A study of waterfowl broods in eastern Montana with special reference to movements and the relationship of reservoir fencing to production
by Paul F Berg

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 at Montana State College
Montana State University

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A study was conducted on two waterfowl trend areas in eastern Montana during the summers of 1953 and 1954 to evaluate the effect of fencing artificial reservoirs on vegetation and brood production. Data were also collected on brood movements, involving marked individuals, during the spring and summer of 1954 on one of the trend areas. Effectiveness of marking is described. Some relationships' between reservoir size, emergent and/or riparian vegetation, and rate of water loss as concerns brood movements and usage are presented.

A STUDY OF WATERFOWL BROODS IN EASTERN MONTANA WITH SPECIAL REFERENCE TO MOVEMENTS AND THE RELATIONSHIP OF RESERVOIR FENCING TO PRODUCTION

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ABSTRACT

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INTRODUCTION

A study of waterfowl production on artificial reservoirs in eastern Montana (Smith, 1953) indicated that the larger reservoirs were superior in brood production. Smith's conclusions were based on monthly visits to all reservoirs, and his data, although indicative of waterfowl and brood usage, do not necessarily supply information of sufficient detail to permit complete evaluation of brood usage of the smaller ponds, or the relationships between the small and the large ponds concerning brood usage and breeding territories. The present investigation was conducted to help clarify this relationship through an evaluation of brood movements involving marked individuals.

Although Smith concluded that reservoir size had more influence on brood production than vegetative type, he also reported that open-type reservoirs, which constituted 31 per cent of 116 under consideration, produced only 18.9 per cent of 196 broods. Smith pointed out that many open-type reservoirs were subjected to heavy grazing and he hypothesized that the low brood production was the result of sparse vegetation which in turn was due to livestock grazing. Twelve of the ponds were fenced to exclude livestock. Changes in the vegetation and brood production were evaluated. The reservoirs are in the waterfowl trend areas of Carter and

McCone counties. For a description of these areas the reader is referred to Smith (op. cit.).

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METHODS AND RESULTS

Sheep-tight fences were constructed in the summer of 1953, by the Montana State Fish and Game Department, excluding livestock from the upper end and a suitable portion of the drainage area of each pond chosen (6 in Carter county and 6 in McCone county). During the same period a pond of similar location, size and type was selected to serve as an unfenced, paired control for each fenced pond. The average size of the 12 Carter and 12 McCone fenced and control ponds was 1.32 and 2.92 surface acres at high water level, respectively. The exclosures on the 6 Carter and 6 McCone fenced ponds averaged 1.47 and 2.03 acres, respectively. Intensive vegetative measurements and brood production data were collected during the summers of 1953 and 1954 at the 12 study ponds in each of

the two areas. Brood movement data were collected during spring and summer of 1954 at 44 ponds (about one per square mile) in the Carter county trend area.

Riparian Vegetation

Four 50-foot base lines were randomly selected within the exclosure of each fenced pond and "permanently" marked with stakes; one at mud flat-grassland ecotone, the other at 50 feet perpendicular to waterline. Similar base lines were delimited on each control pond within an area similar to that of the exclosure of the fenced pond with which it was paired. Vegetation density was measured by point-transects consisting of 10 sliding pins placed at one decimeter intervals on a meterlong "A" frame (Coupland, 1950), and taken perpendicularly at five-foot intervals along each base line. Plants touched at soil surface by a point were recorded as to species and their height measured to nearest one-quarter inch. Because of the importance of Artemisia tridentata, data were recorded when a pin touched its branches at any level. One hundred points were taken on each base line; i. e., 400 points per pond, except in some cases where a complete 50-foot base line was prevented by proximity of fence to water. The total number of points taken each year was 4,750 in Carter county, August 30 to September 3 and 4,450 in McCone county, August 12 to 19. (Fences were

constructed on McCone county ponds during June and July, and Carter county ponds in August and September, 1953.) Major vegetation includes those species which were encountered frequently on point-transects, while all others are considered minor species. The results are expressed as per cent density, per cent species composition, and species height. (Tables I and II). Plant nomenclature followed Booth (1950), and Booth and Wright (1953).

Carter county ponds: The fenced ponds showed a plant density increase from 15.32 per cent in 1953 to 25.62 per cent in 1954 (Table I). Five of the 10 major species, Agropyron smithii, Hordeum jubatum, Poa cambyi, Buchloe dactyloides, and Poa pratensis, contributed largely to the increase. No appreciable change was recorded for A. tridentata, Echinochloa crusgalli, and Beckmannia syzigachne; whereas Bouteloua gracilis and Distichlis stricta decreased. P. cambyi was recorded in 1954 only.

Control pond data indicate that the total plant density increase 1953 to 1954 was less than for fenced ponds: 11.46 to 16.96. A. smithii, B. dactyloides, D. stricta, Koeleria cristata, and H. jubatum made up most of this increase. A. tridentata, B. gracilis, and Stipa viridula showed no appreciable density change.

S. viridula, K. cristata, B. syzigachne, and E. crus-

Table I. Per cent density, species composition, and average height of vegetation for Carter county ponds 1953-54.

Fenced Ponds

Major Species	1953 Density 1.	1953 Species Comp. 2.	1953 Height 3.	1953 Ponds 4.	1954 Density 1.	1954 Species Comp. 2.	1954 Height 3.	1954 Ponds 4.
Agropyron smithii	3.28	21.4	6.8	6	7.28	28.4	10.1	6
Hordeum jubatum	2.89	18.9	12.8	4	4.72	18.4	13.5	5
Buchloe dactyloides	2.59	16.9	2.8	5	3.79	14.8	2.2	5
Bouteloua gracilis	0.51	3.3	4.2	3	0.30	1.2	2.4	3
Artemisia tridentata	0.43	2.8	9.8	2	0.51	2.0	9.4	3
Poa cambyi	-	-	-	-	1.45	5.7	8.8	4
Poa pratensis	0.26	1.7	7.4	2	0.73	2.8	14.0	2
Echinochloa crusgalli	0.34	2.2	4.4	4	0.38	1.5	6.2	2
Beckmannia syzigachne	0.34	2.2	23.2	3	0.38	1.5	26.6	3
Distichlis stricta	0.30	2.0	2.9	1	0.21	0.8	4.5	1
Total Major Species	10.94	71.4	7.8	-	19.75	77.1	9.5	-
Total Minor Species	4.38	28.6	-	-	5.87	22.9	-	-
Total Vegetation	15.32	100.0	-	-	25.62	100.0	-	-
Total No. Species	-	34	-	-	-	39	-	-

Control Ponds

	1953				1954			
Agropyron smithii	2.92	25.4	7.2	6	4.87	28.7	5.7	6
Artemisia tridentata	1.96	17.1	9.2	3	2.00	11.8	8.6	4
Bouteloua gracilis	1.50	13.1	1.6	4	1.38	8.1	2.1	2
Buchloe dactyloides	0.87	7.6	1.8	2	2.13	12.5	2.0	4
Distichlis stricta	0.50	4.4	3.6	2	1.08	6.4	4.9	2
Hordeum jubatum	0.13	1.1	8.5	2	0.38	2.2	12.0	2
Koeleria cristata	0.17	1.5	2.5	1	0.79	4.7	6.1	4
Stipa viridula	0.28	2.5	8.9	2	0.25	1.5	15.8	3
Total Major Species	8.33	72.7	5.9	-	12.88	75.9	5.5	-
Total Minor Species	3.13	27.3	-	-	4.08	24.1	-	-
Total Vegetation	11.46	100.0	-	-	16.96	100.0	-	-
Total No. Species	-	25	-	-	-	24	-	-

1. Per cent density (points occupied divided by total points taken).
2. Per cent species composition (per cent density of species divided by total per cent density).
3. Weighted mean heights in inches.
4. Number of ponds at which species occurred.

Table II. Per cent density, species composition, and average height of vegetation for McCone county ponds 1953-54.

Fenced Ponds

Major Species	1953 Density 1.	1953 Species Comp. 2.	1953 Height 3.	1953 Ponds 4.	1954 Density 1.	1954 Species Comp. 2.	1954 Height 3.	1954 Ponds 4.
Bouteloua gracilis	6.54	26.0	4.4	5	7.85	22.0	3.4	5
Agropyron smithii	5.66	22.5	8.7	6	7.32	20.5	10.7	6
Hordeum jubatum	1.66	6.6	14.0	2	2.29	6.4	13.5	3
Calamovilfa longifolia	1.41	5.6	5.0	2	0.63	1.8	10.1	5
Distichlis stricta	1.22	4.9	4.4	3	2.68	7.5	8.1	3
Echinochloa crusgalli	1.22	4.9	7.5	2	0.39	1.1	5.6	3
Andropogon scoparius	0.78	3.1	9.5	4	1.17	3.3	14.2	3
Carex filifolia	0.68	2.7	2.8	2	1.80	5.0	4.3	6
Muhlenbergia richardsonis	0.44	1.7	5.6	3	1.37	3.8	5.3	5
Stipa comata	0.39	1.6	6.0	1	0.83	2.3	3.8	4
Total Major Species	20.00	79.6	6.8	-	26.33	73.7	7.9*	-
Total Minor Species	5.12	20.4	-	-	9.41	26.3	-	-
Total Vegetation	25.12	100.0	-	-	35.74	100.0	-	-
Total No. Species	-	44	-	-	-	42	-	-

Control Ponds

	1953				1954			
Bouteloua gracilis	6.71	31.3	4.2	5	5.46	24.4	2.1	5
Agropyron smithii	6.17	28.7	7.4	6	5.66	25.4	4.7	6
Distichlis stricta	2.25	10.5	6.0	2	2.96	13.3	5.6	4
Andropogon scoparius	0.96	4.5	3.8	4	0.54	2.4	18.3	2
Stipa comata	0.86	4.0	7.9	3	0.75	3.4	5.2	5
Carex filifolia	0.86	4.0	7.4	4	1.12	5.0	4.3	6
Muhlenbergia richardsonis	0.71	3.3	4.3	4	0.83	3.7	3.3	3
Poa pratensis	0.29	1.4	2.8	1	1.67	7.5	2.0	2
Total Major Species	18.81	87.7	5.7	-	18.99	85.1	3.8**	-
Total Minor Species	2.63	12.3	-	-	3.33	14.9	-	-
Total Vegetation	21.44	100.0	-	-	22.32	100.0	-	-
Total No. Species	-	31	-	-	-	28	-	-

1. Per cent density (points occupied divided by total points taken).
2. Per cent species composition (per cent density of species divided by total per cent density).
3. Weighted mean heights in inches.
4. Number of ponds at which species occurred.

* Two ponds excluded; cattle grazed inside exclosure prior to measurements.

** Two ponds excluded; cattle removed, land plowed fall, 1953.

galli, important at control ponds, were not encountered as major fenced pond vegetation. P. pratensis and P. cambyi, important at fenced ponds, were not recorded at control ponds.

The density of minor vegetation for the fenced ponds showed a smaller increase (4.38 to 5.87) 1953 to 1954 than did major vegetation. The number of species increased from 34 to 39. The same trend seems apparent for control ponds with regard to plant density, but the number of species did not increase.

The average height of major species increased 1.7 inches at fenced ponds and decreased 0.4 inch at control ponds 1953 to 1954.

McCone county ponds: Plant density for fenced ponds increased from 25.12 per cent in 1953 to 35.74 per cent in 1954 (Table II). Five species, A. smithii, D. stricta, B. gracilis, Carex filifolia, and Muhlenbergia richardsonis contributed largely to the increase; H. jubatum, Stipa comata, and Andropogon scoparius increased to a lesser degree, while E. crusgalli and Calamovilfa longifolia decreased.

Total plant density increase at control ponds 1953 to 1954 was only 21.44 to 22.32. A marked increase in density and a decrease in average height were recorded for P. pratensis which appeared only at control ponds.

H. jubatum, C. longifolia, and E. crusgalli, important at fenced ponds, were not encountered at control ponds. Density increase of minor vegetation for fenced ponds was greater (5.12 to 9.41) than that of major vegetation, but the number of species decreased. A similar trend was indicated for control ponds.

The average height of major species increased 1.1 inches at fenced ponds and decreased 1.9 inches at control ponds 1953 to 1954.

The data for both counties indicate that fencing provided conditions which increased plant density, average height of important species, and modified species composition of riparian vegetation.

Emergent Vegetation

An attempt was made to evaluate the effect of fencing on emergent vegetation. Areas of emergent vegetation in all study ponds were drawn to scale on graph paper as determined by calibrated pacing in both 1953 and 1954. Density measurements followed the method of Low (1945). Culms or stalks per square yard or square foot quadrats, taken at random throughout emergent stands, were counted.

Although emergent vegetation (Sagittaria cuneata, Alisma Plantago-aquatica, Scirpus validus, Eleocharis spp. and Typha latifolia) did develop at ponds, it was impossible

to evaluate the effect of fencing. Unstable water levels and the difference in water holding capacity of the ponds seemed to be limiting factors. It is well known that water level is essential in the establishment and maintenance of emergent vegetation.

Water level measurements, taken at monthly intervals in 1954 with a specially constructed pendulum sight used as an Abney level, show positive correlation between development of emergents and water levels.

Scattered stands of emergent vegetation developed on four (two fenced and two control) Carter county ponds in both 1953 and 1954. Water level drop on these ponds averaged 11 inches from April 15 to July 20, 1954. The remaining four fenced ponds averaged 36 inches water loss for the same period; only traces of emergent vegetation developed. The average water loss was 16 inches for the other four control ponds and none developed appreciable amounts of emergent vegetation.

Two of the 6 McCone county fenced ponds and none of the 6 control ponds developed moderate amounts of emergent vegetation in 1953. In 1954 the average water level drop on all McCone county study ponds was 34 inches from April 20 to July 13. No appreciable amount of emergent vegetation developed in any study pond in 1954.

Data, from the two weather stations nearest trend areas in each county (Albion, Boyes; Circle, Vida), show precipitation from May through August, 1953 was 60 per cent more in Carter county, and 102 per cent more in McCone county, than for the same period in 1954.

Brood Production

Brood census was conducted during morning and evening at about three-week intervals from July 13 to September 15, 1953 and 1954. Numerous supplemental observations were made at various times. In addition to visual inspection, the pond periphery was searched to flush concealed broods. The small number of broods and the sparse emergent vegetation of the ponds simplified individual brood observation and recognition.

Calculation of brood production followed the method of Blankenship, et. al. (1953), and Gollop and Marshall (1954). All broods were recorded on first census. Those recorded on successive counts, assumed to have been observed on previous counts, were omitted from production figures.

Twenty-nine broods were recorded on all study ponds in 1953 and 1954 (Table III). Fifteen, observed two to four times each, indicated a minimum average "residence" period of 24 days for 10 mallard broods, 32 days for two pintail, 15 days for two blue-winged teal, and 44 days for one bald-

Table III. Number of broods observed on study ponds of Carter and McCone counties 1953-54.

Brood Species	Carter County				McCone County				Total Broods		
	Fenced		Control		Fenced		Control				
	1953	1954	1953	1954	1953	1954	1953	1954	Fenced	Control	All Ponds
Mallard	3(3)*	3(1)	0	5(1)	2(2)	3(2)	4(1)	1	11(8)	10(2)	21(10)
Pintail	0	0	0	0	2(1)	2(1)	0	0	4(2)	0	4(2)
B.W.Teal	1(1)	1(1)	0	1	0	0	0	0	2(2)	1(0)	3(2)
Baldpate	0	1(1)	0	0	0	0	0	0	1(1)	0	1(1)
Total	4(4)	5(3)	0	6(1)	4(3)	5(3)	4(1)	1	18(13)	11(2)	29(15)
Ponds 6**	6	6	6	6	6	6	6	6			
Ponds 2***	3	0	5	2	3	3	1				

* Figures in parentheses indicate broods assumed to be "resident".

** Number of ponds in each group.

*** Number of ponds with broods.

pate brood. Fourteen broods seen only once were considered "transient".

Combined data for both study areas and for both years show 13 resident and five transient broods for fenced ponds, and two residents and 9 transients for control ponds. The data for 1953 show 7 resident and one transient broods for fenced ponds and one resident and three transients for control ponds; for 1954 there were 6 residents and four transients for fenced ponds and one resident and 6 transients for control ponds.

Two of the 6 Carter county fenced ponds accounted for all (four) broods observed in 1953, and four of five broods in 1954. McCone county fenced ponds show the same brood distribution. No broods were seen on any of the 6 Carter county control ponds in 1953, but 6 were recorded in 1954. Five ponds were represented.

Four broods were noted on McCone county control ponds during 1953; three ponds were represented. Only one brood observation was recorded in 1954.

Considering the combined data of resident broods, it would appear that the fenced ponds were superior to the unfenced control ponds in brood production, but other factors cannot be ignored. The consistency of brood appearance and residency on only two fenced ponds in each area for both

1953 and 1954, and the erratic appearance of broods on the remainder of the fenced and control ponds, prevent definite conclusions.

Brood Movement

Twelve waterfowl nests were located on the study area. Four clutches were color injected by the methods of Evans (1951) and Hyers and Low (no date) to color ducklings for subsequent identification; two hatched successfully. Nest hunting was abandoned, and a method of brood capture for direct marking was initiated, because of predation and desertion (75%) of the nests found.

White, yellow, orange or blue airplane dope was daubed on rump, back, or nape (areas of last visible down) of downy ducklings. Scapular feathers of Class II or older ducklings were marked. Seventy-one per cent of all ducklings of 40 broods was captured with the aid of a small net. It was often possible to capture entire Class Ia or Ib broods. In many cases broods marked when Ia or Ib were recaptured and marked again when Class II or older.

The method of brood capture was unique to the small ponds of this area. After a brood was sighted, the assistant maintained visual contact with binoculars while the catcher attempted a concealed approach to the opposite side of the pond. Proper timing of exposure of assistant to brood often

resulted in the hen leading brood to opposite shore where it hid in vegetation, or on bare ground. It was important that the assistant maintain visual contact with brood and signal exact hiding position to catcher. The flushing hen sometimes disclosed the precise hiding place, and a careful search usually resulted in netting the brood. Class I broods were often captured close to shore, some in the upper, shallow part of the pond. Class II or older broods sometimes scampered as far as 200 yards away from the pond and were more difficult to catch.

Longevity of marks was directly proportional to duckling age at time of marking and pattern of down-shedding from area marked. Rump, back and scapular marks, appropriately applied, were distinguishable about 25 days after marking. Under optimum field conditions, colors were readily identified from 100 yards with an 8 x 30 binocular. A 20X spotting scope increased range and efficiency of observation. All broods were categorized to age-classes on basis of plumage development similar to the methods of Gollop and Marshall (op. cit.) and Southwick (1953): Class Ia (bright ball of fluff); Class Ib (fading ball of fluff); Class Ic (gawky-downy); Class IIa (first feathers); Class IIb (mostly feathered); Class IIc (last down); Class III (completely feathered, flightless); and Class III+ (capable of flight).

Intensive brood search and subsequent observations were carried on from May 15 to August 5. Duties pertinent to vegetative studies in both counties resulted in loss of contact with many Carter county broods after August 5.

Forty-four ponds, randomly scattered over the 43 square-mile area, were included in brood movement studies. They constituted four vegetative classes, five size groups and five water loss classes.

Vegetative classification (based on extent of emergent and/or riparian vegetation):

Class 1, (9 ponds) - Typha-Scirpus-Eleocharis association forms dominant emergent vegetation.

Class 2, (9 ponds) - Eleocharis-Sagittaria-Alisma association provides dominant emergent cover.

Class 3, (12 ponds) - Artemisia-Gramineae and associated species occur to water's edge; with little or no emergent vegetation.

Class 4, (14 ponds) - Emergent or riparian vegetation is sparse or entirely lacking; usually resulting from water loss, and/or livestock grazing and trampling.

Size groups in surface acres (based on surface area in acres at high water): Group A, (2 ponds) 3.7 to 4.5 acres;