3
75-100	66	63	16	3

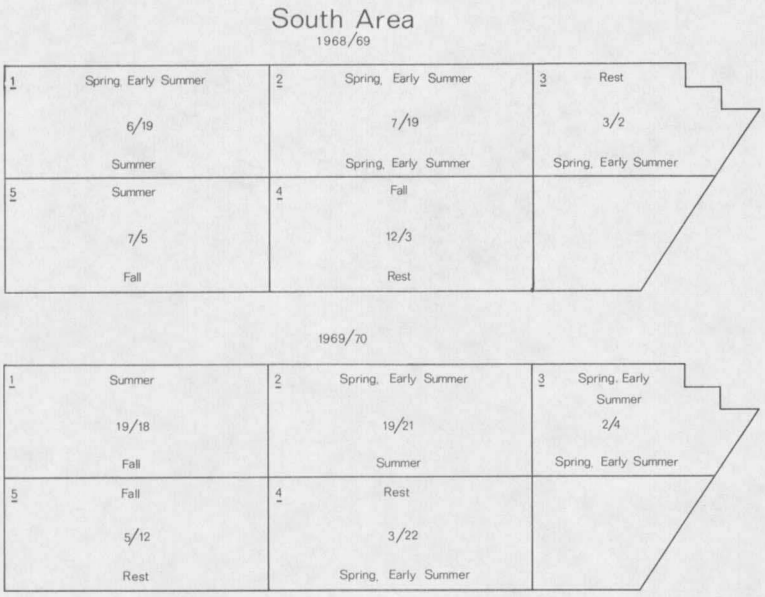


Figure 4. Numbers of broods in relation to grazing treatments.

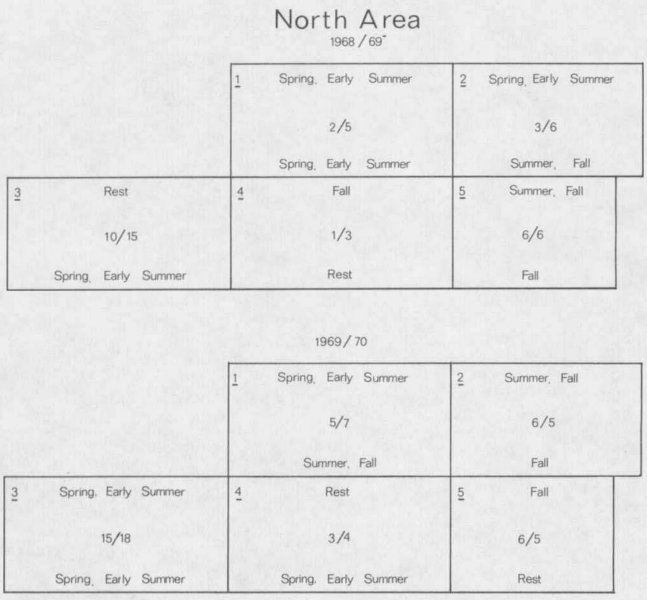


Figure 5. Numbers of broods in relation to grazing treatments.

1970. The only decrease during this period occurred in pasture one and was probably insignificant as it only amounted to one brood.

Fluctuations in brood numbers in individual pastures were small on the north area. Increases occurred on all pastures but one from 1968-69 and minor decreases occurred in pastures two and five during 1969-70.

In addition to the duck broods, 16 coot *(Fulica americana)*, 5 pied-billed grebe *(Podilymbus podiceps)*, and 4 Canada goose *(Branta canadensis)* broods were produced on the south area and 5 horned grebe and one goose brood were produced on the north area. No relationship between grazing treatments and the production of coot and grebes was found. Goose broods were only produced on those pastures which were not grazed during the spring and early summer of the year of production. One goose brood was produced on a south control pond in 1968; no goose broods were produced on any controls during 1969 or 1970. Two coot broods were produced on one south control pond during 1970; no coot broods were produced on controls during 1968 or 1969. No grebe broods were produced on control ponds.

Vegetation

The line intercept data showed an increase in canopy coverage of all three shrub types from 1968-70 with the greatest increase (22.6 percent) occurring in the silver sage type (Table 8). Counts of plants in square foot plots in this type showed an increase in the

Table 8. COMPARISON OF ONE LINE INTERCEPT AND TEN SQUARE FOOT PLOT MEASUREMENTS ON EACH OF THREE SHRUB TYPES OF THE SOUTH STUDY AREA 1968/1970.

	Percent Canopy Coverage 1968/70	Number of Plants in Square Foot Plot at 10' Intervals 1968/70		
SHRUB TYPE		*Agropyron smithii*	*Stipa comata*	*Stipa viridula*
Artemisia cana	16.4/20.1		29/78	
Atriplex nuttalii	.5/.8	58/77		
Rosa spp.	5.1/5.6			5/45

number of mature plants from 2 to 9 and an increase in the number of seedlings from 6 to 16. Total numbers of "key" grasses occurring in all square foot plots increased from 93 to 200. This increase may have been greater as *Agropyron smithii* was present in all types but was counted in only the *Atriplex nuttalii* type.

Mean canopy coverage and frequency of occurrence of each plant species as shown by the 20x50 decimeter plots are listed in Table 9. The canopy coverage provided by grasses in the 20x50 decimeter plots increased about 60 percent from 1969-70, while bare ground decreased about 22 percent. The greatest increases in canopy coverage occurred in *Agropyron smithii, Bouteloua gracilis, Carex eleocharis, Festuca octiflora,* and *Poa secunda.* No significant decreases were found in any particular species of grass. A slight increase in percent canopy of forbs was found over the two year period, with the greatest increase occurring in the dominant forb; *Artemisia frigida.* A decrease in lichens from 21 to 5 percent also occurred.

Large fluctuations were found in the height of vegetation within individual pastures (Table 10). The largest increase in the height of both upland and shoreline vegetation occurred in pastures one and five. Pasture one was grazed in summer of 1969 and fall of 1970. Pasture five was grazed in fall of 1969 and rested during 1970. Transects were read one week after the cattle started grazing pasture one in 1970, which accounts for the low height of shoreline vegetation on this

Table 9. COMPARISON OF VEGETATION ON THE SOUTH STUDY AREA FOR 1969 AND 1970 AS DETERMINED BY MEASUREMENTS WITHIN TWENTY 2x5 DECIMETER PLOTS ON FOURTY STANDS IN UPLAND AND 20 STANDS IN SHORELINE VEGETATION.

	1969		1970	
UPLAND	Mean Canopy Coverage	Frequency of Occurrence	Mean Canopy Coverage	Frequency of Occurrence
GRASSES AND GRASS-LIKE				
PLANTS	41	99	66	99
Agropyron cristatum	2	10		
Agropyron smithii	4	35	7	32
Agropyron spicatum	tr	1		
Bouteloua gracilis	9	61	28	89
Carex eleocharis	7	50	11	59
Festuca octiflora	tr	1	9	44
Koeleria cristata	1	10		
Poa secunda	13	77	24	91
Stipa comata	2	10	tr	5
Stipa viridula	tr	2		
FORBS	16	99	18	95
Allium textile	tr	8		
Artemisia frigida	6	51	12	64
Erigeron spp.			tr	3
Grindelia squarrosa	tr	6		
Gutierrezia sarothrae	tr	3		
Lepidium densiflorum	tr	1	tr	1
Linium rigidum	tr	7		
Opuntia polycantha	2	15	1	10
Phlox hoodii			tr	2
Plantago spp.	6	71	6	74
Psoralea argophylla	tr	1	tr	1
Sphaeralcea coccinea	tr	4	1	11
Tragopogon dubius	tr	5		
OTHERS				
Bare Ground	31	100	24	100
Rock	tr	3	tr	3
Lichens	21	83	5	87
SHORELINE				
Alisma plantago-aquatica			tr	1
Beckmannia syzigachne	tr	16	3	14
Carex spp.			3	1
Eleocharis acicularis	44	58	41	90
Eleocharis macrostachya	95	100	60	88
Polygonum amphibium	tr	2	tr	1
Bare Ground	3	26	29	63

Table 10. MEAN CANOPY COVERAGES OF UPLAND AND SHORELINE VEGETATION IN EACH OF FIVE HEIGHT CLASSES ON THE SOUTH STUDY AREA, 1969-70.

	PASTURE									
	1		2		3		4		5	
	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970
UPLAND										
0- 3	89	89	73	83	81	66	78	73	98	72
3- 6	11	59	4	27	7	16	57	11	39	52
6- 9	5	45	0	11	tr	9	30	5	1	36
9-12	1	26	0	6	tr	3	4	2	0	27
12+	0	18	0	tr	0	0	0	tr	0	9
SHORELINE										
0- 3	95	93	87	55	98	67	98	55	98	98
3- 6	8	12	10	4	81	23	95	23	83	64
6- 9	0	3	0	0	64	0	91	0	67	63
9-12	0	2	0	0	35	0	80	0	52	51
12+	0	tr	0	0	10	0	58	0	3	37

pasture as compared to pasture five. Greatest decreases in heights occurred in pasture four which was rested during 1969 and grazed in spring and early summer of 1970. A decrease also occurred in pasture three which was grazed both years in spring and early summer. A slight increase occurred in pasture one which was grazed both years in spring and early summer. Pasture two was grazed in spring and early summer of 1969 and summer of 1970 and vegetation height remained fairly equal between years.

Species composition of shoreline vegetation changed slightly from 1969-70 (Table 9). Percent canopy coverage of *Eleocharis macrostachya* and *Eleocharis acicularis* decreased while arum-leaved arrowleaf *(Sagittaria cuneata)* increased. The reason for the decrease in *Eleocharis* spp. may be attributed to weather. Heavy rainfall during the summer of 1969 filled all reservoirs to capacity and stimulated a dense growth of *Eleocharis macrostachya.* As the water levels rapidly decreased through August a dense growth of *Eleocharis acicularis* appeared on the exposed shoreline. These conditions did not occur during 1970.

Shoreline vegetation did not develop on most reservoirs until the fall of 1968 and then only on those ponds which were not grazed in late summer or fall. By 1970 shoreline vegetation was abundant on all retention type ponds over three years in age (Figure 6) and had appeared in small amounts on some pit type reservoirs. By 1970 grazing



A



B

Figure 6. Response in shoreline vegetation from (A) 1968 to (B) 1970.

of the shoreline by cattle seemed to result in only a slight reduction in total ground cover but a great reduction in height of vegetation was still apparent. Within a period of two weeks after cattle had been turned into a pasture, grazing and trampling had reduced most of the vegetation within 15 yards of the shore to a height of 3 inches or less (Figure 7).

The same general trends in vegetational changes on the south study area were also shown by the point intercept of the plot frame legs (Table 11).

Weighted utilization of vegetation on the study areas is shown in Table 12. Total percent weighted use decreased from 1968-70.

Although no detailed vegetational measurements were taken on control ponds, visual observation indicated that height of shoreline vegetation seldom exceeded 3 inches.



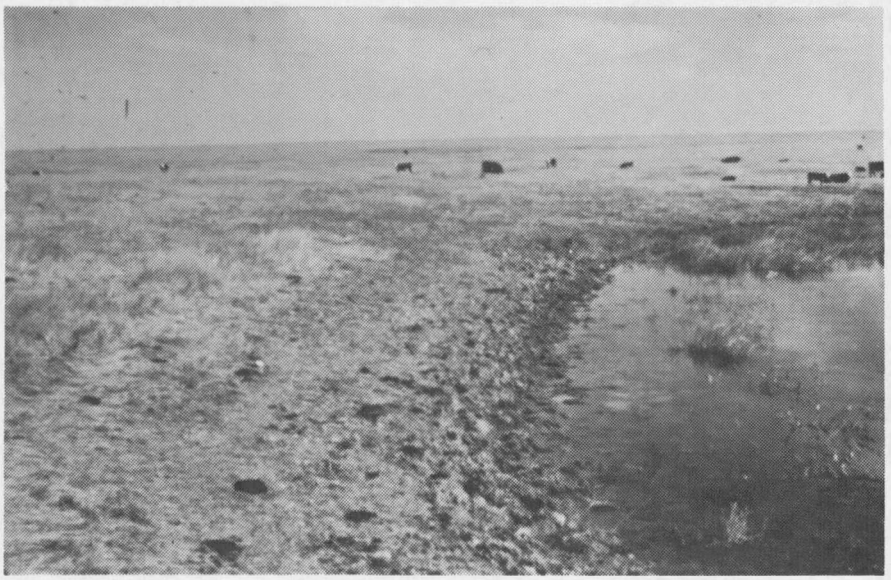


Figure 7. Reduction in shoreline vegetation after 2 weeks of grazing in late July 1970.

Table 11. COMPARISON OF PERCENT COVERAGE OF BARE GROUND, ROCK, LITTER, AND LIVING VEGETATION AS DETERMINED BY 1600 POINTS.

	Upland		Shoreline	
	1969	1970	1969	1970
Bare Ground	14	11	2	11
Rock	3	1	tr	
Litter	12	3	4	
Living Vegetation	72	85	94	90

Table 12. WEIGHTED UTILIZATION OF VEGETATION ON THE SOUTH STUDY AREA.

Pasture	Percent Weighted Use by Pasture 1968	1969	1970
1	51	61	38
2	53	56	52
3		48	47
4	60		56
5	48	56	
Total Weighted Use	49	44	39

WEIGHTED UTILIZATION OF VEGETATION ON THE NORTH STUDY AREA.

1	63		48
2	61		30
3			25
4	21		41
5	63		
Total Weighted Use	44		30

DISCUSSION

Pair populations and brood numbers seemed to respond in a positive manner to increases in residual vegetation. Keith (1961) noted that since some species of waterfowl begin to nest before new growth provides adequate cover, the presence of residual cover from the previous year is extremely important.

Relief from grazing for a full season in 1968-69 was accompanied by an increase of broods on the north area. This same relief in 1969-70 resulted in increases of both breeding pairs and broods on both study areas. Differences between years may have been due to the vegetation in the pastures showing a smaller response to grazing treatments from 1968-69 than from 1969-70. Hormay (1961) working with Idaho fescue in California noted that this plant will produce few if any flower stalks, and therefore, little or no seed the first year after close grazing even though the plants are rested. Reasonably vigorous plants and adequate flower stalks can be expected in the second season.

Some residual nesting cover may result even from partial rest the previous year, the amount depending on the type of vegetation and the time of grazing. The south area is primarily native short-grass prairie and cattle fed on grasses in this type throughout an entire grazing season. Some regrowth of vegetation in this area, resulting in residual cover the following spring, may be expected after the end of the earliest treatment (July 20) if cattle are moved out of pastures

at this time. Both pastures which received this type of treatment in 1969 had increased pair populations and brood numbers in 1970.

Pastures of the native prairie type which are grazed in fall should have the smallest amount of residual cover the following spring. On the south unit pasture four received fall grazing in 1968 and pasture five, in 1969. Brood populations decreased in pasture four in 1969 as did the pair populations in pasture five in 1970. Brood numbers increased on pasture five in 1970. This increase was due to a single pond which was almost dry in 1969 and produced only one brood, but with higher water levels of 1970 this pond produced eight broods.

The north area is primarily crested wheatgrass and this species is utilized heavily by cattle only until seed ripe. Little regrowth occurs in crested wheatgrass after July 20. The greatest amount of residual cover which would remain after partial grazing on this area would then be in those pastures which were grazed only after seed ripe. Breeding pairs increased in years following this treatment in every instance but one (Pasture 5 from 1969-70).

Similar observations on the presence of vegetative cover and breeding pairs have been made by others. Salyer (1962) observed approximately twice as many pairs on idle land as he did on moderately or lightly grazed lands. Kirsh (1969) found a higher number of pairs per 10,000 ft. of shoreline on ungrazed plots than on grazed. Martz (1967) noted that numbers of pre-nesting pairs were greater on unmowed

than on mowed units in his North Dakota study area. Drewin (1968) found more pairs per pond in Soil Bank and other idle land in South Dakota than on hayed, cultivated, or grazed lands.

Increases in brood production in pastures with residual cover may have been greater if cattle were not permitted to graze these pastures until incubation was complete on most nests. Kirsh found that nest success on ungrazed areas was twice as high as on grazed areas. Anderson (1957) reported that 42.2 percent of 116 nests on idle land in California hatched while none of 7 nests on grazed land hatched. Glover (1956) found 24.4 percent nesting success on idle land and lightly grazed areas in Iowa compared to only 10.5 percent success on heavily and moderately grazed areas.

Eight nests were found during the period of study, three of which were trampled by cattle (Table 13). When residual shoreline vegetation is present, certain species of ducks preferring to nest close to water, may be subjected to nest loss by trampling. When such areas are opened to grazing in late spring or early summer and temporary waters are nonexistant, concentrated cattle use is found around existing reservoirs. A flexible grazing system which could delay grazing on such areas until after the peak of hatching may further increase the nesting success. Bennett (1938) suggested that haying be delayed until July 1 to reduce nest losses from mowing. A similar time schedule could be applied to these areas to reduce losses of nests due

Table 13. FATE OF NESTS WITH RESPECT TO DISTANCE TO WATER.

Year	Pasture No.	Species	Distance to Water	Fate
1969	1	Coot	over water	Successful
1970	1 (North Unit)	B.W. Teal	660 yards	Successful
1969	2	Coot	over water	Successful
1968	2 (North Unit)	Shovelor	5 yards	Trampled
1970	3	Mallard	1752 yards	Successful
1970	4	Baldpate	245 yards	Successful
1970	Control	L. Scaup	1 yard	Trampled
1969	Control	Pintail	6 yards	Trampled

to cattle trampling.

Waterfowl breeding habitat must first attract breeding pairs but must also be of sufficient quality to permit successful reproduction. Table 14 provides an opportunity to compare the numbers of breeding pairs and resulting production in 1969 and 1970 on both study units and their controls.

An increase in breeding pairs was indicated from 1969 to 1970 on both study areas and their controls. However, when the numbers of breeding pairs were compared to the number of broods produced, a decided difference was observed in the breeding success of pairs on the study areas as compared to their controls. Reproductive success on both study areas was higher than on their controls in 1969. In 1970, although all areas had an increase in breeding pairs, the study areas showed a further increase in breeding success while the controls showed a decrease. These data suggest that the increased vegetation being provided by the rotational grazing system is providing additional nesting and/or brood rearing security. In contrast, the controls with no noticeable increase in vegetation may be showing a negative response to an increase in breeding pairs. Bellrose, *et al.* (1961) discussed the relationship between ponds and breeding pair productivity and suggests that an inverse relationship exists between population density and production of young ducks (i.e., Errington's inversity principle).

Table 14. ESTIMATED SUCCESS OF BREEDING PAIRS ON BOTH STUDY AREAS 1968-70.

	Number of Pairs			Number of Broods			Percent Success		
	1968	1969	1970	1968	1969	1970	1968	1969	1970
South Unit	--	71	93	35	48	77	--	68	83
South Controls		18	24	12	11	13	--	61	54
North Unit	39	47	49	22	35	39	56	74	80
North Controls		16	21	4	9	11	--	56	52
Totals	--	152	187	73	103	140	--	68	74

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