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
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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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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).

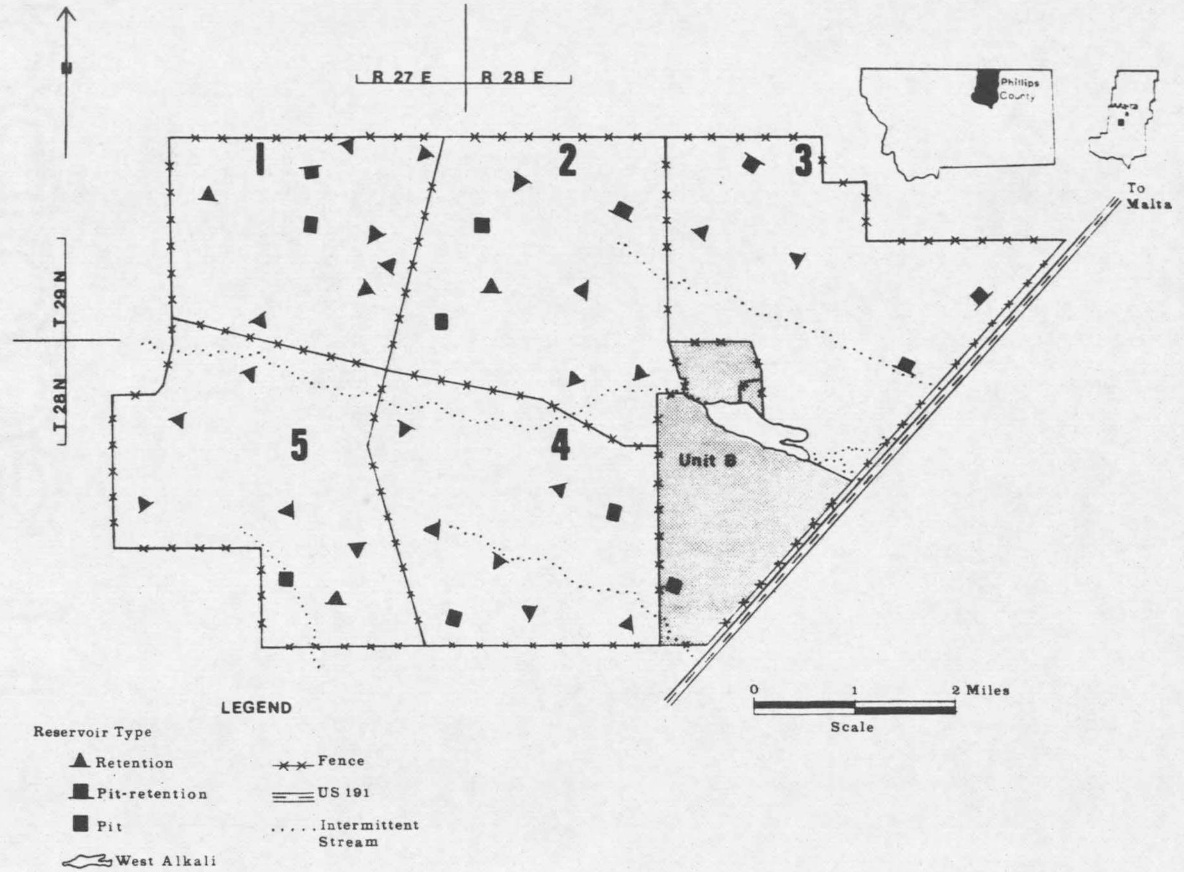

Figure 1. Map of the Study Area.

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 *(Crolatus 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

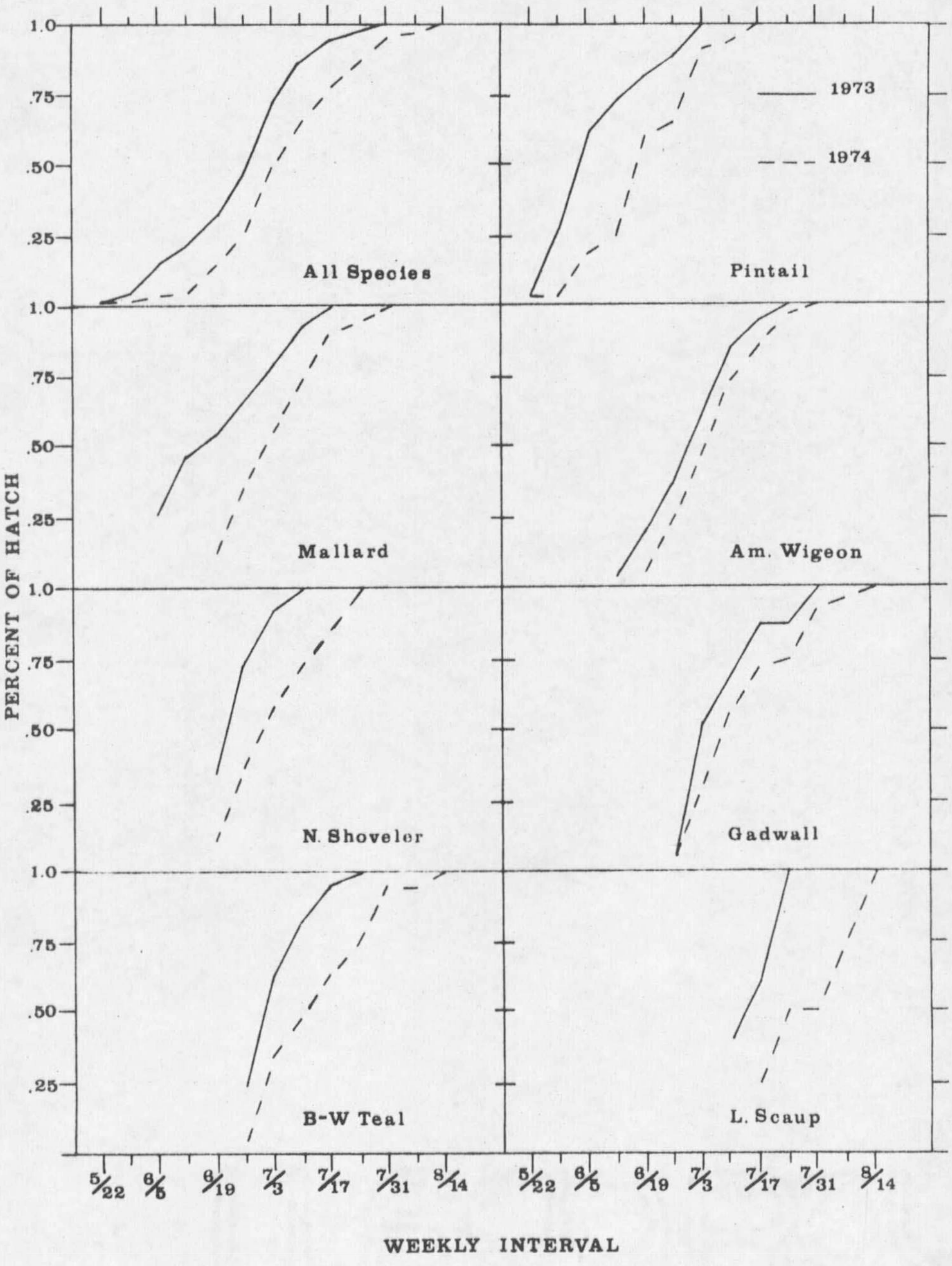

Figure 2. Cumulative percentage of the hatch by weekly intervals.

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.

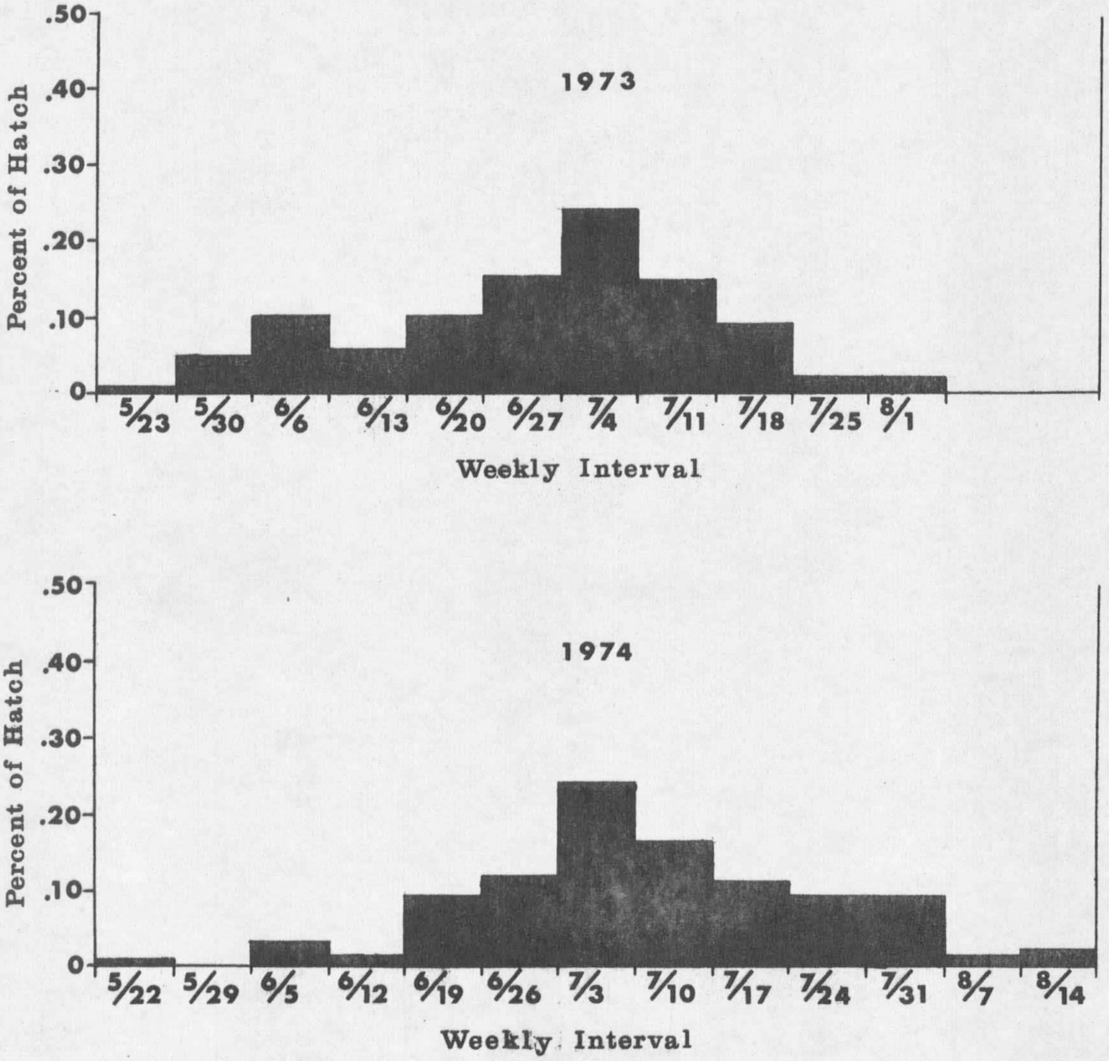

Figure 3. Frequency distribution of the hatch by weekly intervals.

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