MONTANA STATE UNIVERSITY

The influence of rest-rotation grazing management on waterfowl production on stock-water reservoirs in Phillips County, Montana

by John Gerhard Mundinger

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Fish and Wildlife Management

Montana State University

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Abstract:
Waterfowl production on the stock-water reservoirs in the Milk River Association Allotment, Phillips County, Montana was studied during 1973 and 1974 to evaluate the influence of rest-rotation grazing management. Breeding pairs, broods and species diversity increased on the allotment since a study which terminated in 1970. Changes in the distribution of breeding pairs and broods, from 1973 to 1974, suggested a positive response by waterfowl to the previous year's rest treatment, and a negative response to heavy grazing pressure during the late summer and fall of the previous year. These conclusions are further substantiated by the histories of five marked females. Waterfowl responded positively to rest and deferred treatments, and negatively to spring grazing during the current season.

Key shrub and grass species on permanent vegetation transects, established in 1968, responded positively to rest-rotation grazing, with greater responses recorded during years of reduced grazing intensity. Shoreline and upland transects established during 1974 indicated that new vegetation accumulates most rapidly in those pastures' deferred from early season grazing. The greatest accumulation of residual, vegetation occurred in the pasture rested and the pasture grazed only during the spring. Regrowths following relief from grazing, did contribute to the accumulation of residual vegetation. Residual vegetation was an important component at six of seven nest sites analyzed during 1974. These data also indicated that females selected nest sites on the basis of the structure rather than species composition of the vegetation. Canada goose (Branta canadensis) production on the study area increased since 1970. This increase is related to the inclusion of islands in reservoirs. Management recommendations are discussed.

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THE INFLUENCE OF REST-ROTATION GRAZING MANAGEMENT ON WATERFOWL PRODUCTION ON STOCK-WATER RESERVOIRS IN PHILLIPS COUNTY, MONTANA

by

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ABSTRACT

Waterfowl production on the stock-water reservoirs in the Milk River Association Allotment, Phillips County, Montana was studied during 1973 and 1974 to evaluate the influence of rest-rotation grazing management. Breeding pairs, broods and species diversity increased on the allotment since a study which terminated in 1970. Changes in the distribution of breeding pairs and broods, from 1973 to 1974, suggested a positive response by waterfowl to the previous year's rest treatment, and a negative response to heavy grazing pressure during the late summer and fall of the previous year. These conclusions are further substantiated by the histories of five marked females. Waterfowl responded positively to rest and deferred treatments, and negatively to spring grazing during the current season. Key shrub and grass species on permanent vegetation transects, established in 1968, responded positively to rest-rotation grazing, with greater responses recorded during years of reduced grazing intensity. Shoreline and upland transects established during 1974 indicated that new vegetation accumulates most rapidly in those pastures deferred from early season grazing. The greatest accumulation of residual vegetation occurred in the pasture rested and the pasture grazed only during the spring. Regrowth, following relief from grazing, did contribute to the accumulation of residual vegetation. Residual vegetation was an important component at six of seven nest sites analyzed during 1974. These data also indicated that females selected nest sites on the basis of the structure rather than species composition of the vegetation. Canada goose *(Branta canadensis)* production on the study area increased since 1970. This increase is related to the inclusion of islands in reservoirs. Management recommendations are discussed.

INTRODUCTION

The construction of stock-water reservoirs has provided waterfowl breeding habitat in regions where such habitat was sparse or absent (Smith 1953; Uhlig 1963; Bue *et al.* 1964; and Shearer and Uhlig 1965). That these reservoirs make an important contribution to the annual production of waterfowl is related to the large area involved (Smith 1953), the relative stability of water levels between years (Bue *et al.* 1964) and a relatively high rate of nest success, associated with a low population density (Smith 1953; and Rundquist 1973).

A potential conflict between breeding waterfowl and grazing animals exists on these reservoirs. Bue *et al.* (1952) demonstrated that grazing by cattle reduced the nesting cover rating of the upland vegetation around stock ponds. Furthermore, the quality of the shoreline cover decreased with increased grazing intensity, and use by breeding pairs and broods was reduced on ponds with poor shoreline cover. Kirsch (1969) found higher nest densities and nest success on ungrazed, as compared to grazed plots.

Fencing has been suggested as a possible means of minimizing the conflict between livestock and waterfowl on stock ponds (Bue *et al.* 1952; and Berg 1956). However, the cost of installing and maintaining fences, relative to the benefits which might accrue, usually makes this practice prohibitive. Furthermore, fencing a portion of a pond, while protecting the riparian vegetation, is of no value in providing upland

nesting cover. Keith (1961) found that the heavy cover in fenced areas was attractive both to nesting waterfowl and nest predators.

Rest-rotation (Hormay and Talbot 1961) is a grazing system which employs periodic rest to achieve an improved range condition. While the formula may be designed for maximum livestock production, it may also consider other land uses. Gjersing (1971), working in native bunchgrass prairie, found greater amounts of residual vegetation in spring in pastures which were ungrazed or grazed only during spring the previous season, as compared to other pastures in the allotment. The presence of residual cover apparently contributed to increases in waterfowl production in these pastures. Furthermore, breeding success increased on two allotments managed with a rest-rotation grazing system, while decreasing on units subjected to continuous grazing.

This study is a further evaluation of waterfowl responses to rest-rotation management. Field data were gathered during the summer of 1973 and the spring and summer of 1974.

DESCRIPTION OF STUDY AREA

This study was conducted on the Milk River Association Allotment, Gjersing's (1971) south study area. The allotment is located approximately twelve miles south of Malta, Phillips County, Montana, adjacent to U. S. Highway 191 (Fig. 1). The area includes 20,650 acres, divided into five pastures, ranging in size from 3,317 to 4,832 acres. An additional pasture, Unit B, lies adjacent to the southeast corner of the allotment. Although not included in the grazing system, Unit B is used by the Association during the normal livestock operation.

The physiography of the area is rolling plains dissected by deeply entrenched streams and coulees. Rough, broken land is found along most of the streams and in the more feebly glaciated areas (Gieseker 1926).

The climate is characterized by low rainfall, great temperature extremes, and a large number of sunny days (Gieseker 1926). The mean annual temperature is 42.8° F, and the mean annual precipitation is 11.84 inches. Above average precipitation was recorded during 1973 and 1974. However, water conditions of the reservoirs during 1973 was poor, associated with a low spring runoff and below average precipitation during fall 1972 and the first seven months of 1973. Water conditions during 1974 were excellent, associated with above average precipitation during fall 1973, high spring runoff, and heavy rains during the last two weeks in May (U. S. Department of Commerce 1972-1974).

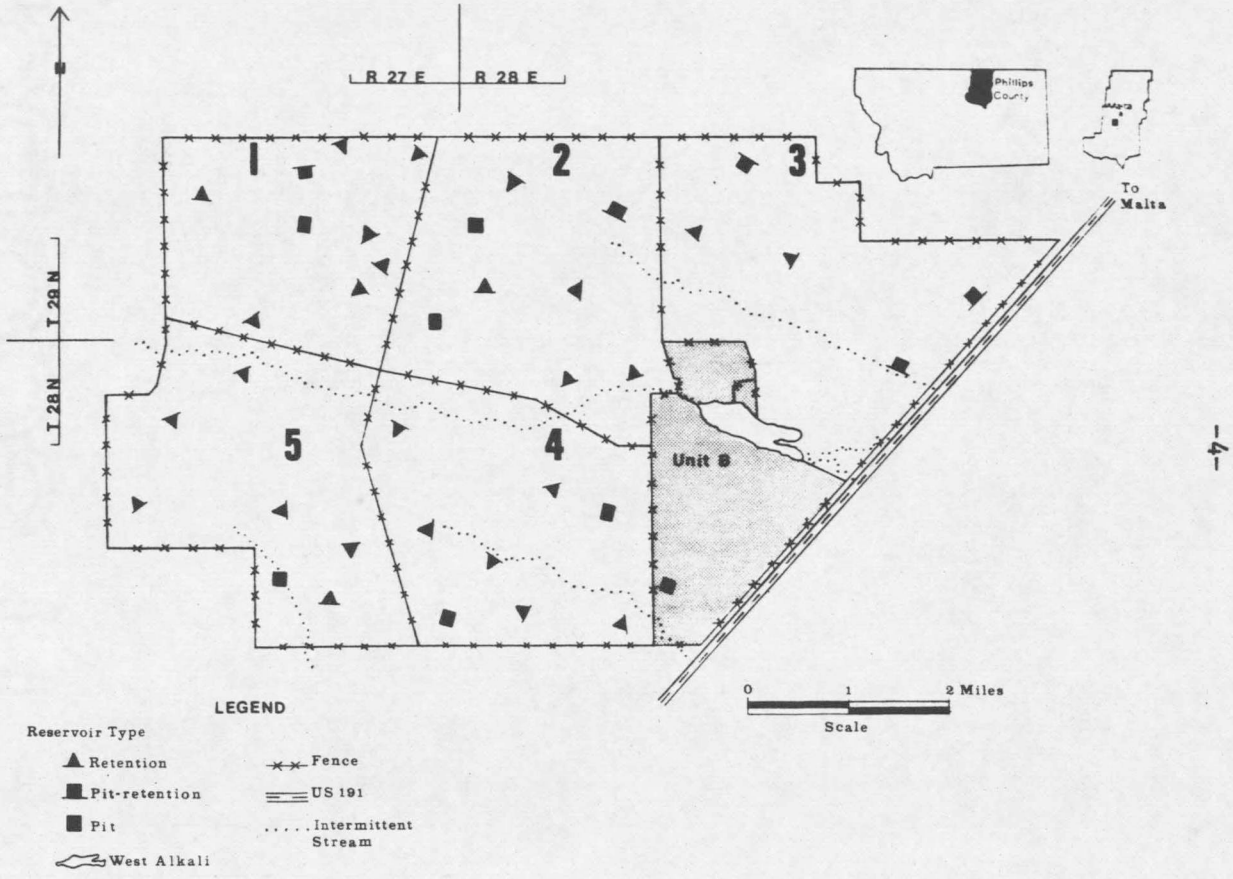


Figure 1. Map of the Study Area.

The vegetation of the area is primarily a grassland community. Upland sites are dominated by clubmoss *(Selaginella densa)* throughout the growing season. Prominent grasses are Junegrass *(Koeleria cristata)* and Sandberg bluegrass *(Poa secunda)* during the late spring, and blue grama *(Bouteloua gracilis)* during the summer. Other major grasslike species include sixweeks grass *(Vulpia octoflora)* and needleleaf sedge *(Carex eleocharis)* during the spring, western wheatgrass *(Agropyron smithii)* and needle-and-thread *(Stipa comata)* during the early summer, and plains muhly *(Muhlenbergia cuspidata)* during the late summer.

Crested wheatgrass *(Agropyron cristatum)* is the dominant species on several upland sites. These areas, totaling 805 acres, were planted with this species. It also occurs as an occasional volunteer.

Fringed sagewort *(Artemisia frigida)* is the dominant forb on upland sites. Other important species include plains prickly pear *(Opuntia polycantha)*, plantain *(Plantago* spp.*)*, milkvetch *(Astragalus* spp.*)*, yarrow *(Achillea millefolium)*, scarlet globemallow *(Sphaeralcea coccinea)*, stiff linen *(Linum rigidum)*, prairie thermopsis *(Thermopsis rhombifolia)*, silver-leaf scurfpea *(Psoralea argophylla)*, broom snakeweed *(Gutierrezia sarothrae)*, and Nuttall saltbush *(Atriplex nuttallii)*. Silver sagebrush *(Artemisia cana)*, with a scattered distribution on some sites, is the only important shrub occurring in the uplands.

Two tracts of upland habitat in Pasture 4 totaling 1,294 acres were contour furrowed and seeded to a range mixture, as a range

renovation practice, in November 1968. Much of the vegetation occurring on the upland sites is also prominent on these areas. There is an increased density of fringed sagewort, western wheatgrass and needle-and-thread. Other important species include green needlegrass *(Stipa viridula)* and alfalfa *(Medicago sativa)*, both included in the seeding mixture, and a variety of annual forbs.

Coulee bottoms include much of the same vegetation as described for the uplands, with an increase in the density of shrubs. Silver sagebrush is common, while big sagebrush *(Artemisia tridentata)* occurs on a few coulee bottom sites typified by heavier soils. These two species appear to be mutually exclusive, perhaps related to edaphic characters.

Moister areas in the coulee bottoms, particularly adjacent to intermittent streams, support dense growths of Woods rose *(Rosa woodsii)* and western snowberry *(Symphoricarpos occidentalis)*. These stands may be intermingled with currant *(Ribes* spp.*)*.

Thirty-nine reservoirs of three types have been constructed on the allotment: (1) twenty-eight retention, (2) six pit, and (3) five pit-retention. At high water, the reservoirs range in size from 0.2 to 10.6 surface acres. The distribution of water, by pasture and reservoir type, during both years of the study is included in Appendix Table 25.

The vegetation associated with the retention reservoirs occurs in rather distinct zones from the open water to the upland. The prominent species in the submerged vegetation zone include pondweed *(Potomogeton* spp.*)*, American milfoil *(Myriophyllum exalbescens)*, and aquatic buttercup *(Ranunculus aquaticus)*.

Spike-sedge *(Eleocharis macrostachya)*, occurring as dense stands in at least a portion of most of the reservoirs, is the dominant species in the zone of emergent vegetation. Giant bulrush *(Scirpus validus)* occurs as well established stands in four of the reservoirs and is gradually pioneering several others. Common cattail *(Typha latifolia)* is well established in one reservoir and was observed in two others. Other prominent species of the emergent zone include American water plantain *(Alisma plantago-aquatica)*, common arrowleaf *(Sagittaria latifolia)*, and colored smartweed *(Polygonum coccineum)*.

A mixture of grasslike species, particularly foxtail barley *(Hordeum jubatum)*, tufted hairgrass *(Deschampsia caespitosa)*, sedge *(Carex* spp.*)*, and bluegrass *(Poa* spp.*)*, dominates the riparian zone of retention reservoirs. Additional species which may occur in this zone include slender rush *(Juncus tenuis)*, needle-spike-sedge *(Eleocharis acicularis)*, American sloughgrass *(Beckmannia syzigachne)*, desert saltgrass *(Distichlis stricta)*, field mint *(Mentha arvensis)*, and dock *(Rumex* spp.*)*. Due to water level fluctuations, the demarcation between the zones of emergent and riparian vegetation is not

distinct.

The vegetation associated with pits is influenced by the site in which they are located. Two pits are situated in coulee bottoms, trapping the water flowing in intermittent streams. The aquatic vegetation in these reservoirs is poorly developed. One of these pits supports a dense growth of vegetation on its banks, similar to the riparian vegetation which occurs at retention reservoirs. The other has a poorly developed shoreline vegetation. Four pits are constructed in large temporary potholes. While the pits support sparse aquatic growth, the adjacent vegetation is strongly dependent upon the water conditions of the potholes. These potholes were full during the spring of 1974 and continued to hold water through the middle of the summer or longer. They were dry in 1973.

Pit-retention reservoirs are constructed in areas of natural runoff, such that water impeded by the dam collects in the pit behind the dam. A narrow band of shallow water surrounds these pits and emergent vegetation is sparsely developed in this margin. Dense growths of spikesedge occur where water overflows the pit, particularly in the upper ends of the reservoirs. A zone of riparian vegetation surrounds these overflow areas.

Natural water areas on the study area include intermittent streams and potholes. Potholes range in size from small depressions to approximately 45 surface acres, with most less than one acre. During

many years, e.g. 1973, the potholes exist briefly following spring run-off and heavy rainstorms. In this condition, the potholes would be classified as ephemeral to poorly developed temporary potholes (Stewart and Kantrud 1969). The vegetation which develops on these sites is quite variable, with much of it appearing after the potholes have dried. During 1974, however, the larger potholes were classified as seasonal potholes and they endured at least through the middle of the summer. In this condition several of the large potholes developed dense growths of spike-sedge. Although the emergent zone was well developed, a distinct riparian zone was not typical of the potholes during 1974.

A complete list of the avifauna observed on the study area during the course of this investigation is included in Appendix Table 26. Prominent resident species, other than Anseriforms, include eared grebe *(Podiceps nigricollis)*, pied-billed grebe *(Podilymbus podiceps)*, great blue heron *(Ardea herodias)*, Swainson's hawk *(Buteo swainsoni)*, marsh hawk *(Circus cyaneus)*, sage grouse *(Centrocercus urophasianus)*, American coot *(Fulica americana)*, killdeer *(Charadrius vociferus)*, long-billed curlew *(Numenius americanus)*, willet *(Cataptrophorus semipalmatus)*, marbled godwit *(Limosa fedoa)*, Wilson's phalarope *(Steganopus tricolor)*, common tern *(Sterna hirundo)*, common nighthawk *(Chordeiles minor)*, eastern kingbird *(Tyrannus tyrannus)*, horned lark *(Eremophila alpestris)*, western meadowlard *(Sturnella neglecta)*, yellow-headed blackbird *(Xanthocephalus xanthocephalus)*, red-winged blackbird

(Agelaius phoeniceus), brown-headed cowbird *(Molothrus ater)*, lark bunting *(Calamospiza melanocorys)*, McCown's longspur *(Calcarius mccownii)*, and chestnut-collared longspur *(Calcarius ornatus)*.

Other vertebrates observed include tiger salamander *(Ambystoma tigrinum)*, leopard frog *(Rana pipiens)*, painted turtle *(Chrysemys picta)*, bull snake *(Pituophis melanoleucus)*, plains garter snake *(Thamnophis radix)*, western rattlesnake *(Crotalus viridis)*, badger *(Taxidea taxus)*, striped skunk *(Mephitis mephitis)*, coyote *(Canis latrans)*, red fox *(Vulpes vulpes)*, Richardson ground squirrel *(Spermophilis richardsonii)*, muskrat *(Ondatra zibethica)*, whitetail jackrabbit *(Lepus townsendi)*, mountain cottontail *(Sylvilagus nuttalli)*, mule deer *(Odocoileus hemionus)*, whitetail deer *(Odocoileus virginianus)*, and North American pronghorn *(Antilocapra americana)*. Blacktail prairie dogs *(Cynomys ludoviciana)* have been reported on the area in previous years, however, the towns were erradicated.

The primary land use of the study area is cattle production. The allotment provides summer pasture for cattle and is grazed from approximately 1 May through 31 October each year. The history of this area is one of heavy use by livestock. An Allotment Management Plan was formulated and rest-rotation grazing initiated in 1967.

METHODS

A waterfowl census was conducted from mid-June through mid-September 1973 and from late March through mid-September 1974. Visits were made to each reservoir at approximately four-day intervals. Observations were made either from the vehicle parked at a distance from the reservoir, or by approaching the reservoir on foot from the base of the dam. As described by Gjersing (1971), this census method minimized waterfowl disturbance. Observations were made with the aid of a 10x40 binocular and a 15-60 variable power spotting scope.

The breeding pair census followed the criteria described by Hammond (1969). Pairs and lone males were used to estimate the breeding pair population. Female diving ducks in courting parties were also counted. The breeding population of Canada geese *(Branta canadensis)* was estimated from observations of pairs and females on nests.

All broods observed were recorded by date as to species, age-class and size. The calculation of brood production followed the procedure outlined by Gollop and Marshall (1954). Broods observed during two or more visits to a reservoir were considered "resident", while broods observed only once were considered "transient" (Berg 1956).

A "permanent" 100-foot transect (Canfield 1941) was established in 1968 by BLM personnel in each of three shrub types. In June 1974 the canopy intercept along the line was measured on the transect in the silver sagebrush and Nuttall saltbush types. The numbers of

individual plants of key species of shrubs and grasses, occurring in a square foot frame placed at ten-foot intervals along the line, were also counted. The Woods rose transect could not be located.

Five sets of permanent transects were established in 1974, each set depicting the riparian and upland vegetation for one representative reservoir in each pasture. Canopy coverage on these transects was estimated using a modification of Daubenmire (1959). Twenty 2x5 decimeter plots were located at five-foot intervals along a 100-foot line. Within each plot the percent canopy coverage for each taxon was visually determined and assigned to one of six classes: Class 1 = 0-5; class 2 = 5-25; class 3 = 25-50; class 4 = 50-75; class 5 = 75-95; class 6 = 95-100. The midpoint of each class was used for calculations. The three-dimensional aspect of the vegetation within each plot was also estimated by recording the total canopy coverage at three-inch intervals from 0 to 12 inches above the ground. Bare ground, lichen, rock, and lodged and standing litter were also recorded. Transects were established in April, just prior to "green-up", and read again at intervals corresponding to the grazing formula. Two additional shoreline transects, one each in Pastures 4 and 5, were established just prior to grazing during 1973 and read at weekly intervals thereafter.

Most of the reservoirs were photographed at least twice during 1973. Permanent photo-stations were established on two reservoirs in each pasture during April 1974. Photographs were taken at approximately

two-week intervals through the summer. A 6x48 inch gridded board was placed ten yards down the shoreline from the photopoint. Each photograph provides both a general aspect and a point description of the shoreline. Aspect photographs were substituted on two of the reservoirs when rising water levels in late May eliminated the photoplots.

Intensive nest searches were not conducted. When located, nests were recorded as to date, species, clutch size, fate, vegetative cover, and distance to water. Canopy coverage was estimated at seven of the nests located in 1974. The method employed required a total of forty-four plots. Twenty plots were located at five-foot intervals along a 100-foot line. The midpoint of this line was placed twenty-five feet from the nest. Five plots were located at five-foot intervals, beginning at two-and-a-half feet from the nest, along each of four, twenty-five foot lines running in the cardinal directions from the nest. One plot was placed on each of the four sides of the nest. Vegetation was analyzed as described for the permanent riparian and upland transects.

Two-hundred-and-three juvenile ducks and six adult females were captured and banded with a Bureau of Sport Fisheries and Wildlife leg-band during the summer of 1973. Of these birds, the 6 adults and 160 juveniles were equipped with a colored, plastic nasal-saddle provided by the Northern Prairie Wildlife Research Center (Dane, Greenwood and Bartonek, Pers. Comm.). A similar technique is described by Sudgen

and Poston (1968). The nasal-saddles were of three colors, red, white and black. Symbols were applied to the saddles with a paint that bonded to the plastic. By applying a given symbol and color combination only once to a particular species and sex, the marked birds were recognizable as individuals. Marked birds were identifiable, with the aid of a binocular, to distances of about 200 yards. Maximum distances varied with light conditions and color combinations.

The physical characteristics of the reservoirs on the study area were described by Gjersing (1971). For those reservoirs constructed since his study, the shoreline length was measured with a calibrated wheel. As a more recent set of aerial photographs was not available, it was not possible to determine acreages for these reservoirs.

Plant nomenclature follows Booth (1950) and Booth and Wright (1959). Avian nomenclature follows the American Ornithologists' Union (1957).

RESULTS

Waterfowl Production

Spring Migration

Information regarding spring migration is based on the 1974 season. Eighteen species of ducks were observed as spring migrants. Twelve of these remained on the study area through the breeding season.

Mallards *(Anus platyrhynchos)* and pintails *(Anas acuta)* did not show an abrupt migration peak. Both were present in small numbers when field work began on 17 March. At this time the reservoirs were still frozen. Numbers of these species gradually increased during late March and early April, while larger increases occurred during mid-April. Stable populations of 32 pairs of mallards and 63 pairs of pintails were established by the last week in April.

The peak of the American green-winged teal *(Anas crecca carolinensis)* migration occurred during the second week in April, when approximately 50 birds were observed. Occasional migrant groups of 20 or more were observed through late May. Except for these groups, the number of green-winged teal on the study area rapidly declined following the peak of migration. Four breeding pairs were established by the first week in May.

American wigeons *(Anas americana)* were first observed in small numbers on 8 April. The migration peak for this species occurred during the last week in April and the first week in May, when

approximately 200 birds were on the study area. Fifty-one pairs were established by 1 June.

The first group of northern shovelers *(Anas clypeata)* was observed on 9 April. Few shovelers were seen until the first week in May, when approximately 75 birds were present. Numbers of shovelers declined slightly thereafter. By the first week in June the population had stabilized at 34 pairs.

Gadwalls *(Anas strepera)* were first observed on 9 April. The peak of migration, approximately 100 birds, occurred during the first week in May. Gadwalls decreased in numbers during mid-May and increased again during late May and early June. The breeding population of approximately 38 pairs was established by the second week in June.

Blue-winged teal *(Anas discors)* were not observed until 19 April. Few blue-winged teal were on the study area until 1 May. The peak of migration for this species occurred between the last week in May and the first week in June. At that time approximately 75 birds were observed. Thirty-two breeding pairs were established by the second week in June.

Cinnamon teal *(Anas cyanoptera)* were not common on the study area. Occasional observations of singles and pairs were made from late April through May. One migrant flock, composed of two females and four males, was seen on 8 June. Two resident pairs were established at about the same time.

Lesser scaup *(Aythya affinis)* first appeared during the second week in April. Approximately 75 birds were observed during the peak of migration, between the last week in April and the first week in May. Scaup numbers decreased during May, but increased again during June. A stable population of 12 pairs was established by the third week in June.

Approximately 50 redheads *(Aythya americana)*, in two groups, were present during the second week in April. No redheads were classified as breeding pairs, although one brood, which hatched in late July, was reared on the study area.

Canvasbacks *(Aythya valisineria)* migrated, in smaller numbers, with the redheads. One pair of canvasbacks remained on the area during the latter part of June.

Ruddy ducks *(Oxyura jamaicensis)* were never observed in groups. Occasional observations of singles were made during June. One resident pair was established during July. Three broods, all of which hatched during late July, were observed.

Migrant common goldeneyes *(Bucephela clangula)*, approximately 20 birds, were present during the first two weeks in April. Buffleheads *(Bucephela albeola)* were observed as individuals and in small groups from the last week in April through the third week in June. One group of six ring-necked ducks *(Aythya collaris)* was observed on 21 April. Individuals of this species were observed through the first week in June. One pair of common mergansers *(Mergus merganser)* was observed

on 12 April. One female with three male red-breasted mergansers *(Mergus serrator)* was seen on 24 April. Two female hooded mergansers *(Lophodytes cucullatus)* were observed on 20 June.

The migration sequence observed on this study area during 1974 generally agrees with that reported by Ellig (1955) for Greenfields Lake, Montana, during 1952; by Keith (1961) for southeastern Alberta, from 1953 through 1957; and by Rundquist (1973) for south Phillips County, Montana, during 1971 and 1972. The migration peak for green-winged teal occurred about three weeks earlier than that reported by Ellig (1955); wigeons and blue-winged teal were about two weeks later. Migration peaks for the other species were consistent with his information.

Of the eight species of puddle ducks observed, only the American wigeon and green-winged teal appeared to represent a greater proportion of the migrant than the pair population. This discrepancy was particularly evident for the green-winged teal. All of the diver species comprised a smaller proportion of the breeding than of the migrant population.

Breeding Pairs

The distribution of breeding pairs, by species, for both years of this study is included in Table 1. As field work was not begun until June 1973, no estimate could be made for the 1973 pintail population. For this same reason, the estimated populations of mallards and shovelers

TABLE 1. DISTRIBUTION OF BREEDING PAIRS DURING 1973/1974, AND WATERFOWL PAIR POPULATIONS ON THE MILK RIVER ASSOCIATION ALLOTMENT DURING 1970, 1973 AND 1974.

Species	Pasture					Total		
	1	2	3	4	5	1973	1974	1970[1]
Mallard	1/12	8/8	7/6	4/3	3/4	23	32	13
Pintail	--/27	--/11	--/8	--/8	--/9	(40)	63	18
American Wigeon	4/15	16/9	5/6	14/11	9/10	48	51	19
Gadwall	2/14	13/9	4/2	10/10	3/3	32	38	8
Shoveler	1/14	3/10	1/1	2/5	3/4	10	34	10
Blue-winged Teal	1/15	11/8	2/3	6/4	2/2	22	32	17
Cinnamon Teal	1/1	0/0	0/0	1/1	0/0	2	2	0
Green-winged Teal	0/1	1/2	0/0	0/1	0/0	1	4	0
Lesser Scaup	0/2	4/4	3/0	4/4	1/2	12	12	8
Redhead	0/0	0/0	0/0	0/0	0/0	0	0	0
Canvasback	0/0	0/1	0/0	0/0	0/0	0	1	0
Ruddy Duck	0/0	0/1	0/0	0/0	0/0	0	1	0
Total	10/101	56/62	22/26	41/47	21/34	190	270	93

[1]Gjersing 1971:11.

for that year are minimum figures. A minimum of 40 pintail pairs for 1973 was derived from 1969, 1970 (Gjersing 1971) and 1974 averages. This figure appears to be reasonably consistent with observations of pintail pairs and broods.

The breeding pair populations of all major species, except lesser scaup, increased from 1973 to 1974. The total population increased by 42.1 percent during this period. Of the major species, mallards, pintails and blue-winged teal increased by about the same percentage as the total population. The increase in shovelers, 240 percent, was substantially greater while the increases in American wigeons and gadwalls, 6.3 and 18.8 percent, respectively, were less. The 1973 and 1974 breeding pair populations represented increases of 104 and 190 percent, respectively, over the population estimates reported by Gjersing (1971) for the 1970 breeding season.

The species composition of the waterfowl population (Table 2) fluctuated between 1973 and 1974, and between these years and the 1969-1970 average (Gjersing 1971). The largest fluctuations were evident in American wigeons, gadwalls and shovelers. The species diversity observed during 1973 and 1974 was greater than in 1970. The waterfowl breeding population was composed of seven species in 1970, while twelve species were represented in 1974.

Table 3 considers the use of different water types by breeding pairs. Retention and pit-retention reservoirs were the most attractive of the

TABLE 2. PERCENTAGE COMPOSITION, BY SPECIES, OF THE BREEDING PAIR POPULATION.

Species	1969-70 Ave.[1]	1973	1974
Mallard	15.0	12.1	11.9
Pintail	20.0	21.0	23.3
American Wigeon	23.0	25.3	18.9
Gadwall	10.0	16.8	14.1
Shoveler	13.0	5.2	12.6
Blue-winged Teal	15.0	11.6	11.9
Cinnamon Teal	--	1.1	0.7
Green-winged Teal	--	0.5	1.5
Lesser Scaup	6.0	6.3	4.4
Canvasback	--	0	0.4
Ruddy Duck	--	0	0.4

[1]Gjersing 1971:11

TABLE 3. DISTRIBUTION AND DENSITY OF BREEDING PAIRS ON DIFFERENT RESERVOIR TYPES.

Pasture	Retention	Pit-retention	Pit-pothole	Pit-creek	Pothole
			1973		
1	10 (1.03)[1]	0	0	0	0
2	52 (3.33)	2 (2.22)	0	0	0
3	19 (2.97)	3 (2.31)	0	0	0
4	40 (2.76)	0	0	0	0
5	21 (0.94)	0	0	0	0
Total	142 (2.01)	5 (2.27)	0	0	0
			1974		
1	50 (2.84)	7 (3.5)	13 (1.43)	0	31 (0.92)
2	47 (2.58)	3 (3.33)	5 (0.27)	0	7 (1.43)
3	18 (1.88)	8 (4.71)	0	0	0
4	33 (2.28)	0	14 (0.27)	0	0
5	32 (1.18)	0	0	2 (10.0)	0
Total	180 (2.07)	18 (3.91)	32 (0.40)	2 (5.0)	38 (0.98)

[1]Pair densities, as pairs/acre of water, are included in parentheses.

available water types. Smith (1953) found that waterfowl usage on stock-water reservoirs increased with increasing size of the reservoir. Uhlig (1963) reported that stable water conditions improve the attractiveness of stock-water reservoirs for waterfowl. Retention reservoirs, although smaller than many of the potholes present in 1974, were the largest of the artificial water areas and had the most stable water conditions. Gjersing (1971) also found that retention reservoirs on this study area supported the greatest densities of breeding pairs.

The importance of retention and pit-retention reservoirs was evident both in 1973, a dry year in which these reservoirs provided 98.6 percent of the available water area, and 1974, a wet year in which these same reservoir types constituted only 43.3 percent of the available water. While the total water area on the allotment increased by 186 percent, from 1973 to 1974, the water area contained in retention and pit-retention reservoirs increased by only 25 percent, from 72.7 to 91.7 acres. These observations support the general contention that stock-water reservoirs provide a comparatively stable habitat for breeding water fowl (Bue *et al.* 1964).

Retention reservoirs appear to have been the most attractive water type during 1973. Considering all reservoirs, pair densities were greatest on the pit-retention reservoirs. However, a comparison of the reservoirs within individual pastures indicates greater pair densi- on the retention reservoirs. Pit-retention reservoirs were the most

attractive during 1974. Pair densities within individual pastures were consistently greatest on this reservoir type. Comparing all reservoirs, pit-retention reservoirs also sustained the greatest pair density. The improved attractiveness of the pit-retention reservoirs during 1974 relates to changes in water conditions between years. At high water levels, the overflow margins of these reservoirs provided 64 percent of the total surface area included by this reservoir type during 1973. These margins were rapidly reduced with falling water levels. During 1974 the overflow margins provided 78 percent of the total surface area included in pit-retention reservoirs, and the margins were maintained for a longer period of time. The changes in pair use of pit-retention reservoirs, as related to water conditions, are consistent with the observations of Shearer (1960), Uhlig (1963), and Gjersing (1971). Pair densities on retention reservoirs remained about the same during both years.

The attractiveness of pit reservoirs to breeding pairs was strongly influenced by the condition of the associated water bodies. Pits constructed in potholes were not used by breeding pairs during 1973, a year in which the associated potholes were dry. These same reservoirs, including the associated potholes, comprised 38.1 percent of the available water area during 1974, and were used by 11.9 percent of the breeding pairs. Even with the ideal water conditions which existed during 1974, this reservoir type was not as attractive as the retention reservoirs.

Pits in creek bottoms were not used in 1973. The associated intermittent streams were dry during most of that summer. One of these reservoirs was used by two pairs in 1974. As the acreage of this reservoir does not include a correction for the area of the associated stream, the pair density figure for this reservoir exaggerates the importance of this reservoir type.

Because of their ephemeral nature, potholes were not included in the total water area for 1973. Even when present, potholes were not used by breeding pairs in that year. Potholes provided a minimum of 18.3 percent of the available water area during 1974, and sustained 14.1 percent of the breeding pairs. Pair densities were greater on potholes than on pits with their associated potholes, but less than on retention reservoirs. As potholes became overgrown with dense stands of emergent vegetation, they contained little open water by early summer. Furthermore, potholes tended toward a more circular form, consequently, the shoreline to surface area ratio was smaller than for retention reservoirs.

Broods

Brood production during both years of this study is depicted in Table 4. The number of resident broods increased by 62.4 percent from 1973 to 1974, a larger margin of increase than that observed for the breeding pairs. Including the transient broods, production increased by 50.4 percent.

TABLE 4. BROOD PRODUCTION ON THE MILK RIVER ASSOCIATION ALLOTMENT, 1973/1974.

Species	Pasture 1	2	3	4	5	Total
Mallard	1/3(1)[1]	4(2)/4(2)	3/1(1)	2(2)/2(2)	2/2	12(4)/12(6)
Pintail	3/11(2)	4(2)/6(1)	2(2)/1	5(1)/7	7/4(1)	21(5)/29(4)
American Wigeon	3/12	6/17(1)	3(2)/1(1)	11(2)/8	1(1)/2(1)	24(5)/40(3)
Gadwall	1/11(2)	4(1)/9(1)	2/0(1)	7(1)/5(1)	6/2(1)	20(2)/27(6)
Shoveler	1/3(1)	3(1)/6(1)	0/1(1)	2(2)/2(1)	2(1)/3	8(4)/15(4)
Blue-winged Teal	1(1)/10(1)	4/8(1)	2(3)/2	3(1)/4(1)	1/5(1)	11(5)/29(4)
Green-winged Teal	0/2	1/1	0/0	0/1	0/0	1/4
Lesser Scaup	0/1	2/1	1/0	0(1)/1	1/1	4(1)/4
Redhead	0/0	0/1	0/0	0/0	0/0	0/1
Ruddy Duck	0/2	0/1	0/0	0/0	0/0	0/3
Total	10(1)/55(7)	28(6)/54(7)	13(7)/6(4)	30(10)/30(5)	20(2)/19(4)	101(26)/164(27)

[1]Transient broods are included in the parentheses.

Of the major species, the percent increase in production was greater for blue-winged teal and shovelers, 163.6 and 87.5 respectively, than for the total population; the percent increase in American wigeon broods was similar; and pintails and gadwalls increased by a smaller percentage, 38.1 and 35.0, respectively. The number of resident broods of mallards and lesser scaups remained unchanged.

The 1973 and 1974 resident brood populations represented increases of 31.2 and 113.0 percent, respectively, over the 1970 population reported by Gjersing (1971). Including the transient broods, production increased by 44.3 and 117.0 percent, respectively. These figures are considerably less than the corresponding values for the pair population.

The only large change, from 1973 to 1974, in the species composition of the brood population was an increase in the proportion of blue-winged teal (Table 5). A comparison of the 1973 and 1974 species composition with the 1968-70 average (Gjersing 1971) suggests an increase in the proportion of American wigeons, gadwalls and lesser scaup, a decrease in mallards and shovelers and, as noted in the breeding pairs, an increase in the species diversity. The species composition of the brood population is similar to that observed in the pair population (Table 2), except for a smaller proportion of broods than pairs of mallards and a larger proportion of broods than pairs of American wigeons and blue-winged teal during 1974.

TABLE 5. RESIDENT BROOD PRODUCTION AND SPECIES COMPOSITION OF THE BROOD POPULATION ON THE MILK RIVER ASSOCIATION ALLOTMENT.

Species	1973		1974		1970[1]	1968-70 Ave.[1]
Mallard	12	11.9%	12	7.3%	11	19.0%
Pintail	21	20.8	29	17.7	17	20.0
American Wigeon	24	23.8	40	24.4	15	18.0
Gadwall	20	19.8	27	16.5	6	12.0
Shoveler	8	7.9	15	9.1	11	15.0
Blue-winged Teal	11	10.9	29	17.7	16	13.0
Green-winged Teal	1	1.0	4	2.4	0	0
Lesser Scaup	4	4.0	4	2.4	1	1.0
Redhead	0	0	1	0.6	0	0
Ruddy Duck	0	0	3	1.8	0	0
Total	101		164		77	

[1]Gjersing 1971:16

Broods were back-dated from the day of the first observation, using the mid-point of the assigned age-class (Gollop and Marshall 1954), to determine the approximate hatching date. The hatching dates of transient broods are included in these data. The cumulative hatch, by weekly intervals, is depicted in Figure 2, for all species combined, and for each of the major species. Hatching began during the fourth week in May both years. Thereafter, however, the progress of the 1974 hatch remained about two weeks later than that observed during 1973, throughout the hatching period.

The delay in the 1974 hatch appears to have resulted from the inclement weather during late May. The influence of this storm would have been to disrupt the nesting efforts of incubating mallards and pintails and to delay the initiation of the breeding season of the

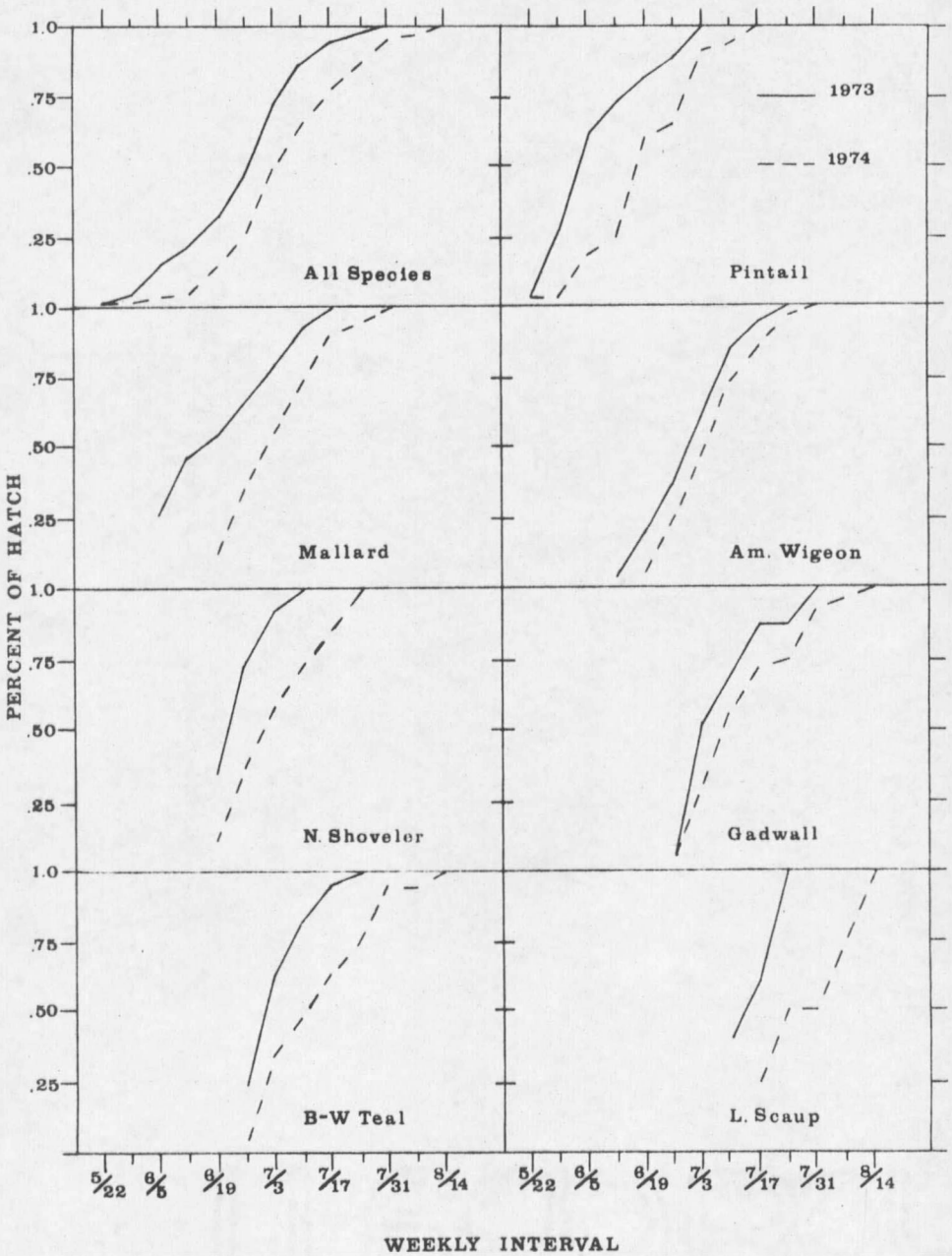


Figure 2. Cumulative percentage of the hatch by weekly intervals.

later nesting species. During late May the majority of the American wigeons would have been in either the pre-nesting or egg-laying phase. As such, the storm would not have effected a serious delay in the hatch of this species. Sowls (1955) suggested that cold weather may cause a cessation of pre-nesting activity and a delay in nesting. Yocum (1950) related delays in hatching peaks with cool, wet, spring weather. Keith (1961), however, was not able to determine any consistent relationships between nesting phenology and weather.

The frequency distribution of the hatch (Figure 3) indicates a distinct hatching peak during the first week in July for both years. This peak resulted from a peak in the hatch of American wigeons and the first appearance of broods of the later nesting species during both years. During 1974 this peak also included 18 and 26 percent of the mallard and pintail hatch, respectively.

Reproductive success was determined by comparing the number of broods observed, including transients, with the number of breeding pairs (Table 6). These data were similar during both years of this study, and high in comparison with other studies (Keith 1961; Smith 1971; and Stoudt 1971). High reproductive success on stock-water reservoirs is consistent with the observations of Bue *et al.* (1952), Smith (1953), and Gjersing (1971). Rundquist (1973) associated a high nest success in this type of habitat with low waterfowl densities.

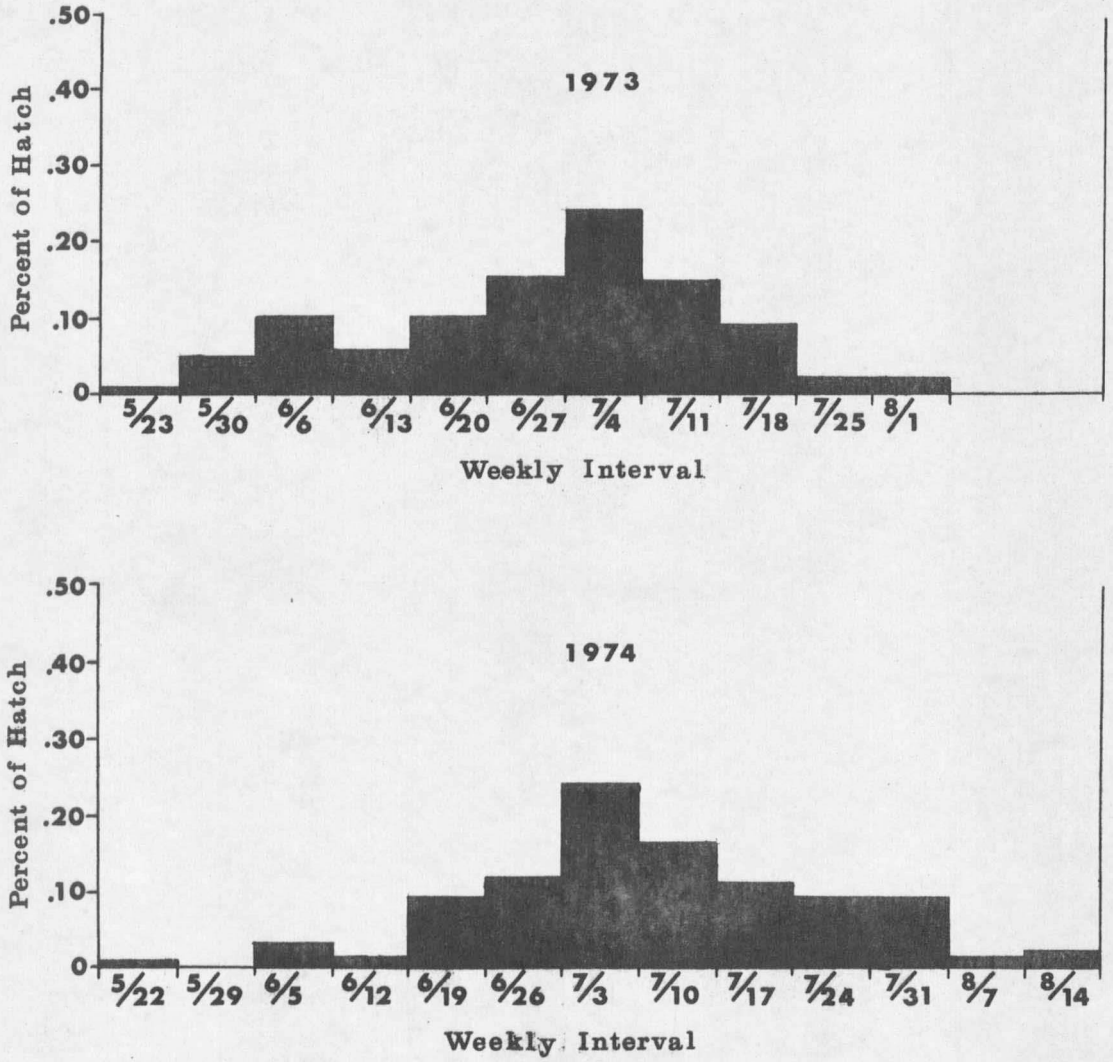


Figure 3. Frequency distribution of the hatch by weekly intervals.

TABLE 6. REPRODUCTIVE SUCCESS: TOTAL BROODS OBSERVED EXPRESSED AS A PERCENTAGE OF THE BREEDING PAIRS.

Species	1973	1974
Mallard	69.6	56.3
Pintail	65.0	52.4
American Wigeon	60.4	84.3
Gadwall	68.8	86.8
Shoveler	100.0	55.9
Blue-winged Teal[1]	66.7	97.0
Green-winged Teal	100.0	100.0
Lesser Scaup	41.7	33.3
Redhead	--	100.0
Ruddy Duck	--	100.0
Total	66.8	70.7

[1]Cinnamon teal pairs included in the estimate of blue-winged teal reproductive success.

Reproductive success was generally high for all species except the lesser scaup. Success of mallards, pintails and shovelers declined from 1973 to 1974. This relates, in part, to an incomplete pair census of these species during 1973. For mallards and pintails this might also reflect the influence of heavy nest losses incurred during late May 1974.

Fifteen nests were located during this study (Table 7). The poor success of these nests, 17 and 22 percent during 1973 and 1974, respectively, is not consistent with the generally high reproductive success. This discrepancy is, in part, a result of the small sample of nests. The three abandoned nests resulted from observer interference, as these nests were found when the hens were flushed from their nests

TABLE 7. DUCK NESTS LOCATED DURING THE STUDY.

Species	Distance to Water	Clutch Size	Fate	Vegetative Cover
			1973	
Mallard	20 yards	9	Successful	Silver sagebrush and Rose
Gadwall	20	0	Abandoned	Rose and Snowberry
Lesser Scaup	0	-	Depredated	Spike sedge
Lesser Scaup	2	6	Trampled	Sedge and Tufted hairgrass
Lesser Scaup	10	10	Depredated	Spike sedge and Tufted hairgrass
Lesser Scaup	23	7	Trampled	Bluegrass and Foxtail barley
			1974	
Pintail	250	8	Washed out	Curlcup gumweed
Mallard	20	10	Washed out	Fringed sagewort and Curlcup gumweed
Gadwall	50	2	Abandoned	Silver sagebrush and Crested wheatgrass
Cinnamon Teal	20	3	Abandoned	Western wheatgrass and Junegrass
Shoveler	130	9	Successful	Crested wheatgrass
Shoveler	40	8	Depredated	Western wheatgrass and Fringed sagewort
Pintail	500	8	Successful	Silver sagebrush and Needle-and-thread
Baldpate	400	8	Depredated	Fringed sagewort
Blue-winged Teal	35	9	Depredated	Crested wheatgrass and Silver sagebrush

early in the egg-laying stage. The two nests which were washed out are further evidence of the influence of the late May storm on the 1974 breeding season.

The location and fate of the four lesser scaup nests suggest that, compared with the puddle ducks, the nests of this species have a high vulnerability, associated with the scaup's more rigid nesting requirements. All of the scaup nests were found in riparian areas, a type of habitat which occupies a narrow margin along the shoreline of the reservoirs. The comparatively low reproductive success observed in this species probably resulted from this vulnerability.

Duckling mortality declined from 1973 to 1974 (Table 8). During 1973 mortality was evident in all age-classes, while most of the mortality occurred in class I broods during 1974. Consistent with higher mortality, transient broods represented a greater proportion of the brood observations during 1973, 20.5 percent as compared with 14.1 percent during 1974. Reduced security, related to low water levels and trampled shorelines, and observer disturbance associated with the marking program, may have been factors responsible for the higher proportion of transients and greater mortality during 1973.

The number of ducklings reared to flight more than doubled from 1973 to 1974 (Table 9). This increase resulted from more broods, a smaller proportion of transient broods, and a larger average brood size.

TABLE 8. PERCENT MORTALITY, BY SPECIES, OF DUCKLINGS IN RESIDENT BROODS.

Species	1973	1974
Mallard	16.2	2.5
Pintail	10.4	2.7
American Wigeon	22.5	17.4
Gadwall	12.0	9.5
Shoveler	20.7	8.3
Blue-winged Teal	31.7	13.9
Green-winged Teal	0	3.4
Lesser Scaup	7.7	5.3
Redhead	--	0
Ruddy Duck	--	0
Total	17.3	10.2

TABLE 9. AVERAGE BROOD SIZE AND NUMBER OF DUCKLINGS REARED TO FLIGHT.

Species	1973		1974	
	Brood Size	Ducklings	Brood Size	Ducklings
Mallard	5.2	62	7.0	84
Pintail	2.9	60	4.0	117
American Wigeon	3.9	93	5.1	205
Gadwall	6.6	132	5.6	152
Shoveler	2.9	23	5.1	77
Blue-winged Teal	3.9	43	7.0	204
Green-winged Teal	3.0	3	7.0	28
Lesser Scaup	6.0	24	4.5	18
Redhead	--	--	3.0	3
Ruddy Duck	--	--	5.7	17
Total	4.4	440	5.5	905

The distribution and density of resident broods by water types indicate that retention reservoirs provided the most attractive brood rearing habitat (Table 10). Smith (1953) found more broods on the

TABLE 10. DISTRIBUTION AND DENSITY OF RESIDENT BROODS ON DIFFERENT RESERVOIR TYPES.

Pasture	Retention	Pit-retention	Pit-pothole	Pit-creek	Pothole
			1973		
1	10 (1.03)[1]	0	0	0	0
2	28 (1.59)	0	0	0	0
3	13 (2.03)	0	0	0	0
4	30 (2.07)	0	0	0	0
5	20 (0.90)	0	0	0	0
Total	101 (1.43)	0	0	0	0
			1974		
1	51 (2.90)	4 (2.00)	0	0	0
2	44 (2.42)	5 (5.55)	3 (0.16)	0	2 (0.41)
3	5 (0.52)	1 (0.59)	0	0	0
4	21 (1.45)	0	9 (0.17)	0	0
5	19 (0.70)	0	0	0	0
Total	140 (1.61)	10 (2.17)	12 (0.15)	0	2 (0.05)

[1]Brood density, as broods per acre of water, in parentheses.

larger reservoirs. Berg (1956) further noted that the presence of emergent vegetation and stable water levels contributed to increased brood numbers. Gjersing (1971) found that reservoir depths influenced brood usage, with brood numbers increasing on those reservoirs with greater areas of shallow water. That retention reservoirs were the most important brood rearing areas is consistent with these observations.

Pit-retention reservoirs provided brood habitat only during the high water conditions which existed during 1974. Pits constructed in potholes were not used in 1973. Pits used by broods during 1974 were located in potholes which held water through the summer. Pits in creek bottoms were not used by resident broods during either year. Potholes generally did not provide brood habitat. Few potholes contained water during the 1973 brood rearing season, while most potholes were overgrown with emergent vegetation by the time the first broods appeared in 1974. The one pothole which did support broods during 1974 contained an area of open water through the summer.

Instances of movement by unmarked broods were recorded during both years of the study. Identification of individual broods was based on species, age-class and size. Brood movements that were not directly related to observer interference were consistent with the patterns observed by Berg (1956), i.e., toward larger reservoirs characterized by stable water levels and emergent vegetation. None of the movements observed could be solely related to concentrations of cattle at the

reservoirs. During 1974 cattle concentrations at individual reservoirs were not severe until late summer, as the cattle were well dispersed until that time. Concentrations of cattle were typical by mid-July, 1973. During that year, however, trapping was an additional source of disturbance.

The Influence of the Grazing Formula

The Grazing Formula

Rest-rotation is a grazing system which incorporates rest "to allow the grazed plants to recover vigor, produce seed, and establish new production. The timing and duration of rest is based on the growth requirements of the key forage species on the range" (Hormay and Talbot 1961:40). The allotment is divided into pastures, with each pasture receiving a different treatment during each grazing season. "The general form of rest-rotation grazing.... consists of four basic steps in the following sequence: (1) Graze the range for maximum livestock production (GL); (2) Rest the range until plant vigor is restored (RV); (3) Rest the range until seed ripens, then graze for maximum livestock production (RS); and (4) Rest the range until reproduction becomes firmly established (RR)" (Hormay and Talbot 1961:32). Under this generalized scheme, the pastures receiving the RV and RR treatments are not grazed during the current season.

The original grazing formula applied to the Milk River Association Allotment was modified in 1968 to alter the sequence of treatments.

Additional amendments were made in 1970 and 1973, which consisted of closing the gates behind the cattle after completion of each treatment. The basic grazing formula in effect from 1967 through 1973 consisted of the following treatments:

Gc - Graze with cows until the breeding season is completed, approximately 30 June, and then open the gates between this pasture and the pasture receiving the following treatment. Graze through 31 August.

Gs - Graze with steers until the breeding season is completed, and then cows and steers may intermingle. Graze through 31 August.

RV - Rest for vigor and then graze. Gates into this pasture are opened on 20 July. Graze through the end of the season.

RS - Rest for seed production and then graze for seed trample. This pasture is grazed from approximately 25 August through the end of the season.

RR - Complete rest.

A final revision of the formula was made in 1974, to accomodate artificial breeding on the allotment. This formula employs four treatments:

G - Graze for maximum livestock production, 1 May through 10 July.

RV - Rest for vigor and then graze, 1 June through 31 October.

RS - Rest for seed production and then graze for seed trample, 15 August through 31 October.

RR - Complete rest.

Under this formula, two pastures receive the RV treatment during a given year. Separate herds are maintained on these pastures through

completion of the breeding season and then the gates between them are opened. During some years, e.g. 1974, artificial breeding is conducted in Unit B. In this case, the second RV pasture is deferred until 1 July. In some years it may be necessary to herd all of the cattle into the pasture receiving the RS treatment for a brief period, to insure an adequate seed trample.

Green needlegrass is the key forage species on which this formula is based. Consideration is also made for needle-and-thread and western wheatgrass.

A summary of the grazing history on the allotment from 1967 through 1974 is included in Appendix Tables 27 and 28. During this period the actual use ranged from 3,953 to 5,396 animal-unit-months (AUM), per grazing year. Estimates of the actual use, by pasture and year, are included in Appendix Table 29. These values were derived from summaries of the grazing season and/or grazing formula and the actual use figures reported by the ranchers.

The grazing formula, demonstrating periods of use, is diagrammed in Figure 4. This diagram represents both the application of the grazing formula to all of the pastures in the allotment during a single year, and the sequential application of the treatments to the individual pastures through the five-year cycle of the formula.

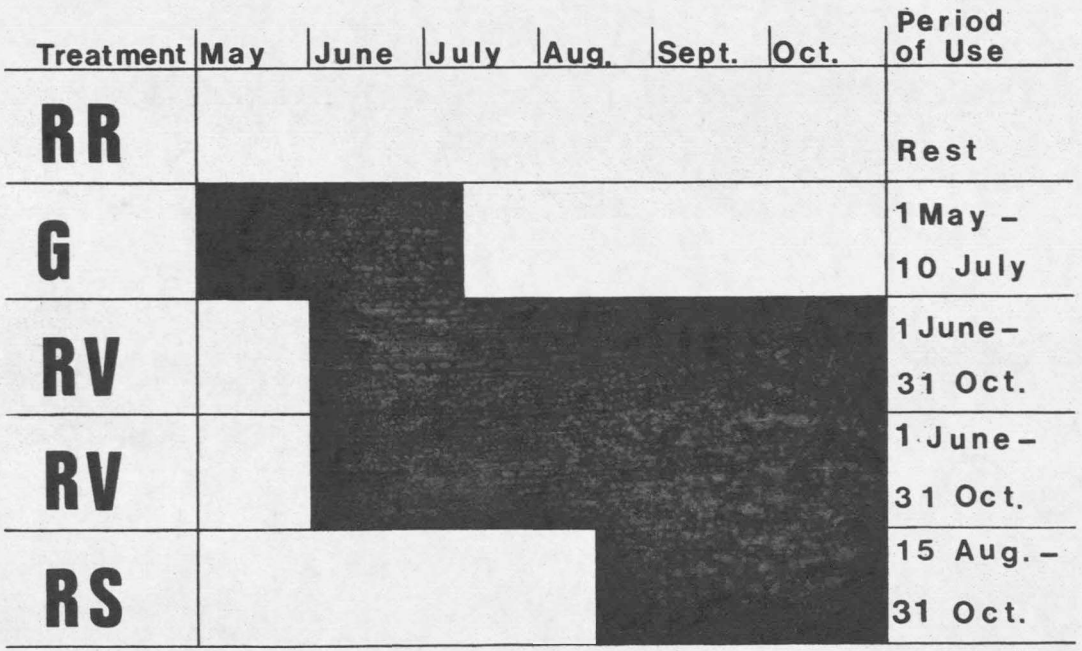


Figure 4. Diagram of the grazing formula in effect during 1974.

Vegetation Responses

The line intercept transects indicated an increase in the canopy coverage of the three shrub types from 1968 to 1970 (Table 11). The canopy coverage of silver sagebrush and Nuttall saltbush declined from that time to 1974. However, the canopy coverage of these species was still greater in 1974 than when the transects were first established in 1968. As the rose transect could not be relocated, no data are available for 1974.

TABLE 11. CHANGE IN THE CANOPY COVERAGE OF SHRUBS ON ONE LINE INTERCEPT AND THE NUMBER OF PLANTS OF "KEY" GRASS SPECIES IN TEN SQUARE FOOT PLOTS IN EACH OF THREE SHRUB TYPES, 1968-1974.

Shrub Type	Percent Canopy Coverage 1968/70/74	Number of Plants in Ten Square Foot Plots at Ten Foot Intervals, 1968/70/74		
		Agropyron smithii	*Stipa comata*	*Stipa viridula*
Artemisia cana	14.4/18.0/16.7	114/97/189	29/79/59	1/0/1
Atriplex nuttalii	0.4/0.8/0.7	58/77/195		
Rosa spp.	5.1/6.0			5/45

The number of western wheatgrass plants counted on the silver sagebrush transect declined from 1968 to 1970, but increased from 1970 to 1974. This species increased during both periods on the Nuttall saltbush transect. The number of needle-and-thread plants increased from 1968 to 1970, but decreased from 1970 to 1974 on the silver sagebrush transect. This species was not found on the other transects. Green needlegrass increased from 1968 to 1970 on the rose transect.

This species occurred as a trace on the silver sagebrush transect.

These data suggest a positive response in the vegetation to rest-totation management. The data for silver sagebrush and Nuttall saltbush also indicate that these species made stronger responses during years of lower cattle stocking rates.

The canopy coverage of the total vegetation within three-inch height classes on the representative shoreline and upland transects during 1974 is included in Table 12. The spring data provide an indication of the residual vegetation accumulated during 1973, while the fall data represent that accumulated during 1974. The primary comparisons to be made are changes which occurred on the individual transects. Comparisons between pastures should be made with caution, recognizing that a portion of the variation is due to species composition and site factors. These limitations particularly apply to the upland transects.

The shoreline transect in Pasture 1 indicated that maximum canopy coverage on this transect was developed by the end of June. Canopy coverage on this transect was maintained through July. A reduction in the vegetation was evident by the end of August and a considerable reduction in the shoreline vegetation had occurred by the end of October. As such, the canopy coverage of the vegetation on this shoreline was similar prior to and following the 1974 grazing season. The vegetation on the upland transect in Pasture 1 followed this same trend. However,

TABLE 12. PERCENT CANOPY COVERAGE OF THE TOTAL VEGETATION WITHIN THREE-INCH HEIGHT CLASSES ON FIVE SETS OF SHORELINE AND UPLAND TRANSECTS, 1974.

Date	SHORELINE Class 0-3	3-6	6-9	9-12	12+	Date	UPLAND Class 0-3	3-6	6-9	9-12	12+
					Pasture 1						
4/8	82	6	0	0	0	4/8	70	12	4	1	0
6/29	90	81	56	45	30	7/29	66	36	20	9	3
10/30	90	9	2	tr	tr	10/30	73	22	8	2	tr
					Pasture 2						
4/6	95	29	12	3	2	4/6	90	16	5	2	tr
6/28	97	94	79	62	40	6/28	90	46	23	16	7
10/30	90	10	1	tr	tr	10/30	93	20	8	4	2
					Pasture 3						
4/5	94	76	50	27	6	4/5	77	16	3	1	tr
5/25	87	66	29	7	1	---	--	--	--	--	--
10/30	95	81	64	47	23	10/30	75	33	16	7	2
					Pasture 4						
4/6	89	11	4	1	tr	4/6	69	4	1	tr	0
10/31	97	87	73	63	47	10/31	80	32	19	11	5
					Pasture 5						
4/9	78	3	1	1	0	4/9	62	14	4	2	tr
8/27	87	60	38	25	16	7/31	61	25	13	4	1
10/31	75	20	5	1	tr	10/31	64	25	11	4	tr

the maximum canopy coverage was not developed until the end of July and the changes between sampling periods were not as dramatic as those recorded on the shoreline. Pasture 1 was grazed from 1 June through 18 July, 1973, and from 15 July through 31 October, 1974. Apparently little regrowth occurred on these transects following grazing during 1973. This would relate to a dry summer and severe concentrations of cattle around reservoirs with water during the 1973 grazing period. Consequently, a greater potential for regrowth existed in the vicinity of the dry reservoirs in this pasture.

The maximum canopy coverage of the vegetation on both the shoreline and upland transects in Pasture 2 was recorded during late June. Canopy coverage on both transects declined through July, increased slightly through August, and declined again during October. The canopy coverage on the shoreline transect was less following the 1974 grazing season than the 1973 season, although the vegetation on the upland transect improved slightly through the 1974 season. Pasture 2 was grazed lightly during May and June, and heavily during October, 1973, and lightly during June, and heavily from 1 July through 15 August, and during October, 1974. Regrowth in the vegetation was evident following the relief from grazing in 1974. Why late season grazing was more influential on this shoreline transect during 1974 than 1973 cannot be fully explained. There were indications of greater concentrations of cattle on this transect during fall, 1974.

The canopy coverage on both transects in Pasture 3 declined between the April and May sampling periods, and improved thereafter. Pasture 3 was rested during 1973 and grazed during May and June, 1974. An additional transect was established in this pasture to consider the potential for regrowth following relief from grazing (Table 13). A site

TABLE 13. CHANGES IN THE PERCENT CANOPY COVERAGE OF THE VEGETATIVE CLASSES, MAJOR GRASS SPECIES, AND IN THE TOTAL VEGETATION WITHIN THREE-INCH HEIGHT CLASSES FOLLOWING RELIEF FROM GRAZING ON A TRANSECT IN PASTURE 3.

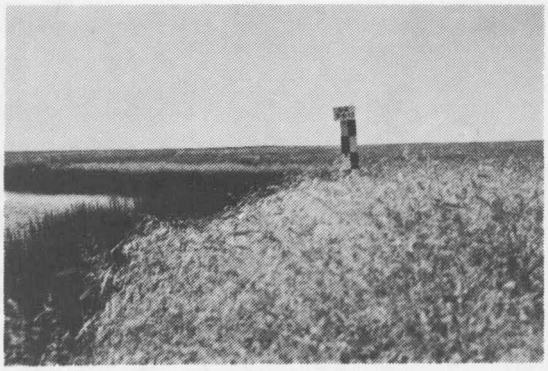
	Date	
	7/17/74	9/3/74
Vegetation Class:		
Bare ground	15	11
Grass	62	74
Forbs	26	29
Selaginella densa	38	62
Lichens	2	2
Standing litter	2	3
Lodged litter	8	11
Species:		
Bouteloua gracilis	50	55
Agropyron smithii	11	21
Stipa comata	10	16
Height Classes:		
0-3	83	93
3-6	24	44
6-9	8	21
9-12	3	10
12+	1	3

was selected which showed evidence of grazing just prior to the removal of cattle from this pasture. The canopy coverage in each of the height

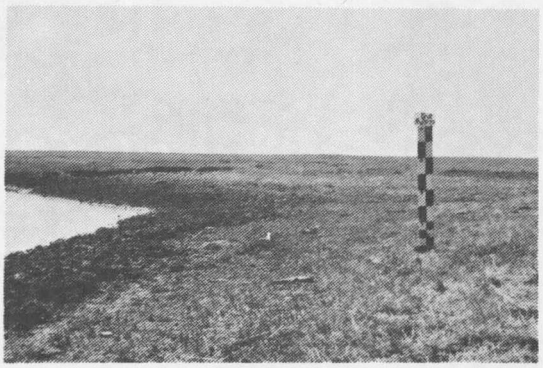
classes increased between samples. Of interest also is the increased canopy coverage of the three major grass species on this transect.

Both transects in Pasture 4 indicated a continuous improvement in the canopy coverage through the 1974 grazing season. Pasture 4 was grazed from late July through the end of October, 1973, and rested completely during 1974. By the end of October a slight decline in the canopy coverage within the taller height classes was evident. This apparently resulted from lodging of the vegetation.

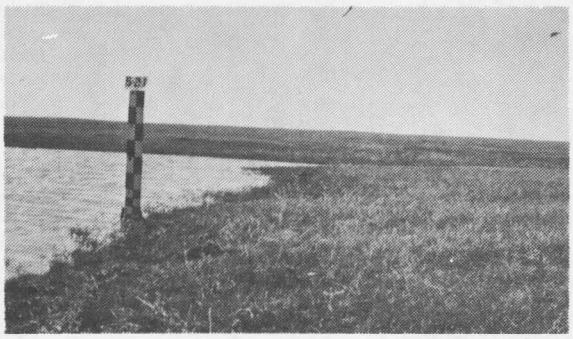
Pasture 5 was grazed from mid-July through 31 August, 1973, and from mid-August through the end of October, 1974. The maximum canopy coverage on the shoreline transect in this pasture was recorded during the August sampling period, shortly after the cattle were turned into this pasture. The vegetation on this transect declined considerably thereafter. The total canopy coverage within each height class was similar, prior to and following the 1974 grazing season. The major difference between these sampling periods was an increase in the canopy coverage of lodged litter from a trace to 40 percent. This shoreline was grazed heavily during 1973, while the major influence of cattle during 1974 was trampling. The vegetation on the upland transect in this pasture shows minor changes through the 1974 grazing season. The largest changes occurred in the lower height classes. Figure 5 presents a sequence of photographs taken on one of the shoreline photoplots in Pasture 5, representing the condition prior to and following grazing



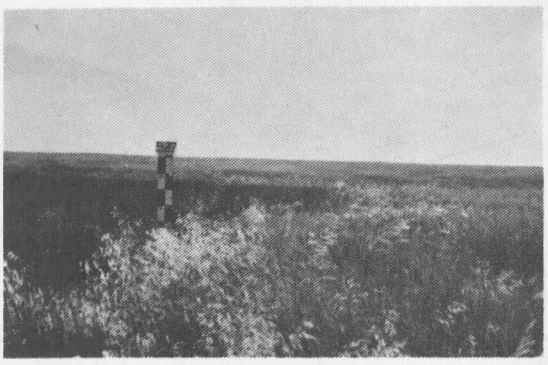
4 July 73



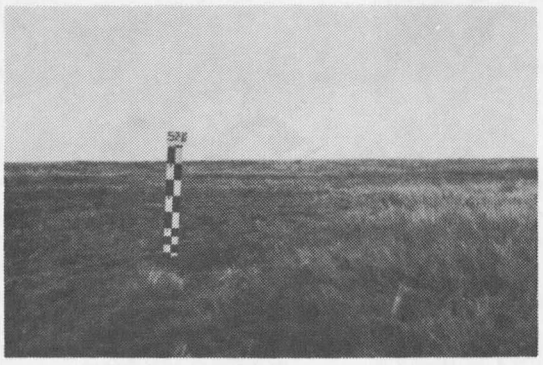
28 Aug 73



24 April 74



22 Aug 74



31 Oct 74

Figure 5. Photoplots on Reservoir 5-2 prior to and following grazing during 1973, prior to "green-up" during 1974, and prior to and following grazing during 1974.

during both years.

The shoreline transects recorded during 1973 follow the same trend as those discussed for pastures subjected to late season grazing during 1974, i.e., a decline in the canopy coverage of the shoreline vegetation during the grazing period (Table 14). The major difference between years was the rapid decline in the canopy coverage of the vegetation during 1973. Large concentrations of cattle were evident earlier in the grazing season during 1973. During 1974 there was a greater availability of water, and green forage was available on the upland for a longer period of time. Declines in the canopy coverage of the shoreline vegetation on these transects during 1973 resulted both from grazing and trampling, while trampling appeared to be more influential during 1974.

TABLE 14. PERCENT CANOPY COVERAGE OF THE TOTAL VEGETATION WITHIN THREE-INCH HEIGHT CLASSES ON TWO SHORELINE TRANSECTS, 1973.

Date	Pasture 4			Pasture 5		
	7/31	8/14	8/28	7/6	7/18	8/2
Class:						
0-3	76	72	56	85	83	69
3-6	57	4	tr	79	45	15
6-9	50	tr	0	59	36	5
9-12	37	0	0	50	24	3
12+	18	0	0	44	16	1

The data from these transects indicate that the greatest potential for the accumulation of residual vegetation, both on the reservoir

shorelines and on upland sites, occurs in the pastures receiving the RR and G treatments. Regrowth, following relief from grazing, does contribute to the accumulation of residual vegetation in the G pasture. New growth, both on shorelines and upland sites, accumulates most rapidly in those pastures deferred from early grazing during the current season.

From the fifteen nests located during this study it is apparent that a variety of plant species provided suitable nesting cover (Table 7). Silver sagebrush, rose, snowberry, fringed sagewort and bunch grasses were the primary cover species used by puddle ducks at upland and coulee nesting sites. Sedges, tufted hairgrass, foxtail barley and bluegrass were the important cover species used by lesser scaup at nests located in riparian areas.

Vegetation around seven of the nests found during 1974 was analyzed to compare the cover at the nest with that in the stand in which the nest was located (Fig. 6). Females selected the densest vegetation within the stand for the location of their nests. This observation and the variety of species found suggest that the structure of the vegetation, rather than species, is important in the selection of a nest site. Keith (1961) found that while different cover types afford different concealment values, ducks tend to select vegetation within different types that provide the same degree of concealment.

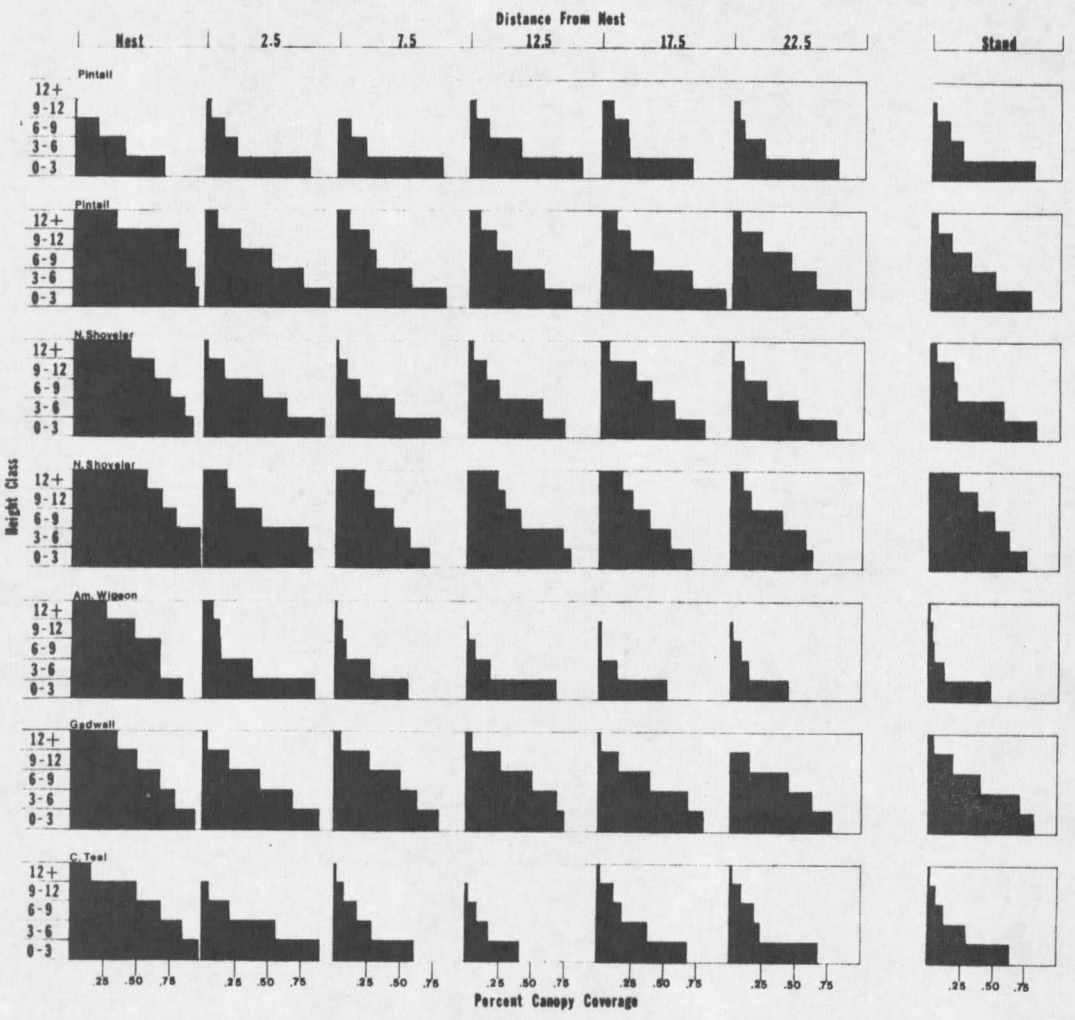


Figure 6. Percent canopy coverage of the total vegetation within three-inch height classes at seven nest sites, at five-foot intervals from 2.5 to 22.5 feet from these nests, and in the general stand in which these nests were located.

The selection of a nest site appears to be related not only to the presence of adequate cover for the nest itself, but also to the concealment value of the vegetation which surrounds the nest. A distinct gradient is evident in the vegetation associated with the American wigeon and cinnamon teal nests, the cover becoming denser, closer to the nest. For the remaining nests this gradient is less obvious in the taller height classes, although apparent in the lower. The vegetation associated with these nests was of a high concealment value, while it was poor at the American wigeon and teal nests. The first pintail nest appears to be a contradiction. This nest was initiated prior to spring green-up, but it was not found until after new growth had appeared.

Residual vegetation is particularly important for early nesting mallards and pintails (Keith 1961). Standing litter was the primary source of cover at the first pintail nest and at five of the six nests initiated after new growth was available for nesting cover (Table 15).

TABLE 15. PERCENT CANOPY COVERAGE OF STANDING LITTER AT SEVEN DUCK NEST SITES.

Species	Nest	Stand	Chi-square	Date
Pintail	35.0	11.3	47.632	1 May 1974
Pintail	37.5	9.0	87.111	19 June 1974
Shoveler	20.6	1.3	271.877	20 June 1974
Shoveler	8.8	2.5	13.456	17 July 1974
Gadwall	26.3	9.1	30.647	8 June 1974
Cinnamon Teal	2.5	3.3	0.512	12 June 1974
Baldpate	8.8	3.6	6.136	19 June 1974

Standing litter had a canopy coverage significantly greater ($P<0.05$) at six of the seven nests than in the stands in which these nests were located.

Waterfowl Responses

Changes in the distribution of breeding pairs and broods, between years, are evident from Tables 1 and 4. The distribution of breeding pairs and broods by pasture, expressed as percentages of the total pair and brood populations, is defined by Table 16. This table also considers the distribution of water on the same basis. Table 17 depicts the change in the relative proportion of pairs, broods, and water between years. While the distribution of breeding pairs and broods was influenced by the distribution of water, the observed changes in the waterfowl distribution cannot be explained solely on that basis.

The largest change, both in pairs and broods, occurred in Pasture 1. The pair density and proportions of pairs and broods sustained in this pasture also increased. Much of the increase in pair and brood use that occurred in this pasture resulted from the improved water conditions. However, pair and brood use both increased out of proportion to the increase in water area.

Pasture 1 was grazed from 29 April through 31 August, 1972 (Appendix Table 28). The actual use (Appendix Table 29) represented 26 percent of the total grazing pressure sustained by the allotment that year. As the entire allotment was heavily grazed, it would be difficult

TABLE 16. DISTRIBUTION OF BREEDING PAIRS, RESIDENT BROODS AND WATER AREA.

Pasture	Pairs	% of Total	Pairs/ Acre	Broods	% of Total	Broods/ Acre	Water Acres	% of Total
				1973				
1	10	6.7	1.03	10	9.9	1.03	9.7	13.2
2	56	37.3	2.96	28	27.7	1.48	18.9	25.6
3	22	14.7	2.86	13	12.9	1.69	7.7	10.4
4	41	27.3	2.75	30	29.7	2.01	14.9	20.2
5	21	14.0	0.93	20	19.8	0.89	22.5	30.5
Total	150[1]		2.04	101		1.37	73.7	
				1974				
1	101	37.4	1.62	55	33.5	0.88	62.4	29.6
2	62	23.0	1.45	54	32.9	1.26	42.8	20.3
3	26	9.6	2.41	6	3.7	0.56	10.8	5.1
4	47	17.4	0.70	30	18.3	0.45	67.2	31.9
5	34	12.6	1.24	19	11.6	0.69	27.4	13.0
Total	270		1.28	164		0.78	210.6	

[1]1973 breeding pairs and pair densities do not include a correction for pintails.

TABLE 17. INDICES OF CHANGE IN THE PROPORTION OF BREEDING PAIRS, RESIDENT BROODS AND WATER AREA, RELATIVE TO THE ALLOTMENT TOTALS, FROM 1973 TO 1974.

Pasture	Change in Pairs	Change in Broods	Change in Water Area
1	+ 4.58	+ 2.28	+ 1.24
2	- 0.38	+ 0.19	- 0.21
3	- 0.35	- 0.71	- 0.51
4	- 0.36	- 0.38	+ 0.57
5	- 0.10	- 0.41	- 0.57

to conclude that waterfowl benefits accrued in any of the pastures grazed during 1972. Pasture 1 was grazed from 1 June through 18 July, 1973. Grazing during this period represented a potential conflict between cattle and waterfowl. This conflict was intensified by the poor water conditions, which tended to concentrate the cattle around the available water. Cattle concentration was further effected by the inclusion of the artificial breeding program in this pasture. The influence of heavy grazing during 1972 and cattle disturbance during the 1973 breeding season are reflected in the small proportion of broods and pairs assigned to Pasture 1 during 1973. Removal of the cattle from this pasture by mid-July provided some opportunity for vegetative regrowth, particularly on sites subjected to lighter grazing during the period of use. Resulting waterfowl benefits were available during 1974, as this pasture was deferred from grazing until 15 July. The improved attractiveness of this pasture is reflected in the 1974 distribution of waterfowl.

The breeding pair population in Pasture 2 increased by 11 percent, broods by 93 percent, and water area by 126 percent, from 1973 to 1974 (Table 16). The proportion of broods assigned to this pasture increased, while the proportion of pairs and water area decreased. The proportion of breeding pairs decreased by a larger margin than did the water area (Table 17). The breeding pair density in pasture 2 declined by 51 percent.

The decline in the breeding pair density in Pasture 2 can be related to the amount of water contained by the less attractive water areas during 1974. However, this change is also predictable from the grazing formula. Pasture 2 was rested during the 1972 grazing season. This pasture was lightly grazed during May and June, and heavily grazed in October, 1973. The breeding pair density, 2.96 pairs per acre of water, was the highest recorded on the allotment in 1973. Although changes in the distribution of breeding pairs, associated with early season grazing in Pasture 2, were not detected, this influence is suggested by the occurrence of a smaller proportion of broods than pairs in this pasture during 1973. The influence of late season grazing during 1973 is reflected in the reduced attractiveness of this pasture to breeding pairs during 1974. A larger proportion of broods than pairs in Pasture 2 during 1974 probably relates more to the availability of retention reservoirs in this pasture than to the influence of the grazing formula. However, this pasture was deferred until 1 June and not grazed heavily until 1 July, 1974. Deferred

grazing may also have contributed to the larger proportion of broods, as heavy grazing in areas adjacent to the reservoirs was not apparent until August.

Both the breeding pair population and water area in Pasture 3 increased from 1973 to 1974, although the number of resident broods declined (Table 16). The relative proportion of each declined. The proportion of the total water area in this pasture declined by a larger margin than did the proportion of pairs (Table 17). This information suggests that the decline in the density of breeding pairs observed in this pasture relates more to the availability of water in other pastures than to an overall decline in the attractiveness of Pasture 3 for pairs during 1974.

Pasture 3 was grazed during September and October, 1972. Although late season grazing is indicated to have negative effects on the use of a pasture by waterfowl during the following season, only 17 percent of the grazing pressure on the allotment was sustained by Pasture 3 during the 1973 grazing season, a year in which the total use was heavy. Due to this light use, as compared to the grazing pressure incurred by other pastures during 1972, Pasture 3 was more attractive to waterfowl during 1973 than might be predicted from the 1972 grazing formula. Pasture 3 was rested during 1973. As such, it was anticipated that this pasture would be attractive during 1974. The greatest pair density, 2.41 pairs per acre of water, was observed in this pasture

during that year. That a more pronounced change was not observed probably relates to the small increase in water area in this pasture, compared with other pastures and the allotment. Although Pasture 3 was attractive to pairs during 1974, its full potential was not realized. A redistribution of pairs, away from Pasture 3, was evident by early June. A decline in the attractiveness of this pasture is further evidenced by the decline in the proportion of broods observed in this pasture. Pasture 3 was grazed during May and June, 1974. Although grazing intensity was not heavy, the waterfowl apparently responded to this disturbance.

In Pasture 4 the breeding pair population increased slightly, the number of resident broods remained unchanged and the total water area increased by 351 percent from 1973 to 1974 (Table 16). The proportion of the total water area included by this pasture increased, however, the proportion of total pairs and broods declined. The breeding pair density declined by 75 percent. The decreased pair density observed in Pasture 4 during 1974 is partially related to the increase in water area provided by two pit reservoirs. However, the pair density on the retention reservoirs in this pasture also declined (Table 3). This information suggests that Pasture 4 was not as attractive during 1974, compared with its use in 1973.

Pasture 4 was grazed from mid-July through the end of October in both 1972 and 1973. That late season grazing in 1972 was less

influential on the subsequent waterfowl breeding season than the same treatment during 1973, relates to the grazing intensity incurred by this pasture during those years. Twenty-four percent (1312 AUM) of the total 1972 grazing use, 5396 AUM, occurred in Pasture 4. In 1973 the grazing pressure increased to 36 percent (1490 AUM), while the total use, 4146 AUM, declined. Pasture 4 was rested during 1974. A redistribution of pairs into this pasture during the latter phases of the 1974 breeding season was evident. The decline in the proportion of broods in 1974 follows the decline in the proportion of pairs. That the proportion of broods did not decline by a larger margin relates to the redistribution of pairs into this pasture. Half of the broods assigned to Pasture 4 hatched after mid-July.

Pairs and water area in Pasture 5 increased from 1973 to 1974, although the number of resident broods remained unchanged (Table 16). The increase in pair density and the changes in the proportion of pairs and water in this pasture indicate that the increase in pair use was greater than what might be predicted from the changes in water conditions alone (Table 17).

Pasture 5 was grazed from 1 May through 31 August, 1972, and received the heaviest grazing pressure on the allotment during that year. This pasture was grazed from 10 July through 31 August, 1973, incurring the lightest grazing pressure that year. While neither of these grazing treatments was beneficial to waterfowl during the subsequent year, the

prolonged, heavy grazing pressure, sustained during 1972, appears to have been the more detrimental. That a greater proportion of broods than pairs was assigned to Pasture 5 during 1973, and that many of these were late broods, suggest a redistribution of breeding pairs into this pasture, associated with deferred grazing. Pasture 5 was deferred until 15 August, 1974. A redistribution of late breeding pairs was also indicated that year. However, this is not reflected in the number of broods, as the proportions of total pairs and broods were similar. As in Pasture 4, a disproportionate number of late hatching broods was evident in this pasture.

The large increases in breeding pairs and resident broods on the entire allotment, from 1973 to 1974, is easily attributed to changes in the water conditions. However, water conditions did not influence the differences observed between the 1970 (Gjersing 1971) and 1973 waterfowl breeding seasons, because conditions were similar during both years. The increases in the pair and brood populations between 1970 and 1973 suggest that rest-rotation grazing, despite deviations from the formula, did contribute to an overall improvement of this allotment as habitat for waterfowl.

Marked Birds

The primary purpose of the bird marking program was to compare the reservoirs on which individual ducks were trapped in 1973 with those used during the 1974 breeding season, and to correlate this

information with the grazing formula. This approach assumes that the returning birds will home precisely to their natal pond, and that any subsequent relocation is related to the vegetative quality of the individual reservoirs concerned.

The major species nesting on the study area are considered to be the most adaptable of waterfowl. This adaptability implies plasticity in the homing response and is related in part to acceptance of a broad spectrum of breeding habitat. As such, these species pioneer rapidly (Hochbaum 1946). The homing instinct in waterfowl is reinforced by a previous successful nesting effort. As this study dealt primarily with first year breeders of the more adaptable species, the criterion of precise homing to the natal pond was not fully met.

One hundred and sixty-six ducks were equipped with nasal saddles (Table 18). An additional 43 ducks were leg-banded but not marked. This group included ducklings judged to be too young to hold the marker, and males of species for which there was a limited number of saddles.

Movements of marked birds were recorded during 1973. While some of these movements might be related to cattle disturbance, the influence of cattle on brood movements was obscured by other factors.

Observations were obtained for several ducks, both prior to and following their first flights. These indicated an affinity for the natal pond prior to the first migrational flight. However, the

TABLE 18. TABULATION OF MARKED BIRDS BY SEX AND SPECIES.

Species	Adult Female	Juvenile Female	Juvenile Male	Marked	Banded[1]	Total
Mallard	0	11	27	38	0	38
Pintail	1	21	7	29	1	30
American Wigeon	0	19	8	27	22	49
Gadwall	0	8	7	15	3	18
Shoveler	0	10	10	20	2	22
Blue-winged Teal	4	19	8	31	15	46
Lesser Scaup	1	3	2	6	0	6
Total	6	91	69	166	43	209

[1]Birds banded but not marked.

activity radius of individual ducks increased with increased flight experience.

Table 19 includes the fate of marked birds. A minimum of 118 marked ducks were reared to flight. Included in this group are the adult females for which observations were obtained, subsequent to marking. The unknown 1 category includes those birds which were not observed after they were marked. Birds assigned to the unknown 2 category are presumed to have died prior to attaining flight. Ducks in this group disappeared after one or more observations, while continued observations were made of their brood-mates. Definitive evidence was used in assigning birds to the dead category.

Direct recoveries were obtained from five marked ducks; none were obtained from the banded but unmarked sample. Although small, the sample of direct recoveries suggests that the study area provides

TABLE 19. FATE OF MARKED BIRDS.

Species	Flight	Unknown 1[1]	Unknown 2[2]	Dead	Direct Recovery	1974 Return
Mallard F	8	2	0	1	0	2
M	17	7	0	3	1	0
Pintail F	17	5	0	0	2	0
M	4	2	0	1	0	0
American Wigeon F	16	0	2	1	2	3
M	8	0	0	0	0	1
Gadwall F	5	2	1	0	0	0
M	7	0	0	0	0	0
Shoveler F	7	3	0	0	0	1
M	5	4	0	1	0	0
Blue-winged Teal F	13	4	4	2	0	1[3]
M	6	0	2	0	0	0
Lesser Scaup F	3	1	0	0	0	0
M	2	0	0	0	0	0
Total	118	30	9	9	5	8

[1]Unknown 1 includes birds whose fate is not known.
[2]Unknown 2 includes birds whose fate is not known, but are presumed to have died.
[3]Adult blue-winged teal female.

breeding habitat for waterfowl from the three western-most flyways (Table 20). This suggestion is consistent with Bellrose's (1972) migration corridors, as defined for mallards.

Eight marked birds were observed on the study area during 1974. This figure represents a return of 6.8 percent of the ducks known to have attained flight, and a return of 9.4 percent of the juvenile females. These percentages are minimum estimates of the homing rate, as no consideration is made for mortality between September 1973 and April 1974. Keith (1961) estimated that the average annual mortality

TABLE 20. DIRECT RECOVERIES FROM MARKED WATERFOWL.

Species	Age and Sex	Location	Date
Pintail	Juvenile female	Kansas	11/73
Pintail	Juvenile female	Louisiana	1/74
Mallard	Juvenile male	Nebraska	11/73
American Wigeon	Juvenile female	Colorado	12/73
American Wigeon	Juvenile female	California	12/73

(from September 1 through September 1) of juvenile ducks was 70 percent. A portion of this mortality is accounted for with the ducks assigned to the unknown 2, dead and direct recovery categories. However, the degree to which the number of extant birds should be further reduced is not known. Sowls (1955:36) reported a return of 18 ducks (9.7 percent) from a sample of 185 captive-reared juvenile females of five species. Poston (1974:11) observed 4 (3.4 percent) marked juvenile shoveler females from a sample of 116 ducks marked during the previous year. These findings are consistent with the return of juvenile females observed in this study. Sellers (1973), however, estimated that 25 and 20 percent of wild strain, hand-reared, juvenile mallard females returned to his study area in Manitoba during 1970 and 1971, respectively.

Mallard female, #184, was one of a brood of six ducklings reared on Reservoir 2-4 in Pasture 2 (Fig. 7a). Three of her brood-mates were captured on 3 August 1973. At that time the ducklings were approximately 40-days-old (Gollop and Marshall 1954). Following this

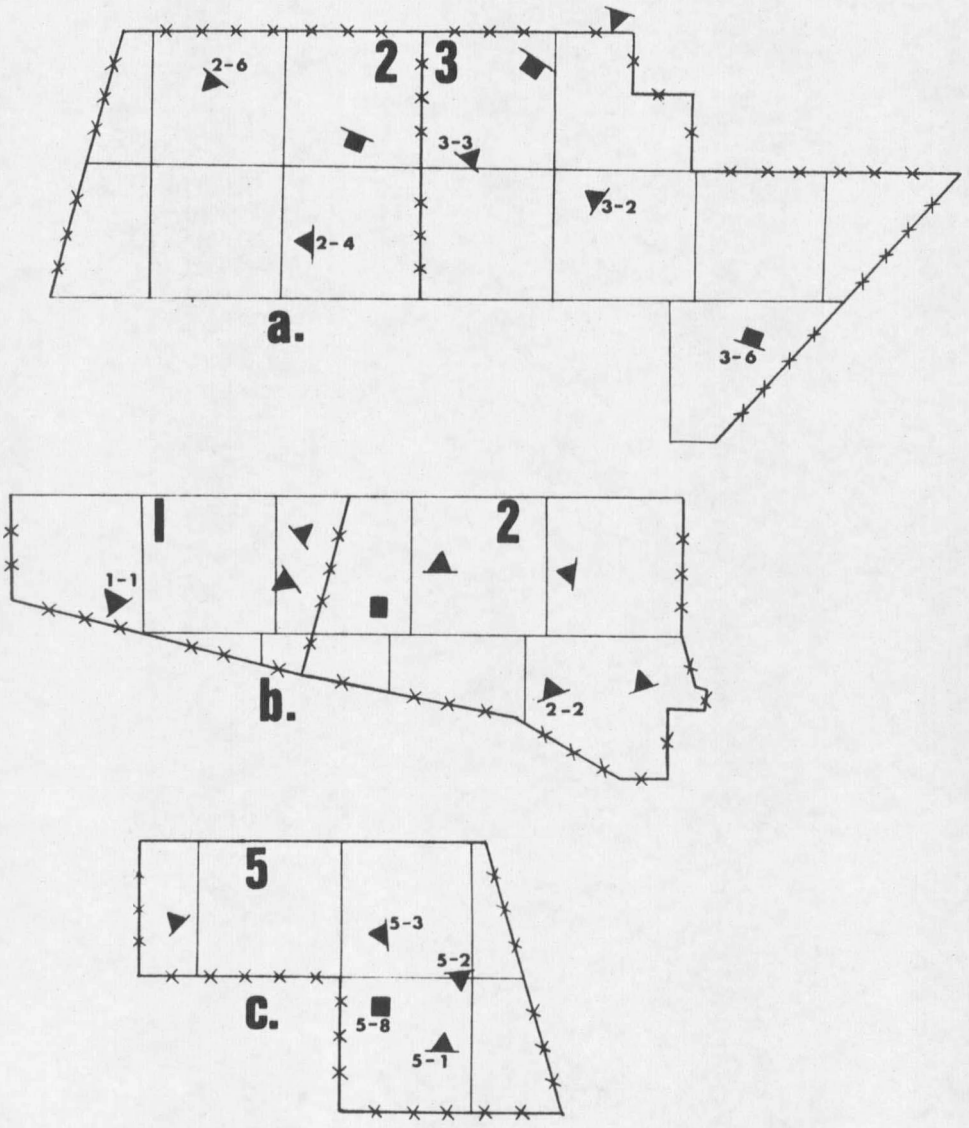
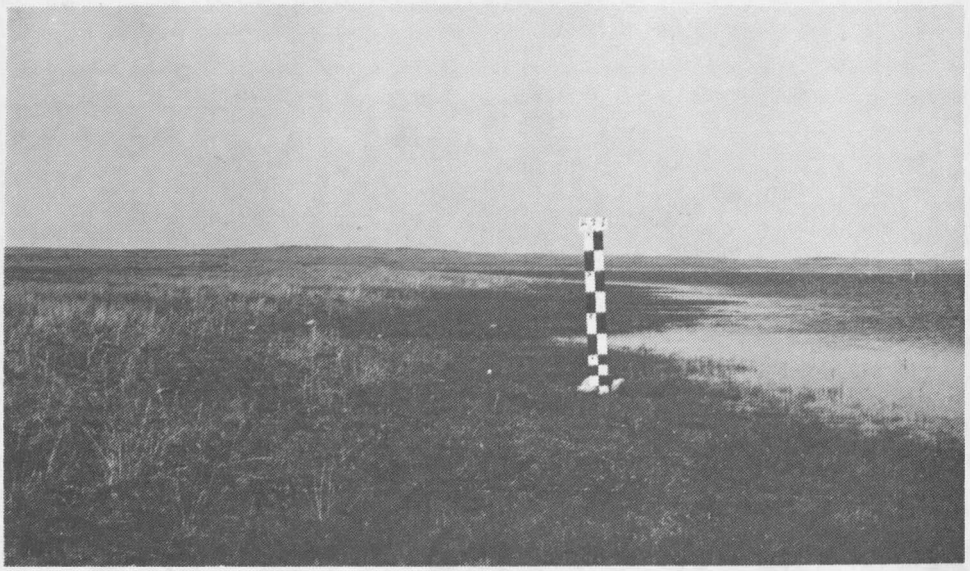


Figure 7. Spatial relation of reservoirs used by marked ducks, a. Mallards #184 and #196, b. American Wigeon #903, and c. Shoveler #922.

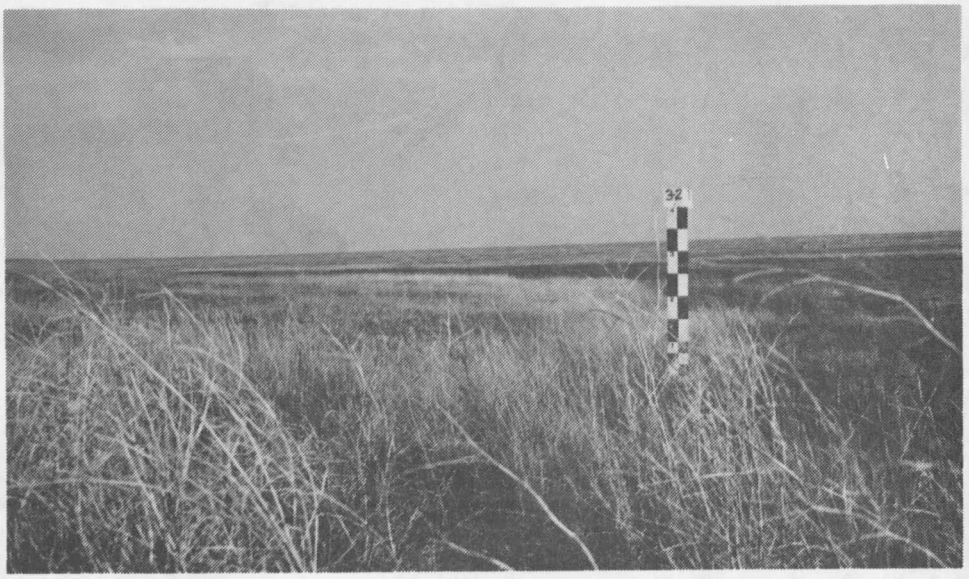
disturbance the brood moved to Reservoir 2-6, approximately 1 mile northwest of 2-4. Number 184 was marked on 8 August, and attained flight from Reservoir 2-6. During 1974, she was first observed on 12 April, using Reservoir 2-4. At that time she was paired. Number 184 was next observed, with her mate, on 19 April, using Reservoir 3-2 in Pasture 3, approximately two miles east of Reservoir 2-4. This duck was observed on ten subsequent occasions, nine of these on Reservoir 3-2. During two of these observations she flew from the reservoir into a large coulee, south of 3-2. On 1 May she was observed on Reservoir 3-6, a reservoir in this same coulee. Number 184 was never seen with a brood. From these observations, the following conclusions are drawn. This duck homed to her natal reservoir and subsequently relocated and became established as a breeding resident on Reservoir 3-2. This conclusion is further supported by several observations of a mallard drake on an appropriate "waiting station" during observations in the absence of the marked female. Number 184 initiated a nest during late April or early May, and the nest site was probably located in the large coulee. As she was still paired on 25 May, and no subsequent observations of this duck or an appropriate drake were made, she probably lost her first nesting attempt during the late May storm. Thereafter, she either relocated prior to an additional nesting effort or failed to renest.

A comparison of Reservoirs 2-4, 2-6 and 3-2 suggests that #184 did respond to the quality of these reservoirs, as indicated by the differences in the residual shoreline vegetation (Fig. 8). Pasture 3 was the 1973 rest pasture. During that year the vegetation within the emergent and riparian zones on Reservoir 3-2 was well developed. This vegetation provided cover along the shoreline of this reservoir during the spring of 1974. Pasture 2 was grazed during the spring and fall of 1973. Fall grazing, particularly, influenced the shorelines of Reservoirs 2-4 and 2-6. A low water level in Reservoir 2-4 during 1973 was also involved, as good growths of emergent and riparian vegetation did not develop that year. Reservoir 2-6 is of recent construction and the shoreline vegetation on this reservoir is not yet well established.

Mallard female, #196, is a brood-mate of #184. She was marked on 17 August 1973, and also took flight from Reservoir 2-6. During 1974, she was observed on 25 April and again the following day, using a large, fenced reservoir just north of the study area (Fig. 7a). This reservoir is approximately 3 miles east of Reservoir 2-6. On both occasions she was paired. On 2 May, #196 was observed, with her mate, on Reservoir 3-2. She was next observed on 25 May, again using this reservoir. During the intervening observations a mallard drake was established on an appropriate "waiting station". These observations suggest that #196 and her mate were established as a breeding pair on



Reservoir 2-4



Reservoir 3-2

Figure 8. Comparative photographs of Reservoirs 2-4 and 3-2 taken on 25 April 1974.

Reservoir 3-2. Number 196 was observed on 15 and 29 July, leading a brood of seven ducklings. These observations occurred on Reservoir 3-3 in Pasture 3. The age of the brood indicated a hatching date during early July. The failure to observe this duck between 25 May and 15 July and the estimated hatching date of her brood indicate an initial nest failure during late May and the initiation of a successful renest during late May or early June. Like her brood-mate, #196 selected a reservoir that was more attractive than her natal pond during her first 1974 nesting effort. It is not known which reservoir she used during her second nesting attempt. However, she did rear the resulting brood in Pasture 3.

American wigeon female, #903, was observed on Reservoir 2-2 in Pasture 2 on 30 May. At that time she was paired. No subsequent observations were made of this duck. However, a lone American wigeon drake remained on a "waiting station" in the vicinity of the initial observation through the third week in June. This suggests that #903 and her mate were established as a breeding pair on Reservoir 2-2.

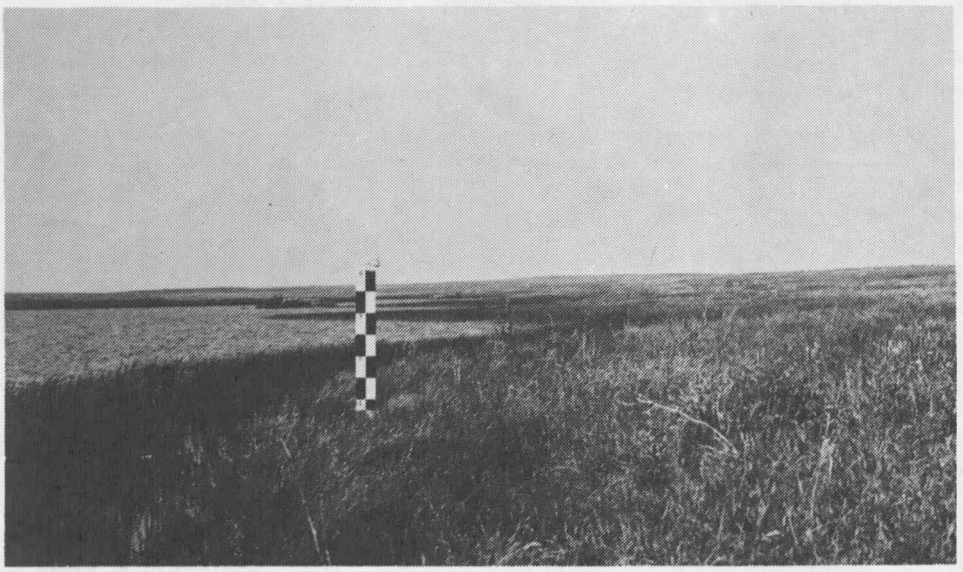
Number 903 was marked on Reservoir 1-1 in Pasture 1 (Fig. 7b), approximately three miles west of Reservoir 2-2. Reservoir 1-1 is a large reservoir with a well developed zone of emergent vegetation, but a poorly developed riparian zone. The poor condition of the shoreline of this reservoir during the spring of 1974 resulted from a poor growth during 1973, associated with a low water level and heavy grazing

pressure during the growing season. Pasture 2 was grazed lightly in the spring and heavily in the fall, 1973. Although late season grazing is indicated to be detrimental to the shoreline vegetation, this was less evident on Reservoir 2-2 than on other reservoirs in Pasture 2. In relocating, #903 selected a reservoir with more residual shoreline vegetation than that present on her natal reservoir (Fig. 9).

American wigeon female, #953, was first observed on 30 May, with a mate, using Reservoir 2-2. She was next observed on 28 June, again on the same reservoir. During the intervening period, a drake was established on an appropriate "waiting station", in the vicinity of the initial and subsequent observations of the marked duck. Number 953 was observed five times between 28 June and 5 July, all of these on Reservoir 2-2. This information indicates that this duck and her mate were established as a breeding pair on this reservoir. The repeated observations of #953 with her mate during late June and early July also suggest the possibility of an earlier nesting failure. Number 953 was not observed with a brood. This duck was marked on and took flight from Reservoir 2-2.

American wigeon female, #999, was observed on 27 July using Reservoir 2-2. At that time she was unpaired, was not accompanying a brood, and appeared to be in a post-breeding condition. This bird was also marked on Reservoir 2-2.

Reservoir 1-1



Reservoir 2-2

Figure 9. Comparative photographs of Reservoirs 1-1 and 2-2 taken on 11 June 1974.

Blue-winged teal female, #095, was marked as an adult, on Reservoir 2-2. She successfully reared a brood during 1973. During 1974 she was observed, with a mate, on 4 and 5 July. Both of these observations were made on Reservoir 2-2. A blue-winged teal drake was observed on an appropriate "waiting station" during prior and subsequent observations of this reservoir. It is concluded that this pair was established as breeding residents on this reservoir. Number 095 was not observed with a brood during 1974.

Shoveler female, #922, was observed flying into Reservoir 5-8 in Pasture 5 on 25 June. At that time she appeared to be returning to this reservoir from a nest, however, no waiting drake was observed. This duck was inadvertently flushed during the observation and she flew to Reservoir 5-1. She did not meet a drake on that reservoir either. No additional observations were made of #922, and no conclusions can be drawn regarding her breeding status. This duck was marked on Reservoir 5-3, although observations prior to marking suggested that she was reared on Reservoir 5-1. Number 922 was observed on Reservoirs 5-2 and 5-3 both prior to and following her first flight. All four of these reservoirs are within one mile of each other (Fig. 7c).

American wigeon male, #938, was observed with a group of unmated males on 9 April. This bird was marked on Reservoir 1-2 in Pasture 1, while the 1974 observation was on a reservoir in Pasture 4, approximately one mile east and three miles south of his natal pond.

This sample of marked birds observed during 1974 suggests that waterfowl do adjust to meet the annual changes in shoreline vegetation that result from the previous year's grazing treatment. Bue *et al.* (1952) demonstrated that the number of breeding pairs using a stock-water reservoir is greatly reduced when shoreline cover is lacking. Furthermore, pairs may range out to find good nesting cover if good shoreline cover is available. Three of the five resident marked females became established on reservoirs other than their natal ponds. One of these birds was observed in the vicinity of her natal pond prior to relocation. In these cases the 1974 home reservoirs were more attractive, defined in terms of residual shoreline vegetation, than the 1973 natal reservoirs. In two instances marked birds returned to the same reservoir used during 1973. The shoreline condition of this reservoir was good. No instance was recorded in which a marked female became established on a reservoir in poorer condition than her natal pond.

Canada Goose Production

As field work was not initiated until mid-June 1973, a complete summary of the Canada goose *(Branta canadensis)* breeding season cannot be made for that year. A preliminary trip to the study area was made on 13 April. At that time paired geese were observed and one goose was flushed from a nest containing a clutch of six eggs.

Four broods of geese were observed on the study area during 1973 (Table 21). An additional three broods were recorded on West Alkali

TABLE 21. CANADA GOOSE BROODS, 1973.

Location	Brood Size	Estimated Hatching Date
Pasture 5	6	22 May
Pasture 4	5	2 June
Pasture 2	2	30 June
Pasture 2	4	24 July
Subtotal	4/17	
West Alkali	6	2 May
West Alkali	6	20 May
West Alkali	3	13 June
Total	7/32	

Reservoir, a large irrigation reservoir adjacent to the study area. Broods were assigned to an age-class according to Yocum and Harris (1965), and the hatching dates were estimated by back-dating from the mid-point of the age-class.

A 111-day nesting season was estimated for 1973. The one nest located was back-dated 1.5 days per egg (Kossack 1950), suggesting that the nesting season began no later than 4 April. The last observed brood hatched no earlier than 24 July. Atwater (1959), while working in south Phillips County during 1956 and 1957, estimated a minimum 75-day nesting season for those years. McCarthy (1973) estimated a 48-day nesting season during 1972. The longest goose nesting season that I found reported was 83 days in Klamath Basin, California during 1952 (Miller and Collins 1953).

Klopman (1958) suggested that destruction of early nests and late renesting are factors which lengthen the nesting season. A heavy rain and snow storm was recorded in northcentral Montana during mid-April 1973. This storm probably disrupted the earliest nesting attempts. A second consideration involved in the unusually long nesting season during 1973 is that with the small sample size I was particularly conscious of the extremes.

Canada geese were present on the study area when field work began in mid-March 1974. At that time the reservoirs were still frozen. The reservoirs were open by the first week in April and the geese immediately began nesting. A breeding population of seven pairs was estimated for 1974 (Table 22). Nine pairs of nonbreeding geese were

TABLE 22. CANADA GOOSE PAIRS, 1974.

Location	Nesting Pairs	Nonbreeding Pairs
Pasture 1	1	2
Pasture 2	1	2
Pasture 3	1	-
Pasture 4	-	3
Pasture 5	4	2
Subtotal	7	9
West Alkali	11	-
Total	18	9

also recorded. Pairs which demonstrated weak territorial defense and infidelity to the territory, and failed to initiate a serious nesting attempt were assigned to the nonbreeding category. These birds remained

paired and associated with the same reservoir for periods of one to seven weeks. Geis (1956), Craighead and Stockstad (1964), Sherwood (1967), and Surrendi (1970) provided evidence that yearling geese may pair and establish territories during the breeding season, although they fail to nest. The nonbreeding pairs were assumed to involve yearlings as one or both members. An additional eleven pairs of breeding geese were estimated on West Alkali Reservoir.

The distribution of breeding geese was strongly influenced by the presence of islands. Six of the seven pairs were established on the four reservoirs on the study area in which islands have been constructed. The proclivity of geese to nest on islands is well documented (Hammond and Mann 1956; Klopman 1958; Vermeer 1970; Hook 1973; and McCarthy 1973). The one pair not associated with an island was established on a reservoir in Pasture 3, the 1973 rest pasture. While the geese used the islands as nest sites, the ganders defended an area along the shoreline of the reservoir.

Nonbreeding pairs were found on reservoirs without islands. Presumably the presence of a breeding pair on the preferred areas prevented the less dominant birds from establishing on the same reservoirs.

By observing the incubating females, nine nests were located during 1974 (Table 23). It is believed that these nests represent the complete nesting effort on the study area by geese during the 1974 breeding season. Seven of the nests were located on islands; two were on

TABLE 23. CANADA GOOSE NESTS, 1974.

Location	Site	Clutch Size	Initiation	Fate
Pasture 1	Island	-	3 April	Hatched 13 May
Pasture 2	Island	6	28 April	Abandoned
Pasture 3	Penninsula	6	9 April	Depredated 29 April
Pasture 5	Island	-	3 April	Hatched 13 May
Pasture 5	Island	-	8 April	Washed out
Pasture 5	Island	-	8 April	Washed out
Pasture 5[1]	Penninsula	4	20 May	Hatched 21 June
Pasture 5	Island	4	11 April	Depredated 23 April
Pasture 5[1]	Island	6	1 May	Abandoned

[1]Probable renests.

penninsulas.

Only three of the nests were considered successful. Two of the nests were depredated by undetermined agents, and the remaining were abandoned during the two weeks of wet weather in late May. Two of the abandoned nests were washed out completely, while the other two suffered only partial damage.

The devastating effect of the May storm on the 1974 goose nesting season is further illustrated by nests located on West Alkali Reservoir. Nine nests were found during a nest search conducted on 31 May, three of which were successful, while the remaining were abandoned and showed evidence of having been damaged by the storm.

While the 1973 storm was early enough to permit an opportunity for the geese to renest, the 1974 storm occurred well after the initiation of the nesting season. This appears to have precluded any renesting attempts. Atwater (1959) suggested that the tendency to renest is

greater when the nest is destroyed during the egg-laying stage. Klopman (1958) thought that geese nesting at Dog Lake, Manitoba may no longer be capable of a renesting effort if the first nest had been incubated for ten days or longer. Three of the deserted nests had been under incubation for at least three weeks prior to the storm. The fourth nest, although incubated for only a week, was thought to be a renesting attempt. The dates of nest initiation are not known for all of the nests found on West Alkali Reservoir, however, the behavior of the pairs suggests that all of these nests were incubated for at least two weeks prior to the storm. If any of the pairs which abandoned their nests during the storm renested, there is no evidence to suggest that they did so on the study area.

A 79-day nesting season was estimated for 1974. The first nest was initiated on 3 April, and the last brood hatched on 21 June. The shorter season in 1974, as compared to 1973, was due to the absence of late renesting pairs.

Three broods of geese were observed on the study area during 1974 and an additional four broods were reared on West Alkali Reservoir (Table 24). Thirty-nine percent of the pairs estimated on the study area and West Alkali Reservoir were successful in rearing a brood. All broods were at least twelve-days-old when first observed. Therefore, an estimate of gosling mortality cannot be made for the first two weeks. No mortality was recorded thereafter.

TABLE 24. CANADA GOOSE BROODS, 1974.

Location	Brood Size	Estimated Hatching Date
Pasture 1	5	13 May
Pasture 2	6	13 May
Pasture 1	3	21 June
Subtotal	3/14	
West Alkali	6	18 May
West Alkali	5	18 May
West Alkali	5	18 May
West Alkali	3	18 May
Total	7/33	

No distinct relationships between the grazing formula and Canada geese production were evident during this study. Gjersing (1971) found that no broods were produced in those pastures grazed during the early spring and summer of the year of production. Two broods were observed in Pasture 2, which was lightly grazed during May and June 1973. The estimated hatching dates for both of these broods occurred after the cattle had been removed from this pasture. Further, there is no evidence to suggest that the pairs accompanying these broods had actually nested in Pasture 2. Pasture 3 was the first pasture grazed in 1974. Although no islands have been constructed in the reservoirs in this pasture, one pair of geese did initiate a nest in Pasture 3. This nest was depredated prior to the turn-in date. McCarthy (1973) indicated that cattle disturbance could induce brood movement with subsequent gosling mortality. One example of brood movement, in response to cattle disturbance, was recorded in 1974, however, no gosling mortality occurred.

There are several indications that the Canada goose breeding population, on the study area, although small, is increasing. Gjersing (1971) observed only four broods on this area during the three years of his study. Seven goose broods were observed during the two years of this study. This difference probably would have been greater had it not been for the May storm in 1974. The activity of the yearling pairs on the area also suggests an increasing population. Additional islands have been constructed since Gjersing's study.

Currently, three of the reservoirs have two man-made islands. The fourth has two natural islands and a man-made island. While only one pair was established at a given time on the first three reservoirs, three pairs nested on the latter reservoir. Sherwood (1968) recommended an island spacing of greater than 150 feet in order to minimize conflict between adjacent nesting pairs. All of the islands on this reservoir were within 150 feet of each other. McCarthy (1973) found that only one pair of geese occupied a reservoir, regardless of the number of islands. He suggested that a breakdown in this spacing would indicate an increase in the number of nesting pairs and a shortage of the preferred nesting sites. The presence of three nesting pairs on the one reservoir in Pasture 5 further suggests an increase in the nesting population of Canada geese.

DISCUSSION

Range land, particularly that peripheral to the prairie pothole region, represents waterfowl habitat that has developed since 1930, resulting from the construction of an increasing number of stock-water reservoirs. Considering this recent origin, it is consistent that the most adaptable waterfowl species would be the first inhabitants.

Although the puddle ducks were still the primary species using the study area, it is of interest that the species diversity, as indicated both in the breeding pair and brood populations, increased during the brief period since Gjersing's (1971) study. This increase in species diversity is related, in part, to the improved water conditions which existed during 1974. However, it also appears to reflect a general trend for stock-water reservoirs in Montana. Smith (1953), working in Musselshell, Carter and McCone Counties in eastern Montana, observed diving species in his spring counts, but they were not represented in his brood census. Gjersing's (1971) data indicated that the lesser scaup was pioneering Phillips County. Rundquist (1973) and the current study indicate that the lesser scaup has become an established breeding species and that the cinnamon and green-winged teal, redheads, canvasbacks and ruddy ducks are pioneering this type of habitat.

This increased species diversity in the waterfowl population associated with stock-water reservoirs probably relates to an increase in the habitat diversity, which may be associated with the maturation

of the existing and the construction of new reservoirs, and in an increase in the habitat stability, associated with an increase in the application of grazing management systems.

Despite a large response to the improved water conditions which occurred during the second year of this study, certain relationships between the distribution of waterfowl and the grazing formula are evident. The greatest densities of breeding pairs were recorded in Pasture 2 during 1973, and in Pasture 3 during 1974. These pastures were rested during the previous respective grazing seasons. This positive response by waterfowl to the rest treatment during the previous year is consistent with the findings of Gjersing (1971). The influence of the rest treatment on the subsequent waterfowl breeding season appears to result from increased residual vegetation. The presence of shoreline vegetation improves the attractiveness of stock-water reservoirs for breeding pairs (Bue *et al.* 1952; Glover 1956; Shearer 1960; and Uhlig 1963). Residual vegetation on upland sites is particularly important for the early nesting species (Keith 1961), and was found to be an important component of the nesting cover at six of the seven nests analyzed.

While the greatest densities of breeding pairs were recorded in Pastures 2 and 3, the lowest densities were recorded in Pasture 5 during 1973 and in Pasture 4 during 1974. Both of these pastures sustained the heaviest grazing pressure during the previous respective grazing

year, and at a time during the growing season which permitted little opportunity for regrowth.

These observations demonstrate an inverse relationship between the attractiveness of a pasture for waterfowl and the grazing treatment, both intensity and period of use, during the previous grazing season. This conclusion is further substantiated by the observations of marked waterfowl. The three females which relocated, relative to their natal reservoirs, selected reservoirs with greater shoreline cover.

Precise relationships between other grazing treatments and waterfowl use during the subsequent season were obscured by the heavy grazing pressure incurred during 1972 and modifications to the 1973 formula. Gjersing (1971) suggested that those treatments which permit the accumulation of residual vegetation will benefit waterfowl. On native prairie, the most important treatment in this respect, other than complete rest, is early season grazing. This treatment provides the opportunity for regrowth following relief from grazing. There was little opportunity for regrowth in any of the pastures grazed during 1972. Pasture 2, the first pasture grazed during 1973, was grazed again in the fall. Some regrowth would have been possible in Pasture 1, as it was only grazed through mid-July. Regrowth was not suggested on the transects located in this pasture. However, heavy concentrations of cattle were observed in the vicinity of these transects

during 1973. The potential for regrowth would have been greater in those areas of this pasture away from these concentrations. Pasture 1 was more attractive to waterfowl during 1974 than in 1973.

Waterfowl responses to grazing during the current season were also apparent. A reduction in pair use, during early season grazing, was observed in Pasture 1 during 1973, and in Pasture 3 during 1974. The same response was suggested for Pasture 2 during 1973, as the use of this pasture by pairs exceeded its use by broods. Conversely, an increase in the use of Pasture 5 by later nesting pairs was suggested in 1973, when this pasture was deferred. This response was also indicated in Pasture 4, which was rested, and Pasture 5, which was deferred until mid-August, during 1974.

The potential to relocate, during current grazing, would be greatest either prior to nest initiation or following the loss of a nesting attempt. This latter response is suggested by the histories of the two marked mallards. Sowls (1955) determined that hens locate their renests in the vicinity of the first nest. Perhaps this pattern is altered when cattle disturbance is an additional consideration.

Because a female appears to select a nest site both on the basis of a dense clump of vegetation and the vegetation which surrounds that clump, the influence of the grazing formula on the availability of nesting cover becomes more apparent. Attractive nesting sites are available for early nesting ducks in those pastures which provide

residual vegetation, specifically the pasture given complete rest and the pasture grazed early during the previous grazing season. Attractive nesting sites for later nesting ducks will develop in those pastures deferred from grazing during the early part of the current season. Deferred grazing in those pastures with residual cover would maximize the cover values in two of the five pastures in this particular system.

Dense clumps of vegetation are available in all pastures because several of the potential cover species are not palatable to cattle and the actual use seldom exceeds 60 percent in any pasture. However, late season grazing may reduce the quality of the vegetation which surrounds these clumps, thereby reducing their suitability as nesting sites for the following waterfowl breeding season. Spring grazing, by reducing the amount of new vegetation and standing litter, also reduces the attractiveness of potential nesting sites. Bue *et al.* (1952) demonstrated that ducks preferred the tallest, densest cover available for the location of their nests, while cover ratings dropped with increased grazing intensity. Kirsch (1969) found higher nest densities in ungrazed and lightly grazed plots than in moderately and heavily grazed plots.

Lesser scaup are the most upland of the diving duck species (Kortright 1942). Their attraction to riparian vegetation on this study area relates to a preference for good concealment at the nest site (Miller and Collins 1954). Since scaup are a late nesting

species, they particularly benefit from the current season's growth in the riparian zone. Nesting cover benefits for this species, and other divers, are primarily achieved in those pastures deferred from grazing during the current season.

From this and an earlier study (Gjersing 1971) it is apparent that rest-rotation grazing, in contrast to continuous grazing, benefits waterfowl production in three respects:

1. The presence of residual vegetation in two pastures, the previous season's RR and G treatments.
2. Accumulation of new growth in two pastures, the current season's RR and RS treatments.
3. Long-term improvement in the overall range condition.

RECOMMENDATIONS

The maximum benefit for waterfowl should result from a grazing formula which permits deferred grazing during the current season in those pastures which provide residual vegetation from the previous season, a practice recommended by Gjersing (1971). This objective could be accomplished with the grazing formula here considered by reversing the sequence of treatments (Fig. 10). This modification would carry over the residual vegetation resulting from regrowth following the G treatment into the following treatment of complete rest, and the residual vegetation resulting from complete rest into the deferred grazing treatment.

The grazing formula should consider the phenology of the waterfowl nesting season (mid-April through the first week in August on this study area). The recommended formula maintains the two most attractive pastures for waterfowl because one pasture is completely rested and the other is deferred until after the completion of the hatch.

Grazing formulae applied to adjacent allotments should be complementary. Because waterfowl exhibit the potential to relocate in response to current pasture conditions, similar treatments should not be applied during the current season to adjacent pastures in adjoining allotments.

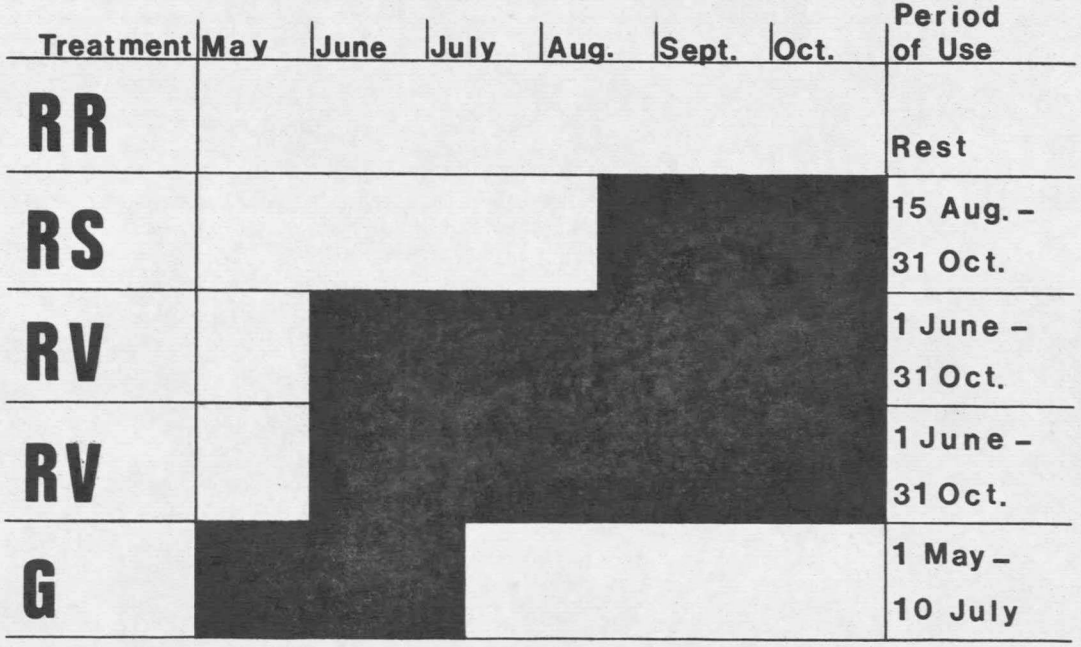


Figure 10. Recommended modification of the grazing formula to achieve maximum waterfowl benefits.

The construction of retention reservoirs should be favored when multiple management plans include considerations for water development. Reservoirs of this type were the primary habitat for breeding pairs and broods during two years of extreme water conditions. Pit-retention reservoirs were less stable habitat than retention reservoirs, as their use by waterfowl was more responsive to current water conditions. Pit reservoirs were of minor importance to the waterfowl population. While the inclusion of a pit in existing potholes appears to have improved the value of the potholes for broods, the pits detracted from the value of these potholes for breeding pairs. Maintaining potholes for use by pairs is probably more critical. In addition to their attractiveness to waterfowl, retention reservoirs provide a greater flexibility in location. Gjersing (1971) defined the physical parameters of retention reservoirs, as they influence use by waterfowl. These parameters should be considered when selecting a site for a new reservoir.

APPENDIX

TABLE 25. DISTRIBUTION OF WATER AREA BY RESERVOIR TYPE.

Pasture	Retention	Pit-retention	Pit-pothole	Pit-creek	Pothole
		1973			
1	9.7 (3)[1]	0	0	0	0
2	17.6 (5)	0.9 (1)	0.2 (1)	0.2 (1)	0
3	6.4 (3)	1.3 (3)	0	0	0
4	14.5 (6)	0	0.4 (2)	0	0
5	22.3 (6)	0	0	0.2 (1)	0
Total	70.5 (23)	2.2 (4)	0.6 (3)	0.4 (2)	0
		1974			
1	17.6 (7)	2.0 (1)	9.1 (1)	0	33.7 (5)
2	18.2 (5)	0.9 (1)	18.6 (1)	0.2 (1)	4.9 (2)
3	9.6 (4)	1.7 (3)	0	0	0
4	14.5 (6)	0	52.7 (2)	0	0
5	27.2 (6)	0	0	0.2 (1)	0
Total	87.1 (28)	4.6 (5)	80.4 (4)	0.4 (2)	38.6 (7)

[1]Number of reservoirs considered is included in parentheses.

TABLE 26. AVIFAUNA OBSERVED ON THE STUDY AREA.

Red-necked Grebe *(Podiceps grisegena)*
Horned Grebe *(Podiceps auritus)*
Eared Grebe *(Podiceps nigricollis)*
Western Grebe *(Aechmophorus occidentalis)*
Pied-billed Grebe *(Podilymbus podiceps)*
White Pelican *(Pelecanus erythrorhynchos)*
Double-crested Cormorant *(Phalacrocorax auritus)*
Great Blue Heron *(Ardea herodias)*
Black-crowned Night Heron *(Nycticorax nycticorax)*
Yellow-crowned Night Heron *(Nyctanassa violacea)*
American Bittern *(Botaurus lentiginosus)*
Canada Goose *(Branta canadensis)*
Mallard *(Anas platyrhynchos)*
Gadwall *(Anas strepera)*
Pintail *(Anas acuta)*
American Green-winged Teal *(Anas crecca carolinensis)*
Blue-winged Teal *(Anas discors)*
Cinnamon Teal *(Anas cyanoptera)*
American Wigeon *(Anas americana)*
Northern Shoveler *(Anas clypeata)*
Redhead *(Aythya americana)*
Ring-necked Duck *(Aythya collaris)*
Canvasback *(Aythya valisineria)*
Lesser Scaup *(Aythya affinis)*
Common Goldeneye *(Bucephala clangula)*
Bufflehead *(Bucephala albeola)*
Ruddy Duck *(Oxyura jamaicensis)*
Hooded Merganser *(Lophodytes cucullatus)*
Common Merganser *(Mergus merganser)*
Red-breasted Merganser *(Mergus serrator)*
Sharp-shinned Hawk *(Accipiter striatus)*
Swainson's Hawk *(Buteo swainsoni)*
Ferruginous Hawk *(Buteo regalis)*
Golden Eagle *(Aquila chrysaetos)*
Marsh Hawk *(Circus cyaneus)*
Peregrine Falcon *(Falco peregrinus)*
American Kestrel *(Falco sparverius)*
Sharp-tailed Grouse *(Pedioecetes phasianellus)*
Sage Grouse *(Centrocercus urophasianus)*
Sora *(Porzana carolina)*
American Coot *(Fulica americana)*
Killdeer *(Charadrius vociferus)*

TABLE 26. (Continued).

Long-billed Curlew *(Numenius americanus)*
Upland Sandpiper *(Bartramia longicauda)*
Willet *(Catoptrophorus semipalmatus)*
Greater Yellowlegs *(Tringa melanoleuca)*
Lesser Yellowlegs *(Tringa flavipes)*
Long-billed Dowitcher *(Limnodromus scolopaceus)*
Marbled Godwit *(Limosa fedoa)*
American Avocet *(Recurvirostra americana)*
Wilson's Phalarope *(Steganopus tricolor)*
California Gull *(Larus californicus)*
Ring-billed Gull *(Larus delawarensis)*
Common Tern *(Sterna hirundo)*
Black Tern *(Chlidonias niger)*
Mourning Dove *(Zenaida macroura)*
Great Horned Owl *(Bubo virginianus)*
Burrowing Owl *(Speotyto cunicularia)*
Short-eared Owl *(Asio flammeus)*
Common Nighthawk *(Chordeiles minor)*
Common Flicker *(Colaptes auratus)*
Eastern Kingbird *(Tyrannus tyrannus)*
Western Kingbird *(Tyrannus verticalis)*
Horned Lark *(Eremophila alpestris)*
Barn Swallow *(Hirundo rustica)*
Black-billed Magpie *(Pica pica)*
Brown Trasher *(Toxostoma rufum)*
Western Meadowlark *(Sturnella neglecta)*
Yellow-headed Blackbird *(Xanthocephalus xanthocephalus)*
Red-winged Blackbird *(Agelaius phoeniceus)*
Brewer's Blackbird *(Euphagus cyanocephalus)*
Common Grackle *(Quiscalus quiscula)*
Brown-headed Cowbird *(Molothrus ater)*
Lark Bunting *(Calamospiza melanocorys)*
McCown's Longspur *(Calcarius mccownii)*
Chestnut-collared Longspur *(Calcarius ornatus)*

TABLE 27. SYNOPSIS OF THE GRAZING HISTORY OF THE MILK RIVER ASSOCIATION ALLOTMENT, 1967-1974.
1. Grazing treatments.

Year	Pasture 1	Pasture 2	Pasture 3	Pasture 4	Pasture 5
1967	Gc	Rest	RS	RV	Gs
1968	Gs	Gc	Rest	RS	RV
1969	RV	Gs	Gc	Rest	RS
1970	RS	Gs	RV	Gc	Rest
1971	Rest	RS	RV	Gs	Gc
1972	Gc	Rest	RS	RV	Gs
1973	Gc	Gs	Rest	RS	RV
1974[1]	RV	RV	GL	Rest	RS

[1]Grazing formula revised, see text.

TABLE 28. SYNOPSIS OF THE GRAZING HISTORY OF THE MILK RIVER ASSOCIATION ALLOTMENT, 1967-1974.
2. Periods grazed.

Year	Pasture 1	Pasture 2	Pasture 3	Pasture 4	Pasture 5
1967	5/2-8/1 and 9/16-10/31	--	9/5-11/16	8/2-9/4	5/5-7/31
1968	5/1-8/12	4/27-8/12	--	8/13-11/11	8/13-11/11
1969	7/15-11/3	5/1-8/15	5/1-7/15	--	8/15-11/3
1970	9/1-11/24	5/1-9/24 and 10/15-11/24	7/1-7/31 and 10/15-11/24	5/1-7/31	--
1971[1]	--	8/25-11/9	7/20-11/9	5/3-10/26	4/29-8/31
1972[1]	4/29-8/31	--	8/25-10/26	7/20-10/26	5/1-8/31
1973	6/1-7/18	5/1-6/25 and 10/1-10/31	--	7/20-10/26	7/10-8/31
1974	7/15-11/4	6/1-8/15 and 10/1-11/4	5/1-6/30	--	8/15-11/4

[1]Grazing summary not available for these years. Dates from the formula.

TABLE 29. SYNOPSIS OF THE GRAZING HISTORY OF THE MILK RIVER ASSOCIATION ALLOTMENT, 1967-1974.
3. Actual use.

Year	Pasture 1	Pasture 2	Pasture 3	Pasture 4	Pasture 5	Allotment
Survey	684	769	996	781	783	4013
1967	1439	0	1398	915	546	4298
1968	1165	1389	0	905	974	4433
1969	1306	1012	1042	0	819	4179
1970	648	1826	554	924	0	3953
1971[1]	0	1045	1447	1172	1223	4887
1972[1]	1379	0[2]	932	1312	1773	5396
1973	870	948	0	1490	838	4146
1974	1316	1083	821	0	911	4131

[1]A grazing summary was not available for these years. Actual use estimated from the grazing formula.

[2]Large groups of cattle, approximately 100, were twice reported using the rest pasture during 1972.

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