PHENOLOGY AND ECOLOGY OF MIGRATORY WATERFOWL AT THE FORT GIBSON REFUGE AND VICINITY DURING THE SEASON 1960-1961

By

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PREFACE

This study was made possible through a fellowship from the Oklahoma Cooperative Wildlife Research Unit.* Thanks goes to Dr. A. M. Stebler, Leader of the Oklahoma Cooperative Wildlife Research Unit, for directing the study. I am also indebted to Dr. F. M. Baumgartner and Prof. Nat Walker for their additional counsel and encouragement. Thanks are due, too, to the Oklahoma Department of Wildlife Conservation for the use of certain facilities at the refuge and for the complete cooperation extended by all the Department's employees at the refuge. Special thanks is expressed to Mr. and Mrs. Robert Lancaster, residents at the refuge, for their assistance and warm hospitality given throughout the study.

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CHAPTER I

INTRODUCTION

With the encroachment of civilization upon the breeding areas of waterfowl and the prolonged droughts in these, the future of waterfowl is, at the present time, a cause for concern.

While the breeding areas available to waterfowl have been decreasing, hunting pressure has been increasing. It has been pointed out that with increased hunting pressure it may become necessary to seek to adjust shooting pressure to particular waterfowl species (Grieb and Boeker, 1954). Knowledge of waterfowl migration movements will be a prerequisite to any such adjustments. While a mass of banding data has been and is being gathered, the migration chronology of waterfowl species in various sections of our nation still is not sufficiently well known.

This study is concerned with the phenology of migration of waterfowl species using Fort Gibson Refuge in Oklahoma during the 1960-61 season. A study of the ecologic relationships existing between certain waterfowl species and their use of available feeding and resting areas on the refuge makes up a secondary concern of the problem. Specifically, the objectives of this study were: 1) to determine the phenology of migration of waterfowl species using the Fort Gibson Refuge in 1960-61, 2) to study ecologic relationships between waterfowl species and their use of available feeding and resting areas, and 3) to point out any management

implications stemming from this investigation.

Since this study was limited in scope to one season and one location of study, it does not constitute a guide to be used in the establishment of hunting seasons for the several waterfowl species in the entirety of Oklahoma. It does, however, form a basis for predicting the migration movements of waterfowl species through the Fort Gibson Refuge, and thus could conceivably be useful in planning hunting seasons for waterfowl species in the vicinity of that refuge. Further censusing at the refuge would increase the reliability of such predictions.

While the migration chronology data obtained could be of use in planning hunting seasons by species, it may, of course, be particularly useful to the Oklahoma Department of Wildlife Conservation in their development of management plans for the refuge.

The census data obtained, by providing a basis for predicting migration movements of waterfowl species using the refuge, should be useful in planning acreages and planting dates of various food crops to be provided for certain waterfowl species. The relative abundance of the various waterfowl species on the refuge, their use of available feeding and resting areas, and the factors affecting such use, all suggested by the census data presented, should be of use in planning wintering habitat improvements for various species. Finally, by comparing the use made of the Fort Gibson Refuge by waterfowl, with the use made of adjacent, non-refuge areas, some indication of the relative value of the refuge has been obtained.

CHAPTER II

METHODS

In order to recognize the migration phenology of waterfowl species using the Fort Gibson Refuge during the 1960-61 season, it was necessary to establish some reliable method of recording fluctuations in the waterfowl populations moving through there. To that end, periodic ground censusing of waterfowl using the refuge was conducted.

Censusing was begun on October 8, 1960, and continued weekly through March 27, 1961. Although no complete census was made in April, 1961, observations were made on April 1 and 16 to see which waterfowl species could be seen on those dates and what their relative abundance might be.

Censuses were conducted weekly throughout the period of study, except no census was made on the final week end in December, 1960. Censuses were made on week ends including Fridays and/or Mondays. On one occasion, December 21, 1960, two censuses were conducted at mid-week.

During the six months of censusing, a total of 83 censuses were made on 24 week ends for an average of about 3.5 censuses per week end. When possible four censuses were made each week end, including two morning and two evening censuses. On one occasion, rain, and on another fog, by restricting vision, limited the number of censuses that could be made. For various reasons including the personal, the number of censuses made was less than four on 5 week ends. On two

week ends observations of field use by ducks were made which reduced the number of censuses made. Five censuses were conducted on one week end.

Censusing was conducted twice daily. The times of censusing chosen were 8:00 A.M. and 3:30 P.M. It was thought that a majority of ducks using the refuge would have returned to the water after early morning field feeding by the time of the morning census. Winner (1959) observed that mallard morning flights occurred when light was still too poor for observation and that the greatest length of time spent on feeding fields was usually not more than 30 minutes. The time of the evening census, 3:30 P.M., was chosen to allow sufficient time for censusing before darkness. Winner (1959) found that the time of evening feeding flights of mallards varied greatly from day to day. It is probable that the time of evening censusing had little correlation with feeding activity.

In order to compare censuses taken throughout the course of this study, it was necessary to keep the area censused constant. If the entire refuge area had been censused, it would have been necessary to walk several miles during rainy periods in order to view the entire shoreline. The time spent in such a complete inventory would, it was thought, have been excessive to the point that censused waterfowl would become so mixed with those not yet censused that censusing would become extremely complicated. Soon after field work was begun, it was found that seven observation stations could be used in observing a large portion of the refuge area and that even in rainy weather, enough points or stations could be visited to keep the censused area constant. Normally, these seven stations were accessible by automobile since dirt roads connect them; however, when rainy weather made these dirt roads

impassable, it was necessary to walk to six of the observation stations. Although one station was not visited during periods of inclement weather, the area censused did remain constant, since another of the stations could be used in viewing the area normally observed from this one station which was inaccessible.

Waterfowl moving to and from grain fields, and those seen on these fields were also censused. These grain fields were visible from one of the seven observation stations or were visible during travel to the various observation stations.

During October, November, December, and January, five estimates of waterfowl numbers present in a portion of North Bay of the Fort Gibson Reservoir were obtained on the same days that censuses were made at the refuge. The area censused at North Bay was only about 150 acres in area, whereas the water area censused at the refuge included 950 acres. In order to compare the abundance of waterfowl species observed on these areas, the numbers of each species censused was converted to number per acre.

Waterfowl were censused in a manner similar to that described by Grieb and Boeker (1954). When ducks and geese were seen in relatively small groups, not more than 200 individuals, it was possible actually to count each member of the flock. Usually, however, the number present in each waterfowl flock was estimated as reliably as possible. When flocks contained more than about 200 ducks, when ducks were moving about rapidly in a flock, or when high winds and long observation distances caused some members of a flock to be periodically hidden by waves, individual enumeration of flock members was almost impossible. Thus, waterfowl groups were usually censused by subdividing each group into blocks of 10, 50, or 100 individuals. An estimated flock total

was obtained by totaling blocks counted in that flock and multiplying this total by the number in each block.

Many times, as might be expected, a large group of waterfowl was found to contain more than one species. When this occurred, it was necessary to estimate the group total then estimate the per cent of each species in the entire group. Application of these percentages to the group total made it possible to calculate the approximate number of each waterfowl species in the group.

A 30-power spotting scope was used in estimating waterfowl numbers and identifying waterfowl species. Although seven-power binoculars were useful at times in identifying waterfowl in flight, they were found to be much less useful than the spotting scope for most field identification.

The waterfowl names used here are in accord with the 1957 edition of the American Ornithologists Union's check list. No attempt was made to distinguish between lesser and greater scaup in this study; however, since most of the scaups found in Oklahoma are lesser scaups, it is assumed that few greater scaups were censused.

Waterfowl were usually identified to species while they were sitting on the water or on land; however, on occasion, it was necessary to identify them in flight. For flight identification, Peterson's Field Guide to the Eastern Birds proved helpful. Van Tyne (1956) states "the ornithologist has the advantage of what may be called the 'Roger Peterson effect' for, thanks to Peterson, identification of birds in the field has become a science in itself."

As noted above, waterfowl were on occasion censused while they were in grain fields. Although such feeding activity was not observed every

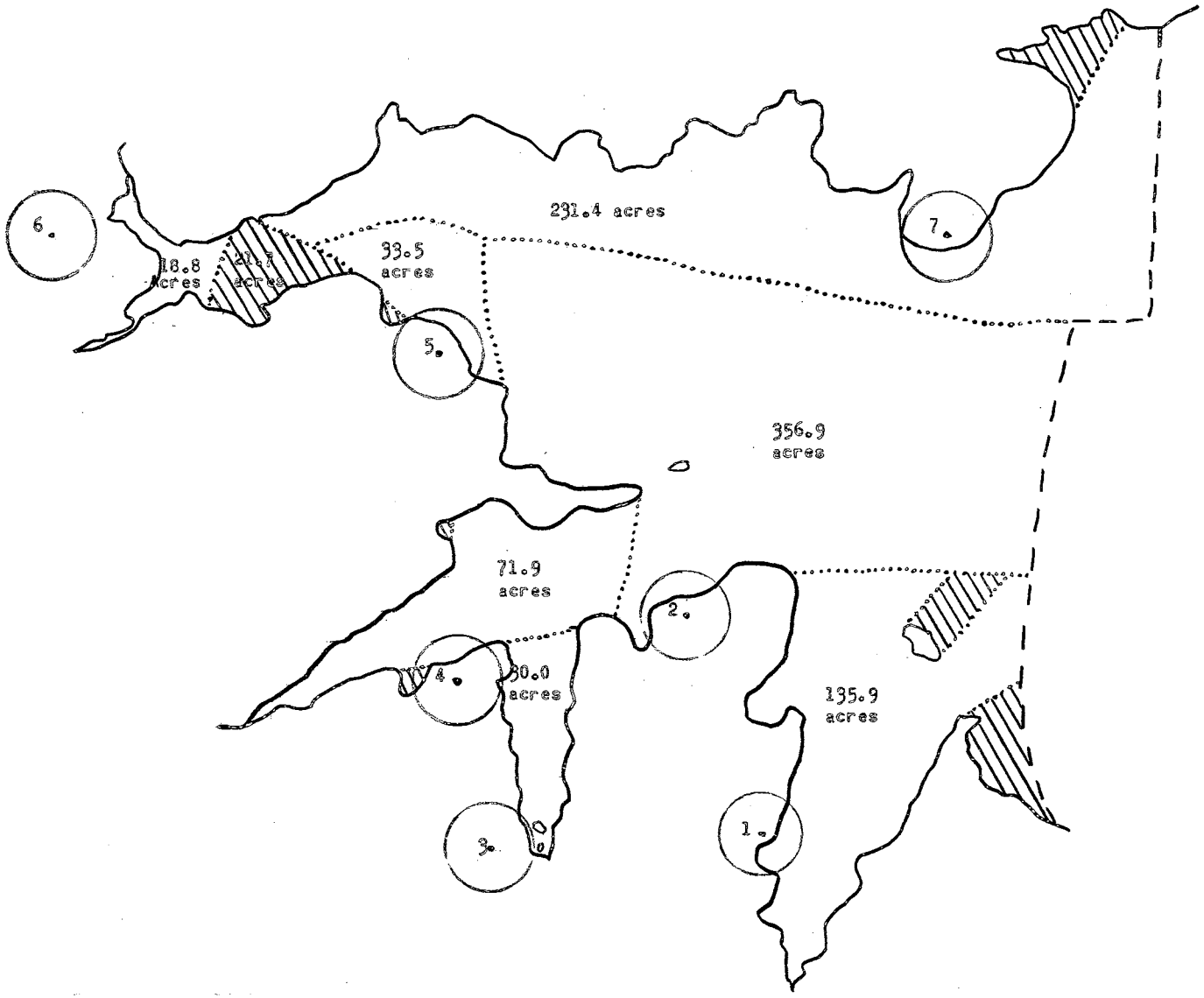

Figure 1. Jackson Bay, Fort Gibson Refuge, Oklahoma, showing the location of the seven observation stations, and census areas with the acreage of each. Hatched areas were not censused.

week ends, record was made of the number of each waterfowl species censused in certain grain fields. Admittedly, these observations do not form a basis for asserting food preferences of the various species since the observations were restricted to week ends and grain field usage could have varied during the week. The observations of field usage do, however, indicate the relative use which certain waterfowl species made of the grain crops on week ends of this season.

In order to determine which water areas on the refuge attracted greatest numbers of certain waterfowl species and to determine reasons for any apparent preferences, seven areas were delineated to be studied. These areas were visible from the seven observation stations normally used in censusing throughout the season. Figure 1 illustrates the location of these stations on the refuge and shows the seven study areas viewed from each.

During February and March, record was made of the number of each species present in each of these areas. Waterfowl abundance noted during 21 censuses made during these two months was correlated with the respective acreage of each area to reduce numbers censused to number per acre. The relative abundance of each species censused then was determined for each area.

Three factors, amount of shoreline cover, degree of protection from winds, and relative water depth were considered in evaluating use of each area.

The protection from north and northwesterly winds afforded waterfowl by each area was guaged by the directional layout of each area. Directional layout of each area was obtained from a map traced from an aerial photograph of the refuge, and from observations made at

the refuge of such wind protection.

The area of each of the seven censusing areas was determined with a planimeter. A map traced from an aerial photograph, scale 8" to one mile, was used in acreage determinations which are presented in Figure 2.

The water depth of each study area was compared by calculating the approximate areas of various depth ranges in each area. A contour map of the refuge, made prior to the partial inundation of the refuge area by Fort Gibson Reservoir, was used in determining water depths in each area. A planimeter was used to determine the acreages present between adjoining contour lines in each area. These acreages represented areas of certain depth ranges in each study area. Now the normal water level of the reservoir is about 554 feet. In order to approximate the shoreline of the refuge water area on this map, the 555 foot contour line on the map was outlined. The areas of various depth ranges in each study area were calculated from this base datum.

After the acreages of each depth range in each area had been calculated they were divided by the total acreage of each respective study area. Thus the percentage which a depth range made of the total area was determined.

Shoreline cover of each study area was determined by visual survey and estimation of cover types and densities. Cover was noted that was not more than 50 feet from the waterline. Because this vegetation survey was limited by time, only overstory and understory cover which might affect waterfowl visibility of shoreline surroundings was measured. No attempt was made to make an intensive study of aquatic plants available in each area, but amount and density of smartweeds along the shoreline were noted. Cover densities were estimated and given numerical ratings of I, II, III, and IV. Cover rated I occupied 0-25% of space

available; that rated II occupied 25-50% of available space; that rated III occupied 51-75%; while, that rated IV occupied 75-100% of available space. The shoreline in each study area was paced and the linear amount of each cover type along the shoreline in each area was noted. Cover types included shoreline having persimmon, willow, and buttonbush in any combination, shoreline devoid of any of these plants and essentially bare of cover that would tend to obstruct waterfowl vision of surrounding shoreline, and shoreline on which smartweed was present. The persimmon-willow type was given 4 different density ratings; smartweed was given 3 ratings. It was possible for an area to be both persimmon-willow type and smartweed type, or both open type and smartweed type. The percentage of each of these types and densities of the total shoreline in each area is presented in Table 12.

CHAPTER III

DESCRIPTION OF THE STUDY AREA

The study area included Fort Gibson Refuge and its vicinity, including certain corn fields located not more than two miles west of the refuge. Fort Gibson Refuge is located on Jackson Bay of the Fort Gibson Reservoir in northeastern Oklahoma. Its approximate position in the state is illustrated in Figure 2. A portion of North Bay, also on Fort Gibson Reservoir and about 3 miles north of the refuge, was also a part of the study area.

Fort Gibson Reservoir, 19,100 acres in area at power pool level, is located on Grand (Neosho) River about 5 miles north of Fort Gibson and 12 miles northeast of Muskogee, Oklahoma. Closure of the reservoir was started in June, 1949, and was completed in September, 1959. Regulated storage in the reservoir was operated as a detention reservoir until June, 1952. Impoundment of power pool to elevation 554.0 began in October, 1952, and the top of power pool was reached in March, 1953.

During the fall of 1958, the state-operated Fort Gibson Game Management Area, located on Jackson Bay of Fort Gibson Reservoir, was converted to a waterfowl refuge. This is operated by the Oklahoma Department of Wildlife Conservation as a federal aid project. The total area of the refuge is approximately 3,250 acres, of which, 950 acres is water area. The relation of this water area to the land

area on the refuge is illustrated in Figure 2.

Duck and Fletcher (ca. 1944) point out that the oak-hickory forest game type in Oklahoma is bounded on the west by the Grand River. The tallgrass prairie type begins just west of Grand River in northeastern Oklahoma; several small areas of postoak-blackjack type appear to represent an ecotone in this area. Jackson Bay, in the southwestern section of Fort Gibson Reservoir, apparently lies in this ecotone type with oak-hickory on shorelines on the eastern shore of the reservoir and tallgrass prairie to the west. Most of the refuge land area, located immediately west, north, and south of Jackson Bay, as seen in Figure 2, could be designated ecotone between tallgrass prairie and postoak-blackjack. Some of the refuge area approaches the tallgrass prairie in appearance, but overall the refuge land area is similar to the savannah type as described by Odum (1953), with postoaks, blackjacks, and various small hardwoods scattered about grassland.

Before the game management area was converted into a refuge and while the area was being managed primarily for production of quail and prairie chickens, a total of 21,400 trees and shrubs were planted on 13 acres within the area to increase cover. Thus some small areas on the refuge have cover that is somewhat denser than it would have normally been, had plantings not been made.

Along much of the shoreline of the refuge there was an abundance of gravel. Generally speaking the shoreline does not have a marshy appearance with a rank aquatic growth. Aquatics are present along much of the shoreline, and smartweeds are abundant in some areas. Persimmon, willow, and buttonbush are the three plants forming the limited overstory and understory vegetation levels of the shoreline.

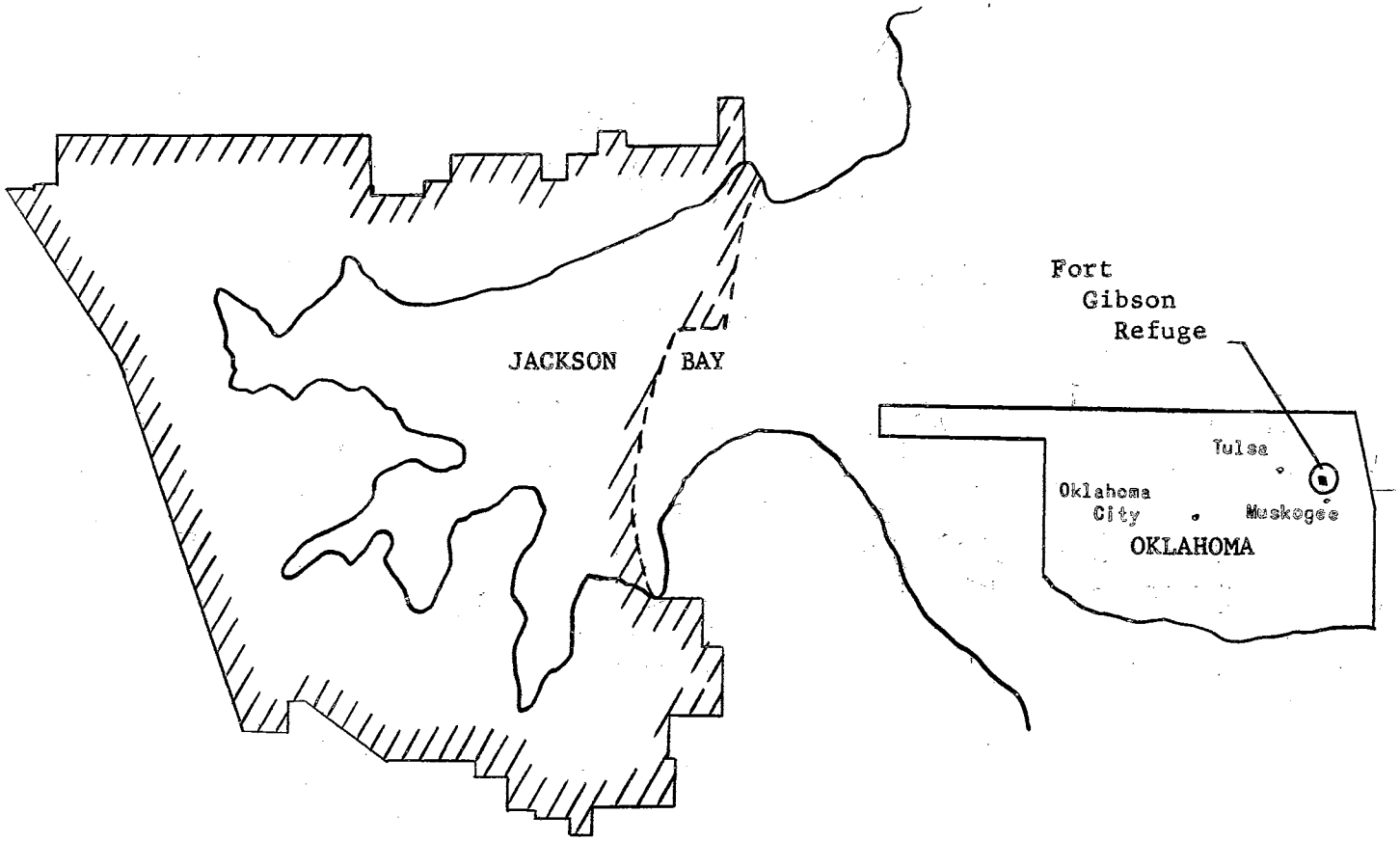

Figure 2. The Fort Gibson Refuge (area enclosed by hatching) located on Jackson Bay, Fort Gibson Reservoir in northeastern Oklahoma.

Observations and signs indicate that some potential waterfowl predators are using the refuge. Throughout this study, however, there was no indication that predation was at all significant. Coyotes, raccoons, owls, and eagles are at times present on or over the refuge.

CHAPTER IV

RESULTS OF FIELD INVESTIGATIONS

Relative Abundance of Waterfowl Censused Throughout Study

The relative abundance of each waterfowl species censused at the Fort Gibson Refuge during the 1960-61 censusing period is presented in Table 1. This table contains the percentage which each species comprised of the total number of waterfowl censused throughout the six months of censusing. It also lists the percent which each species made up of the total number of waterfowl censused during each month of censusing.

Mallards made up 80.34% of all waterfowl censused throughout the censusing period of October, November, and December of 1960, and January, February, and March of 1961. Of all waterfowl censused in October, 1960, the mallard constituted 40.6%. They made up 85.43% of all waterfowl censused in November; 97.49% of those censused in December; 94.72% of those censused in January; 77.26% of those censused in February, and 31.71% of those censused in March, 1961.

Considering the entire censusing period, the common merganser was second in abundance on the refuge. On a monthly basis, however, it was second in abundance only in December, 1960 and January and February of 1961. The common merganser was an important overwintering duck species on the refuge on a basis of relative numbers present.

TABLE 1.

RELATIVE ABUNDANCE OF WATERFOWL, OVERALL AND BY MONTH - FORT GIBSON REFUGE, OKLAHOMA, 1960-61 SEASON.

Waterfowl Species	Total Censused	% of Total Censused	% of October Total	% of November Total	% of December Total	% of January Total	% of February Total	% of March Total
Mallard	125,091	80.34	40.60	85.43	97.49	94.72	77.26	31.71
Common Merganser	9,526	6.12	-	.31	1.13	5.01	17.95	10.44
Snow Goose	6,707	4.31	13.66	.90	.02	.09	1.87	30.30
Scaup	3,991	2.56	20.88	4.95	.06	-	.12	2.18
Blue Goose	2,694	1.73	4.38	.43	-	-	1.17	11.84
Canada Goose	1,823	1.17	6.41	1.02	.93	.15	.11	3.70
Redhead	1,287	.83	.06	3.37	-	-	.03	.09
Green-winged Teal	1,258	.81	.65	2.19	.23	.01	-	2.08
Ring-necked Duck	843	.54	.11	.29	-	-	.66	3.40
Shoveler	527	.34	5.66	.11	-	-	-	.07
American Widgeon	487	.31	3.48	.03	-	-	.09	.99
Pintail	409	.26	.94	.17	.01	-	.59	.49
White-fronted Goose	339	.22	.02	-	-	-	-	2.22
Gadwall	317	.20	2.58	.18	-	-	.01	.19
Hooded Merganser	173	.11	-	.29	.12	.01	.07	.03
Blue-winged Teal	65	.04	.36	-	-	-	-	.23
Ruddy Duck	53	.03	.19	.10	-	.01	-	-
Bufflehead	42	.03	-	.11	-	-	-	-
Canvasback	37	.02	.02	.09	-	-	-	.01
Common Goldeneye	26	.02	-	.02	-	-	.05	-
Black Duck	10	.01	-	-	-	-	.02	.03
Whistling Swan	3	.002	-	.01	-	-	-	-

The snow goose was third in relative abundance throughout the censusing period. In March, 1961, it vied with the mallard for first place in abundance.

Scaups followed snow geese in relative abundance throughout the entire censusing period, and were especially abundant during October and November, 1960 and March, 1961.

Following scaup in order of their relative abundance of all waterfowl censused throughout the entire censusing period are the blue goose, Canada goose, redhead, green-winged teal, ring-necked duck, shoveler, American widgeon, pintail, white-fronted goose, gadwall, hooded merganser, blue-winged teal, bufflehead, ruddy duck, canvasback, common goldeneye, black duck, and whistling swan.

Listed in order of their relative abundance of all waterfowl censused during October only in 1960 were the: mallard, scaup, snow goose, Canada goose, shoveler, blue goose, American widgeon, gadwall, pintail, green-winged teal, blue-winged teal, ruddy duck, ring-necked duck, redhead, canvasback, and white-fronted goose.

Listed in order of their relative abundance of all waterfowl censused during November only in 1960 were the: mallard, scaup, redhead, green-winged teal, Canada goose, snow goose, blue goose, common merganser, ring-necked duck, hooded merganser, gadwall, pintail, shoveler, bufflehead, ruddy duck, canvasback, American widgeon, common goldeneye, and whistling swan.

Listed in order of their relative abundance of all waterfowl censused during December, 1960, are the: mallard, common merganser, Canada goose, green-winged teal, hooded merganser, scaup, snow goose, and pintail.

Listed in order of their relative abundance of all waterfowl censused during January, 1961, are the: mallard, common merganser, Canada goose, snow goose, green-winged teal, ruddy duck, and hooded merganser.

Listed in order of their relative abundance of all waterfowl during February, 1961, are the: mallard, common merganser, snow goose, blue goose, ring-necked duck, pintail, scaup, Canada goose, American widgeon, hooded merganser, common goldeneye, redhead, black duck, and gadwall.

Listed in order of their relative abundance of all waterfowl censused during March, 1961, are the: mallard, snow goose, blue goose, common merganser, Canada goose, ring-necked duck, white-fronted goose, scaup, green-winged teal, American widgeon, pintail, blue-winged teal, gadwall, redhead, shoveler, hooded merganser, black duck, and canvasback.

Migration Phenology

Census data, presented in Tables 2, 3, 4, 5, 6, and 7, point out the use made of the Fort Gibson Refuge by waterfowl and indicate the migration phenology of certain species using the refuge during the 1960-61 season. With one exception, a single mid-week census, these data are composed of week end observations. The possibility that migration movements occurred between censusing periods must be recognized. This study is nevertheless based entirely on weekly observations with the belief that the major migration movements of certain waterfowl species using the refuge during the 1960-61 season are pointed out. Grieb and Boeker (1954) state that weekly ground waterfowl censuses show a regular, definite yearly pattern of fall migration, by species.

TABLE 2.

WATERFOWL CENSUS - FT. GIBSON WATERFOWL REFUGE, OKLAHOMA, OCTOBER, 1960.

Waterfowl Species	Morning Census Day of Month						
	9	15	16	22	23	29	30
Geese:							
Canada	-	14	4	10	27	80	75
Snow	-	28	30	200	195	200	90
Blue	-	12	8	50	59	70	12
White-fronted	-	-	2	-	-	-	-
Total Geese	-	54	44	260	281	350	177
Ducks:							
Mallard	-	19	27	395	300	810	238
Green-winged Teal	-	-	-	-	14	6	-
Blue-winged Teal	-	30	-	-	-	-	-
Pintail	-	-	-	11	15	1	2
American Widgeon	-	-	-	-	-	1	120
Shoveler	-	-	-	-	-	-	276
Gadwall	-	16	-	20	-	9	-
Scaup	-	-	-	-	6	400	700
Redhead	-	-	-	-	-	-	-
Canvasback	-	-	-	2	-	-	-
Ring-necked Duck	-	-	-	6	-	-	-
Bufflehead	-	-	-	-	-	-	-
Common Goldeneye	-	-	-	-	-	-	-
Ruddy Duck	-	-	-	-	-	-	-
Common Merganser	-	-	-	-	-	-	-
Hooded Merganser	-	-	-	-	-	-	-
Black Duck	-	-	-	-	-	-	-
Total Ducks	0	119	71	694	616	1577	1513

Waterfowl Species	Evening Census Day of Month						
	8	9	15	16	22	28	30
Goose:							
Canada	55	-	50	4	70	70	80
Snow	-	-	41	38	120	107	100
Blue	-	-	12	10	40	45	50
White-fronted	-	-	-	-	-	-	-
Total Geese	55	0	103	52	230	222	230
Ducks:							
Mallard	-	-	1	6	35	684	900
Green-winged Teal	-	-	17	1	-	-	17
Blue-winged Teal	-	-	-	-	-	-	-
Pintail	-	-	-	-	-	20	30
American Widgeon	-	-	-	-	-	22	150
Shoveler	-	-	-	-	-	-	200
Gadwall	22	-	-	-	-	150	-
Scaup	-	-	-	-	-	50	600
Redhead	-	-	5	-	-	-	-
Canvasback	-	-	-	-	-	-	-
Ring-necked Duck	2	1	-	-	-	-	-
Bufflehead	-	-	-	-	-	-	-
Common Goldeneye	-	-	-	-	-	-	-
Ruddy Duck	-	-	-	-	-	3	13
Common Merganser	-	-	-	-	-	-	-
Hooded Merganser	-	-	-	-	-	-	-
Black Duck	-	-	-	-	-	-	-
Total Ducks	79	1	126	59	265	1151	2140

TABLE 3.

WATERFOWL CENSUS - FT. GIBSON WATERFOWL REFUGE, OKLAHOMA, NOVEMBER, 1960.

Waterfowl Species	Morning Census Day of Month							
	5	6	12	13	19	20	26	27
Geese:								
Canada	-	-	3	3	35	37	37	36
Snow	-	60	23	24	-	-	-	-
Blue	-	15	17	13	-	-	1	1
White-fronted	-	-	-	-	-	-	-	-
Total Geese	0	75	43	40	35	37	38	37
Ducks:								
Mallard	1850	1946	2305	2724	1199	2500	2200	1950
Green-winged Teal	200	90	32	20	-	-	2	4
Blue-winged Teal	-	-	-	-	-	-	-	-
Pintail	-	10	-	-	-	-	7	-
American Widgeon	-	-	-	-	-	-	1	-
Shoveler	-	-	-	-	-	-	-	-
Gadwall	-	15	-	4	-	-	-	-
Scaup	-	300	-	-	-	-	-	-
Redhead	4	250	-	-	-	-	-	-
Canvasback	-	7	-	-	-	-	-	4
Ring-necked Duck	-	-	-	-	-	-	-	-
Bufflehead	-	7	5	-	-	-	-	-
Common Goldeneye	-	-	-	-	-	-	-	-
Ruddy Duck	-	-	-	-	-	-	-	-
Common Merganser	-	-	3	3	18	11	70	-
Hooded Merganser	-	-	-	22	-	25	18	7
Black Duck	-	-	-	-	-	-	-	-
Total Ducks	2054	2700	2388	2813	1252	2573	2336	2002

Waterfowl Species	Evening Census Day of Month						
	4	5	6	12	13	20	26
Geese:							
Canada	70	80	-	3	3	37	37
Snow	80	100	-	23	27	-	-
Blue	30	50	-	17	14	-	1
White-fronted	-	-	-	-	-	-	-
Total Geese	180	230	-	43	44	37	38
Ducks:							
Mallard	480	1970	2067	2970	3255	2715	1859
Green-winged Teal	150	160	15	100	-	-	48
Blue-winged Teal	-	-	-	-	-	-	-
Pintail	-	4	40	-	-	3	-
American Widgeon	5	3	1	-	-	-	2
Shoveler	-	40	-	-	-	-	-
Gadwall	-	20	30	-	-	-	-
Scaup	500	850	200	-	-	1	-
Redhead	150	650	200	-	-	6	-
Canvasback	-	8	7	-	-	-	7
Ring-necked Duck	100	-	-	-	-	-	8
Bufflehead	-	-	30	-	-	-	-
Common Goldeneye	-	-	-	3	-	-	6
Ruddy Duck	7	15	15	-	-	-	-
Common Merganser	-	-	-	-	-	7	5
Hooded Merganser	-	3	-	-	-	17	17
Black Duck	-	-	-	-	-	-	-
Total Ducks	1572	3953	2605	3116	3299	2787	1970

TABLE 4.

WATERFOWL CENSUS - FT. GIBSON WATERFOWL REFUGE, OKLAHOMA, DECEMBER, 1960.

Waterfowl Species	Morning Census Day of Month					
	4	10	11	17	18	21
Geese:						
Canada	37	34	34	37	37	37
Snow	-	-	6	-	-	-
Blue	-	-	-	-	-	-
White-fronted	1	-	-	-	-	-
Total Geese	38	34	40	37	37	37
Ducks:						
Mallard	3250	1276	1500	3700	3150	3000
Green-winged Teal	-	-	-	5	14	10
Blue-winged Teal	-	-	-	-	-	-
Pintail	-	-	-	2	-	-
American Widgeon	-	-	-	-	-	-
Shoveler	-	-	-	-	-	-
Gadwall	-	-	-	-	-	-
Scaup	-	-	-	-	-	15
Redhead	-	-	-	-	-	-
Canvasback	-	-	-	-	-	-
Ring-necked Duck	-	-	-	-	-	-
Bufflehead	-	-	-	-	-	-
Common Goldeneye	-	-	-	-	-	-
Ruddy Duck	-	-	-	-	-	-
Common Merganser	-	-	-	-	140	6
Hooded Merganser	-	6	-	-	-	-
Black Duck	-	-	-	-	-	-
Total Ducks	3288	1916	1540	3744	3341	3068

Waterfowl Species	Evening Census Day of Month			
	3	4	11	21
Geese:				
Canada	37	-	-	-
Snow	-	-	-	-
Blue	-	-	-	-
White-fronted	-	-	-	-
Total Geese	37	-	-	-
Ducks:				
Mallard	2900	3000	1500	3130
Green-winged Teal	-	-	3	31
Blue-Winged Teal	-	-	-	-
Pintail	-	-	1	-
American Widgeon	1	-	-	-
Shoveler	-	-	-	-
Gadwall	-	-	-	-
Scaup	-	-	-	-
Redhead	-	-	-	-
Canvasback	-	-	-	-
Ring-necked Duck	-	-	-	-
Bufflehead	-	-	-	-
Common Goldeneye	-	-	-	-
Ruddy Duck	-	-	-	-
Common Merganser	155	-	-	4
Hooded Merganser	12	12	-	3
Black Duck	-	-	-	-
Total Ducks	3105	3012	1504	3168

TABLE 5.

WATERFOWL CENSUS - FT. GIBSON WATERFOWL REFUGE, OKLAHOMA, JANUARY, 1961.

Waterfowl Species	Morning Census Day of Month						
	2	8	15	21	22	28	29
Geese:							
Canada	38	-	-	4	-	-	-
Snow	3	3	3	3	3	3	-
Blue	-	-	-	-	-	-	-
White-fronted	-	-	-	-	-	-	-
Total Geese	41	3	3	7	3	3	-
Ducks:							
Mallard	1950	2400	1950	2200	3750	1050	1300
Green-winged Teal	-	-	1	-	-	-	-
Blue-winged Teal	-	-	-	-	-	-	-
Pintail	-	-	-	-	-	-	-
American Widgeon	-	-	-	-	-	-	1
Shoveler	-	-	-	-	-	-	-
Gadwall	-	-	-	-	-	-	-
Scaup	-	-	-	-	-	-	-
Redhead	-	-	-	-	-	-	-
Canvasback	-	-	-	-	-	-	-
Ring-necked Duck	-	-	-	-	-	-	-
Bufflehead	-	-	-	-	-	-	-
Common Goldeneye	-	-	-	-	-	-	-
Ruddy Duck	-	-	-	-	-	-	-
Common Merganser	40	120	1	3	245	10	52
Hooded Merganser	-	-	-	-	1	-	-
Black Duck	-	-	-	-	-	-	-
Total Ducks	1990	2520	1952	2203	3996	1060	1353

Waterfowl Species	Evening Census Day of Month						
	7	8	15	21	22	28	29
Geese:							
Canada	4	-	-	-	-	4	4
Snow	3	-	3	3	3	-	3
Blue	-	-	-	-	-	-	-
White-fronted	-	-	-	-	-	-	-
Total Geese	7	-	3	3	3	4	7
Ducks:							
Mallard	3450	3370	2100	3000	2775	2260	2250
Green-winged Teal	-	4	-	-	-	-	-
Blue-winged Teal	-	-	-	-	-	-	-
Pintail	-	-	-	-	-	-	-
American Widgeon	-	-	-	-	-	-	-
Shoveler	-	-	-	-	-	-	-
Gadwall	-	-	-	-	-	-	-
Scaup	-	-	-	-	-	-	-
Redhead	-	-	-	-	-	-	-
Canvasback	-	-	-	-	-	-	-
Ring-necked Duck	-	-	-	-	-	-	-
Bufflehead	-	-	-	-	-	-	-
Common Goldeneye	-	2	-	-	-	-	-
Ruddy Duck	-	-	-	-	-	-	-
Common Merganser	370	199	200	100	312	125	10
Hooded Merganser	-	1	-	-	-	-	2
Black Duck	-	-	-	-	-	-	-
Total Ducks	3820	3576	2300	3100	3087	2385	2262

TABLE 6.

WATERFOWL CENSUS - FT. GIBSON WATERFOWL REFUGE, OKLAHOMA, FEBRUARY, 1961.

Waterfowl Species	Morning Census Day of Month							
	5	6	11	12	18	20	26	27
Geese:								
Canada	-	5	5	5	-	-	-	-
Snow	3	3	-	3	3	3	120	130
Blue	1	1	-	1	-	-	60	95
White-fronted	-	-	-	-	-	-	-	-
Total Geese	4	9	5	9	3	3	180	225
Ducks:								
Mallard	1669	2248	1582	1537	1410	818	850	1280
Green-winged Teal	-	-	-	-	-	-	-	-
Blue-winged Teal	-	-	-	-	-	-	-	-
Pintail	1	4	7	9	-	-	4	70
American Widgeon	-	-	-	-	-	-	4	23
Shoveler	-	-	-	-	-	-	-	-
Gadwall	-	-	-	-	-	-	-	2
Scaup	-	-	-	-	-	-	-	-
Redhead	-	-	-	-	-	-	-	8
Canvasback	-	-	-	-	-	-	-	-
Ring-necked Duck	-	-	-	4	-	17	-	23
Bufflehead	-	-	-	-	-	-	-	-
Common Goldeneye	-	-	6	5	-	-	-	-
Ruddy Duck	-	-	-	-	-	-	-	-
Common Merganser	12	7	609	323	64	93	610	50
Hooded Merganser	-	-	-	4	-	-	-	-
Black Duck	-	-	-	-	-	2	-	1
Total Ducks	1682	2259	2204	1882	1474	930	1468	1457

Waterfowl Species	Evening Census Day of Month							
	4	5	11	12	18	19	25	26
Geese:								
Canada	5	-	-	5	5	5	-	1
Snow	3	-	3	-	3	3	200	120
Blue	1	-	1	-	-	-	130	85
White-fronted	-	-	-	-	-	-	-	-
Total Geese	9	-	4	5	8	8	330	206
Ducks:								
Mallard	1731	2323	1877	1747	1500	1203	1141	938
Green-winged Teal	-	-	-	-	-	-	-	-
Blue-winged Teal	-	-	-	-	-	-	-	-
Pintail	1	-	6	25	20	17	10	15
American Widgeon	-	-	-	-	-	1	2	-
Shoveler	-	-	-	-	-	-	-	-
Gadwall	-	-	-	-	-	-	-	-
Scaup	-	-	-	25	-	1	13	-
Redhead	-	-	-	-	-	-	-	-
Canvasback	-	-	-	-	-	-	-	-
Ring-necked Duck	-	-	-	50	4	74	16	24
Bufflehead	-	-	-	-	-	-	-	-
Common Goldeneye	-	2	-	2	-	-	-	-
Ruddy Duck	-	-	-	-	-	-	-	-
Common Merganser	818	403	736	300	-	262	695	755
Hooded Merganser	5	-	4	10	-	-	-	-
Black Duck	-	-	-	-	-	2	-	-
Total Ducks	3400	2728	2623	2159	1524	1560	1877	1732

TABLE 7.

WATERFOWL CENSUS - FT. GIBSON WATERFOWL REFUGE, OKLAHOMA, MARCH, 1961.

Waterfowl Species	Morning Census Day of Month							
	4	5	12	13	19	20	26	27
Geese:								
Canada	-	-	-	-	5	5	140	130
Snow	-	-	-	130	35	122	1000	1150
Blue	-	-	-	80	42	70	360	390
White-fronted	-	-	6	-	15	15	65	65
Total Geese	-	-	6	210	97	212	1565	1735
Ducks:								
Mallard	308	1060	452	339	73	173	13	17
Green-winged Teal	3	8	6	-	13	7	13	-
Blue-winged Teal	-	-	-	-	-	-	16	-
Pintail	-	6	-	-	-	-	-	-
American Widgeon	8	-	-	4	-	-	21	44
Shoveler	-	-	-	-	-	-	2	2
Gadwall	-	-	5	2	-	-	6	4
Scaup	-	-	20	40	-	-	-	28
Redhead	-	-	-	4	-	-	-	-
Canvasback	-	-	-	-	-	-	-	-
Ring-necked Duck	-	-	-	30	8	-	-	2
Bufflehead	-	-	-	-	-	-	-	-
Common Goldeneye	-	-	-	-	-	-	-	-
Ruddy Duck	-	-	-	-	-	-	-	-
Common Merganser	130	44	243	46	7	4	41	32
Hooded Merganser	-	2	-	-	-	-	-	-
Black Duck	2	1	-	-	-	-	-	-
Total Ducks	451	1121	726	465	101	184	112	135

Waterfowl Species	Evening Census Day of Month							
	4	5	11	12	18	19	26	27
Geese:								
Canada	-	-	-	-	5	5	140	130
Snow	35	1	-	1	34	77	1000	1000
Blue	25	2	-	2	38	63	360	360
White-fronted	-	-	6	6	15	13	65	65
Total Geese	60	3	6	9	92	158	1565	1555
Ducks:								
Mallard	664	521	509	456	56	104	29	24
Green-winged Teal	12	4	18	6	87	109	5	23
Blue-winged Teal	-	-	-	-	-	-	9	4
Pintail	6	52	-	3	3	3	1	-
American Widgeon	15	14	-	-	-	-	16	28
Shoveler	-	-	-	-	-	-	6	1
Gadwall	-	-	-	-	-	3	9	-
Scaup	3	6	49	30	9	50	-	95
Redhead	-	-	10	-	-	-	-	-
Canvasback	-	-	-	-	-	-	2	-
Ring-necked Duck	55	50	182	10	20	130	22	5
Bufflehead	-	-	-	-	-	-	-	-
Common Goldeneye	-	-	-	-	-	-	-	-
Ruddy Duck	-	-	-	-	-	-	-	-
Common Merganser	189	366	195	85	21	46	130	1
Hooded Merganser	-	-	2	-	-	-	-	-
Black Duck	1	-	-	-	-	-	-	1
Total Ducks	945	1013	965	590	196	445	229	182

MALLARD. Mallards made up about 80% of the total number of waterfowl censused at the Fort Gibson Refuge throughout the course of this study.

They were first sighted, by this investigator, on the refuge during the week end of October 15-16, 1960. A significant rise in the mallard population was noted on the morning of October 22, when 395 mallards were counted, as compared to only 27 being counted the morning of October 16, 1960. Only 35 mallards were counted on the censusing area on the evening of October 22. During the final week end in October the mallard population continued to increase until a peak number of 900 was noted on the evening of October 30, 1960. Crail (1951) reported that mallard flights begin to build up in Missouri at the end of October.

By the next week end, November 5-6, 1960, the mallard population using the refuge had more than doubled. Whereas 900 mallards were noted on the evening of October 30, 1960, 1,850 were censused on the morning of November 5, 1960, and on that evening 1,970 mallards were tallied. The following morning 1,946 mallards were censused and on the evening of November 6, 2,067 mallards were estimated to be on the censusing area. Thus a significant increase in the mallard population occurred the first week end in November, 1960. Bellrose and Sieh (1960) reported spectacular waterfowl flights in the Mississippi Flyway from October 31 through November 3 in 1955; from November 6 through November 8 in 1956; and from October 23 through October 25 in 1957. They noted that an observer in Minnesota reported that the 1957 flight was composed largely of mallards.

As indicated in Table 3, the peak mallard population in November, 1960, was recorded on the week end of November 12-13. On the morning

of November 13, 2,724 mallards were censused, while on that evening 3,255 were estimated to be on the censusing area. Crail (1951) reported that in Missouri the fall peak of the mallard population was reached about November 10 in 1947, about November 30 in 1948, about October 25, November 15, and December 15 in 1949, and about November 15 in 1950.

Throughout the third week end in November, 1960, the mallard population remained at a level slightly below that noted the week end of November 12-13, 1960. On the morning of November 20, 2,500 mallards were censused, and on that evening 2,713 were noted.

On the evening of November 26, 1960, only 1,839 mallards were observed on the censusing area, while 1,950 were censused on the morning of November 27. Thus the mallard population decreased during the final week end in November, 1960. Bellrose (1944), in reporting a five-year average, 1938-1942, of the seasonal migration of the mallard in the Illinois River Valley, illustrated that the peak in the population occurred November 23-29. After this peak was reached the population declined steadily through mid-January. Bellrose did, however, in illustrating the chronology of the 1942 mallard flight in the Illinois River Valley, show that the peak of the flight that year was reached about November 18, after which the population decreased sharply. These peaks, although in most cases occurring later than was noted at the Fort Gibson Refuge in 1960, do parallel the peak observed at the refuge in November, 1960. The refuge population did not, however, continue to steadily decline through January, as Bellrose had observed, but increased to a level slightly higher than the greatest mallard population recorded during November.

On the morning of December 4, 1960, 3,250 mallards were censused, constituting a sharp increase over the number observed during the final week end in November. A decline in the mallard population was noted on December 11, when only 1,500 mallards were censused. The population increased again the following week end, and numbered about 3,000 on both the morning and evening of December 21, 1960.

On the morning of January 2, 1961, 1,950 mallards were estimated to be present on the censusing area. No evening census was made on this date. During January, evening censuses on five occasions were higher than morning censuses of the same dates. Perhaps this is a result of mallard feeding activity being greater at the time of the evening census. Since no evening census was made on the refuge on the evening of January 2, 1961, and since there is a strong possibility that such a census would have been considerably higher than the morning census of January 2, it is not known if the mallard population was actually lower on January 2 than that noted December 21, 1960.

On the evening of January 7, 3,450 mallards were censused. The following morning, January 8, 2,400 were tallied, while on that evening 3,370 were censused.

Only 1,950 mallards were censused on the morning of January 15, while 2,100 were noted that evening. This decrease from the mallard size of January 7-8 possibly represents a migration flight from the refuge.

The mallard population at the refuge rose again on the week end of January 21-22. On the morning of January 22, 1961, 3,750 mallards were censused; but on that evening only 2,775 were censused.

Only 1,050 mallards were observed on the morning of January 28, 1961, while 2,250 were censused the evening of January 29. Apparently the drop in the mallard population noted on the evening of January 22, 1961, was the beginning of a somewhat gradual population decline associated with the annual spring migration.

Evening censuses made in February, 1961, show a steady decline in the mallard population from a high of 2,323 on February 5 to a low of 938 on the evening of February 26, 1961 (Table 6). Although morning censuses of February do not show such a steady decline, it is noted that the mallard population observed on mornings dropped from a high of 2,248 on the morning of February 6 to 850 and 1,280 on the mornings of February 26 and 27, respectively.

As noted in Table 7 the mallard population using the refuge continued to decline in numbers during March, 1961. On the evening of March 4, 664 mallards were censused. On the following morning 1,060 mallards were noted, and on the evening of March 5, 521 mallards were censused. Only 456 mallards were estimated to be present on the censusing area on the evening of March 12 and only 339 were censused the following morning. On the evening of March 19, 1961, 104 mallards were observed, while 173 were noted the following morning. Only 17 mallards were counted the morning of March 27, while 24 were observed that evening.

In summary, following a buildup in October, 1960, the mallard population using the Fort Gibson Refuge continued to increase in numbers through November 13. The following week end, November 19-20, it remained about stable, then on the final week end of that month dropped significantly. Dodson (n.d.), in a 1950-52 study, noted that the heaviest mallard flights in Oklahoma developed during November. After

again increasing the first week end in December, the mallard population decreased the week end of December 10-11. It rose again however the following week end to the level noted during the first week end in December and remained stable through December 21, 1960. The next decline in the population was noted January 15, 1961, while on the final week end of that month the beginning of spring migration became evident.

Mallards apparently overwintered on the refuge throughout December and January. Crail (1951) observed that overwintering species provided the only significant waterfowl numbers observed in Missouri during December. The fact that some mallards did remain on the refuge for considerable periods of time, even as early as November, is suggested by one banding record from the area. One mallard was banded at the refuge on November 10, 1960 then bagged by a hunter on December 10 only three miles southwest of the refuge. Throughout December and January, the mallard population did remain more or less stable as would be expected of an overwintering population. Following what appeared to be the onset of the spring migratory movement during the final week end in January, a steady decline in the mallard population on the refuge was observed throughout February and March, 1961.

GREEN-WINGED TEAL. Green-winged teal were first censused at the refuge on the evening of October 15, 1960, when 17 were seen. During the morning census of October 23, 14 were observed. On the morning of October 29 six were counted, and on the following evening 17 were tallied. It seems that the green-winged teal population remained rather constant during October.

A great increase in the population was observed the first week end in November, 1960. On the evening of November 4, 150 green-winged

teal were censused, and on the following morning 200 were noted. During the evening census of November 5, 160 green-wings were seen. On the morning of November 6, 90 were tallied, while on that evening only 15 were seen. During the morning count of November 12, 30 green-wings were seen, and 100 were censused that evening. On the morning of November 13, 20 green-winged teal were tallied. No green-wings were observed on the refuge during the week end of November 19-20, 1960. On the evening of November 26, 48 were noted, but on the following morning only four green-wings were observed.

The greatest number of green-winged teal noted during the fall of 1960 were observed on the first and second week ends of November. Bellrose (1944) found in the Illinois River Valley that the peak seasonal migrations of the green-winged teal during a five year period, 1938-42, took place about October 12-13 and November 1 with a decline between. Heit (1948) noted that green-winged teal waited until late November and December before appearing at Texas coastal areas during the 1947-48 season. Crail (1951) found that the peak fall migration of the green-winged teal in Missouri occurred October 10 in 1947, November 5 in 1948, November 5-10 in 1950.

Green-winged teal were not censused in December, 1960, until the evening of December 11 when three were counted. On the evening of December 17, five were seen, and on the following morning 14 were tallied. On the evening of December 21, 1960, 31 green-winged teal were censused.

During January 1961, green-winged teal were censused on two week ends. On the evening of January 8, four were seen, and on the morning of January 15, one was noted.

No green-wings were censused in February, 1961.

On the evening of March 4, 1961, 12 green-winged teal were counted on the censusing area, and on the following evening four were seen.

BLUE-WINGED TEAL. Throughout the fall migration period blue-winged teal were observed only on one occasion at the Fort Gibson refuge. On the morning of October 15, 1960, 30 were observed. No others were seen throughout November and December of 1960 and January and February of 1961. Grieb and Boeker (1954), in studying waterfowl migration movements in Colorado during 1950, 1951, and 1952, noted that the major flights of blue-wings begin in August and end by October 11 in Colorado. Siegler (1945) reported blue-winged teal appearing in eastern Texas the first part of August, and increasing until the end of September when their population declines. Bellrose (1944), studying duck population and kill in the Illinois River Valley from 1938-1942 reported that, for a five-year average, the seasonal migration peak of the blue-winged teal was reached during the first two weeks in September after which the population declined until by the first week in November no blue-wings were present. Bennett (1938) observed that the main blue-winged teal fall flight took place in Iowa from October 15 to October 22 in 1932.

No blue-winged teal were censused during early spring of 1961 until the morning of March 26 when 16 were seen. On that evening nine were counted. During the morning census of March 27, 1961, six blue-wings were observed and on that evening four were counted. Although a complete census was not made in April, 1961, several blue-winged teal were seen on the refuge censusing area on April 1, 1961. At that time

the refuge was opened to recreational activities, consequently boating and fishing caused considerable disturbance to waterfowl on the refuge waters. Nevertheless, while at the refuge on April 1, this investigator did see more blue-wings flying over refuge waters that had previously been seen. Thus the major spring migration movement of blue-winged teal through the refuge began the last week end in March, but probably was greatest sometime in April, 1961. Siegler (1945) noted that the blue-winged teal is still common in eastern Texas at the end of April. Bennett (1938) stated that in general the main blue-winged teal flight of the spring passed through the southern states between March 15 and April 15, 1932-36.

PINTAIL. Pintails were first censused on the morning of October 22, 1960, when 11 were counted. The following morning 15 were sighted. An increase in the pintail population was noted at the refuge on the final week end in October. On the evening of October 28, 1960, 20 pintails were seen, and on the evening of October 30, 30 were counted.

Although no pintails were observed on the censusing area on the evening of November 4, 1960 or the morning of November 5, four were seen on the evening of November 5. On the morning of November 6, ten were counted, and on that evening 40 were censused. Very few pintails were sighted on the censusing area throughout the remainder of November. On the evening of November 20, three were noted, and on the morning of November 26, seven were counted.

Only three pintails were seen on the censusing area during December, 1960. On the evening of December 11, one was seen, and on the morning of December 17, two were noted.

No pintails were observed on the censusing area during week ends in January.

One pintail was seen on both the evening of February 4, 1961 and the morning of February 5, 1961. Although none were observed on the evening of February 5, four were noted the following morning, February 6. An increase in the pintail population was observed on the week end of February 11-12, 1961. On the morning of February 11, seven pintails were counted, and on that evening six were seen. On the morning of February 12, nine were censused and on that evening 25 were counted on the censusing area. During the morning census of February 18, 20 were censused, while on the following evening, 17 were seen. No pintails were observed on either the morning of February 19 or February 20. On the evening of February 25, 1961, ten pintails were censused. The following morning four were counted, while on that evening 15 were seen. A sharp increase in the pintail population was noted on the morning of February 27, 1961, when 70 were censused.

Although no pintails were seen on the refuge on the morning of March 4, 1961, on that evening six were censused. On the morning of March 5, six were noted and on that evening 52 were tallied. Throughout the remainder of March, no more than three pintails were seen during single censusing period.

The major fall migration movement of pintails as observed on week ends at the refuge was noted the last week end in October and the first week end in November, 1960. Crail (1951), in analyzing waterfowl flights in Missouri, reported that pintail populations reached a peak in Missouri about October 30 in 1947, October 30 in 1949, and November 10 in 1950. Bellrose (1944) found that the peak fall migration of the pintail in the Illinois River Valley for a five-year average,

1938-1942, was reached October 19-25. Grieb and Boeker (1954), studying fall movements of waterfowl in Colorado, found the pintail flights to be erratic; in 1950 the peak of the major flights was reached October 17-24; in 1951 it was reached on November 29.

The largest population of pintails counted during a single census in the early spring of 1961 was noted on the final week end in February, while a relatively large population was also recorded the first week end in March, 1961. Siegler (1945) observed that pintails become numerous in eastern Texas toward the end of February. Heit (1948) noted that pintails moved northward away from the coastal region of Texas in February, 1948.

AMERICAN WIDGEON. American widgeons were first seen on the refuge during week ends in the fall of 1960 on the final week end in October. On the evening of October 28, 22 were counted, while only one was seen the following morning. An increase in the American widgeon population was noted October 30. On that morning 120 were censused and that evening 150 were estimated to be on the censusing area.

By the following week end the population had decreased. Only five were counted the evening of November 4, 1960. None were seen the morning of November 5, and only three were counted that evening. No American widgeons were observed on the morning of November 6, and only one was seen that evening. With the exception of three censused on November 26, none were seen throughout the remainder of November, 1960.

Only one American widgeon was censused during December, 1960; that being one tallied the evening of December 3, 1960.

No American widgeons were seen during week ends in January, 1961, until the morning of January 29, when one was observed.

No American widgeons were seen on the censusing area during week ends in February, 1961, until the evening of February 19, when one was counted. On the evening of February 25, two were tallied, and on the morning of February 26, four were noted. Although no American widgeons were observed on the evening of February 26, 23 were censused the following morning.

On the morning of March 4, 1961, eight American widgeons were seen, while on that evening 15 were counted. None were observed the morning of March 5, but on that evening 14 were censused. The only American widgeon seen during the week end of March 11-12-13, were four that were censused on the morning of March 13. None were seen on the week end of March 19-20, 1961. A significant increase in the American widgeon population was noted the final week end in March. On the morning of March 26, 21 American widgeons were counted and on that evening 16 were observed on the censusing area. During the morning census of March 27, 44 were counted, and on that evening 28 were observed.

The largest American widgeon population censused on week ends in the fall of 1960 was noted the last week end in October. Grieb and Boeker (1954) reported that in Colorado the peak of the American widgeon flight in the fall of 1950 occurred October 24, and that this peak was reached on both November 16 and November 29 in 1951. These authors also state that the American widgeon is a winter resident in Colorado. Bellrose (1944) over a five-year period, 1938-1942, found that the average peak of the fall migration of the American widgeon in Illinois River Valley was reached October 12-18.

American widgeons were not seen at the Fort Gibson Refuge in significant numbers in the early spring of 1961 until the final week end

in February. The peak American widgeon population observed during the 1961 spring censusing period, through March 27, was noted on the final week end in March.

SHOVELER. Shovelers were first censused at the Fort Gibson Refuge during week ends of the 1960 fall season on the week end of October 29-30. On the morning of October 30, 1960, 276 shovelers were censused, and on that evening 200 were tallied.

During November, 1960, only 40 shovelers were censused on the censusing area; these were observed on the evening of November 5.

No shovelers were seen on the censusing area during week ends of December, 1960, January, 1961, or February, 1961.

Shovelers were not observed on the censusing area in March until the final week end of that month. On the morning of March 26, two were noted, and on that evening six were counted. On the following morning, March 27, two were seen, while on that evening one was observed.

Although a complete census was not made in April, 1961, observations made on the refuge on April 1, 1961, revealed that several shovelers were present on the refuge.

Thus, the peak shoveler migration movement of the 1960 fall season, observed on week ends, was recorded the final week end in October. Bellrose (1944) averaging the migration movements of the shoveler over five years, 1938-1942, found that the average peak of the fall migration of this duck is reached in the Illinois River Valley during the final week of October. Grieb and Boeker (1954) observed that the shoveler begins moving through northern Colorado in late September or early October, usually reaching a peak about

about the third week of October.

Shovelers were not observed on the refuge during the spring migration season until the final week end in March. Their peak movements through the refuge probably occurred after that week end. Siegler (1945) noted that shovelers were still common in eastern inland Texas at the end of April.

GADWALL. Gadwall were observed on the refuge during the first week end of censusing in the fall of 1960. On the evening of October 8, 1960, 22 were observed. None were seen on either the morning or evening of October 9. The only gadwalls noted the week end of October 15-16 were 16 that were seen on the morning of October 15. On the morning of October 22, 20 gadwalls were counted on the censusing area; no others were seen that week end. During the evening census of October 28, 150 gadwalls were censused, while only nine were seen the follow-morning.

On the morning of November 5, 1960, 20 gadwalls were counted on the censusing area. During the morning census of November 6, 15 were seen, and on that evening 30 were censused. The only other gadwalls seen during week ends in November were four that were observed on the morning of November 13, 1960.

No gadwalls were seen during week ends of December, 1960, or January, 1961.

The only gadwalls censused during February, 1961, were two that were counted on the morning of February 27, 1961.

During the first week end in March, 1961, no gadwalls were seen on the census area. On the morning of March 12, five were censused, and on the following morning two were seen. The only ones seen the

next week end were three that were observed on the evening of March 19. On the morning of March 26, 1961, six gadwalls were tallied; nine were censused on that evening. Although four gadwalls were seen on the morning of March 27, none were observed on the censusing area that evening.

Census data thus indicate that the major fall migration movements of gadwall through the refuge on week ends of 1960 reached a peak during the final week end of October. After the first week end of November, 1960, the gadwall population dropped to almost zero and remained there until the second week end of March, 1961. Grieb and Boeker (1954) found that gadwalls begin moving through northern Colorado in late September or early October, usually reaching a peak about the third week of October, and then generally are gone by the first to third week of November. This fall migration pattern that they observed for the gadwall in northern Colorado very closely approximates the apparent migration pattern noted at the Fort Gibson Refuge during the fall of 1960.

Relatively few gadwall were observed on the refuge during week ends of the early spring of 1961. They first appeared on the final week end of February, then apparently reached a peak in numbers on the final week end of March, 1961.

SCAUP. Scaups were first censused at the Fort Gibson Refuge during week ends of the 1960-61 season on the week end of October 22-23, 1960. During the morning census of October 23, six were seen on the censusing area. A significant increase in the scaup population was noted the final week end of October, 1960. On the morning of October 28, 50 were counted, while on the following morning, 400 were estimated to be on the censusing area. On the morning of October 30, 700 scaups were censused, and on that evening 600 were tallied.

The scaup population remained relatively high in numbers on the first week end in November, 1960. On the evening of November 4, 500 were censused. Although no scaups were seen the morning of November 5, on that evening 850 were censused. On the morning of November 6, 300 scaups were noted, and on that evening 200 were censused. Throughout the remaining week ends of November, 1960, only one scaup was seen.

Except for 15 scaups counted on the morning of December 21, 1960, no scaups were observed on the censusing area of the refuge during December, 1960.

No scaups were censused on the censusing area during week ends of January, 1961.

None were censused in February, 1961, until the evening of February 12, when 25 were counted. One scaup was seen the following week end on the evening of February 19. On the evening of February 25, 13 were noted; no other scaups were seen during this final week end in February.

Although no scaups were censused during the morning censuses of the initial week end of March, 1961, three were observed the evening of March 4, and on the following evening six were noted. The scaup population increased the following week end; 49 scaups were censused the evening of March 11. On the morning of March 12, 20 were counted, and on that evening 30 were censused. During the morning census of March 13, 1961, 40 scaups were tallied. On the evening of March 18, nine were observed, while on the following evening 50 were counted. No scaups were sighted on the mornings of March 19 and 20; also, none were seen during the morning or evening of March 26, 1961. On the morning of March 27, 28 were counted and on that evening 95 were censused.

Week end censusing conducted at the refuge during the fall of 1960 indicates that the peak fall migration movement of scaups through Fort Gibson Refuge took place during the final week of October and first week of November. Bellrose (1944), averaging five years of censusing, 1938-1942, noted that the seasonal fall migration peak of the lesser scaup occurred November 9-15 in the Illinois River Valley. Grieb and Boeker (1954) observed that lesser scaups commence moving through northern Colorado in late September or early October, usually reach a peak about the third week of October, and generally are gone by the first to third week of November. This migration pattern follows closely the fall migration movements of the scaup as noted on week ends of October and November, 1960 at the Fort Gibson Refuge.

The peak spring migration of the scaup through the refuge is not as apparent as was the fall movement. Scaups were noted in much greater abundance in the fall migration period of 1960 at the refuge than they were during the early spring migration period of 1961.

Scaups were first observed during the early spring on the second week end in February, 1961. A slight increase in the population was noted on the second week end of March, 1961, and another increase was observed on the final week end of that month. Bent (1923) stated that the lesser scaup's average date of arrival at Loveland, Colorado, is March 12. Kortright (1942) states that the lesser scaup in the spring are on the move in March and April. Thus while the peak spring migration movement of scaups occurred during the final week end in March, a greater movement could possibly have occurred in early April, 1961.

REDHEAD. Redheads were first censused during the fall season of 1960 at the Fort Gibson Refuge on the week end of October 15-16. On the evening of October 15, five were observed. No other redheads were censused during October week ends of 1960.

A sharp increase in the redhead population was noted the first week end in November, 1960. On the evening of November 4, 150 redheads were censused. Only four were seen the morning of November 5, but on that evening 650 were censused. On the morning of November 6, 250 redheads were tallied, and on that evening 200 were observed. The only redheads seen on the refuge throughout the remaining week ends in November were six which were sighted on the evening of November 20.

No redheads were censused during week ends of December, 1960 or January, 1961.

The only ones seen during week ends in February, 1961, were eight which were observed on the morning of February 27.

Redheads were noted during two censusing periods on the second week end in March 1961, and were not seen on any other week end of that month. On the evening of March 11, ten redheads were censused, and on the morning of March 13, four were counted.

Thus the peak redhead population seen during week ends of the 1960 fall migration period at the Fort Gibson Refuge was recorded on the first week end in November. Grieb and Boeker (1954) noted that the redhead begins moving through northern Colorado in late September or early October, usually reaches a peak about the third week of October, and generally is gone by the first to third week of November. The peak was reached somewhat later at the refuge that Grieb and Boeker noted in Colorado, but the redhead was absent at the refuge by the third week of

November, 1960. Crail (1951) noted that the redhead moves through Missouri in November.

Very few redheads were observed during the spring censusing period at the refuge. The only ones censused during February and March of 1961 were seen during the last week end in February and the second week end in March. Kortright (1942) reported that in the spring, redheads are on their way north by the middle of March.

CANVASBACK. Very few canvasbacks were seen at the Fort Gibson Refuge during week ends of the 1960-61 season.

On the morning of October 22, 1960, two were censused at the Fort Gibson Refuge. These were the only ones noted throughout October.

A greater number of canvasbacks were counted on the censusing area during the first week end in November, 1960, than during any other week end of the 1960-61 season. On the evening of November 5, eight were observed. On both the morning and evening of November 6, seven canvasbacks were observed. Not until the final week end of November were canvasbacks again observed at the refuge. On the evening of November 26, seven were seen, and on the morning of November 27, four were counted.

Canvasbacks were not seen on the censusing area during week ends in December, January, or February.

Only two were noted on week ends in March, these being seen on the evening of March 26.

The greatest number of canvasbacks counted during a week end of the fall season were noted on the first week end in November. Allen (1931) pointed out that some canvasbacks move southward in October, but the bulk in November and December when frozen out of their nesting grounds. Kortright (1942) reported that A. Hockbaum, in notes sent to him, says:

"The early flight of Canvas-backs from the north is apparently influenced by weather, as strong north winds and storms in September always bring down an early flight to the Delta Marsh. Weather, however, apparently plays no part in the mass movement of Canvas-backs southward from Delta, and, come what may, north winds, ice and snow, or mild Indian summer — the Canvas-backs always leave Delta Marsh about the middle of October."

Canvasbacks were observed at the refuge only on the final week end in March. Kortright (1942) states that canvasbacks start their northward voyage in late February and early March.

RING-NECKED DUCK. Ring-necked ducks were seen at the Fort Gibson Refuge on the first week end of censusing, October 8-9, of the 1960-61 season. although no ring-necks were observed on the mornings of this first week end, on the evening of October 8, two were seen, and on the following evening one was noted.

During the evening census of November 4, 100 ring-necks were censused. No others were observed during week ends in November until the evening of November 26 when eight were counted on the censusing area.

No ring-necks were seen on the refuge during week ends in December, 1960, or January, 1961.

None were seen the first week end in February, but on the morning of February 12, four were counted, and on that evening 50 were tallied. On the evening of February 18, four were seen. None were sighted on the censusing area the following morning, but on that evening, 74 ring-necks were censused. On the morning of February 20, 17 ring-necks were tallied. During the evening count of February 25, 16 ring-necks were observed. None were seen on the morning of February 26, but on that evening 24 were counted. On the morning of February 27, 23 ring-necks were censused.

Although no ring-necks were seen on the censusing area during the morning censuses of the first week end of March, 55 were counted on the evening of March 4, and on the following evening 50 were observed. On the evening of March 11, a significant increase in the ring-neck population was noted. On that evening 182 were censused. No ring-necks were seen on the morning of March 12, and only ten were counted that evening. On the following morning 30 ring-necks were censused. The ring-necked population reached a greater level of abundance on the third week end in March. On the evening of March 19, 130 were estimated to be on the censusing area. Only eight ring-necks were observed on the morning of March 19, and on the following morning none were seen. No ring-necks were observed on the morning of March 26, but on that evening 22 were counted. On the morning of March 27, only two ring-necks were tallied and on that evening only five were noted on the censusing area.

The peak fall migration movement of the ring-necked duck through the Fort Gibson Refuge appears, from week end censusing, to have taken place the first week end in November, 1960.

Bellrose (1944) over a 5-year period 1938-1942, found that the average peak fall migration movement of the ring-necked duck in the Illinois River Valley occurred November 2-8. Mendall (1958) noted that the ring-neck is an erratic, yet comparatively early fall migrant in Maine, coming after the redhead, pintail, and blue-winged teal. The ring-neck was censused in greatest numbers shortly after the peak movements of the pintail and blue-winged teal were noted at the Fort Gibson Refuge, but the peak redhead migration coincided with the ring-neck's period of greatest abundance.

The 1961 spring migration movements of the ring-neck through the refuge are not so clearly evident as its fall migration. One significant increase in the population was noted the second week end in February. The population appeared to be at the same level on the third week end of that month. A decline in ring-neck numbers was observed the final week end of February. An increase in the population was noted on the first week end in March, with the peak spring population observed on the second and third week ends in March, after which a decline was noted. Kortright (1942) observed that ring-necks are usually well on their way in the latter part of March and April. Crail (1951) noted in Missouri that as March wanes the first ring-necks move through that state. Thus the spring migration movements of the ring-neck at the Fort Gibson Refuge during week ends of 1961 did not closely parallel its movements in other areas of the nation in past seasons. Possibly this is correlated with what Mendall (1958) describes as the restless, erratic wanderings of the ring-neck on its wintering grounds, which at times approach vagrant migrations.

BUFFLEHEAD. Buffleheads were seen on week ends of the 1960-61 season at the Fort Gibson Refuge in comparatively small numbers (Table 1).

They were first censused at the refuge on the week end of November 5-6. On the morning of November 6, seven were seen and on that evening 30 were counted. The only other buffleheads seen on the refuge during week ends of the 1960-61 season were five which were observed on the morning of November 12, 1960.

Thus, the only migration movements of the bufflehead observed at the refuge on week ends of the 1960-61 season was noted during the first and second week end in November, 1960. Kortright (1942) re-

ported that the bufflehead moves south with the hardier ducks late in October and November.

COMMON GOLDENEYE. Common goldeneyes were first seen during week ends of the 1960-61 season at the Fort Gibson Refuge on the week end of November 12-13. On the evening of November 12, three were observed. Two weeks later, on the evening of November 26, six common goldeneyes were noted.

Common goldeneyes were next seen on the censusing area on the evening of January 8, when two were observed.

On the evening of February 5, two were again noted on the censusing area. More common goldeneyes were observed on the second week end of February than during all other week ends of the 1960-61 season combined. On the morning of February 11, six were counted. During the morning census of February 12, five were seen, and on that evening two were noted.

No common goldeneyes were seen on the refuge during week ends in March.

Common goldeneyes were first seen on the refuge on the second week end in November, while a greater number was observed the last week end in November. None were seen after this final week end in November until the first of January. Grieb and Boeker (1954) found that in Colorado the American goldeneyes (common goldeneyes) begin movement the first week in November, peak sometime during the last of November, and, leave the area by late December.

The major common goldeneye spring movement of 1961 at the refuge was detected on the second week end of February. Kortright (1942)

states that the common goldeneye is an early spring migrant, and while April is the month of greatest movement, many start moving north in March and follow the iceline.

RUDDY DUCK. Ruddy ducks were first censused on the final week end of October at the Fort Gibson Refuge during the 1960-61 season. On the evening of October 28, three were seen, and on the evening of October 30, 13 were observed.

Ruddies were also seen on the censusing area during the first week end in November. On the evening of November 4, seven were noted, and on the evenings of November 5 and 6, 15 were censused.

No ruddy ducks were censused on the refuge throughout the remainder of the 1960-61 season.

Apparently Oklahoma is not included in a major fall migration route of the ruddy duck (Aldrich, et al, 1949). Bent (1925) indicates that the major wintering ranges of the ruddy duck are located along the Atlantic and Pacific coasts.

The data obtained at the refuge indicate that the major fall migration movement of the ruddy duck through the refuge took place during the last week end of October and the first week end of November. Grieb and Boeker (1954) observed in Colorado that the ruddy duck begins moving through northern Colorado in late September or early October, usually reaches a peak about the third week of October, and generally is gone by the first to third week of November. It is interesting to note that Bellrose (1944) found the peak seasonal migration of the ruddy duck to occur between October 19-25 and November 2-8 in the Illinois River Valley.

No ruddy ducks were seen at the refuge during week ends of the 1961 spring migration period.

COMMON MERGANSER. The common merganser made up 6.12% of the overall total of waterfowl censused at the Fort Gibson Refuge during week ends of the 1960-61 season. It was an important overwintering species. Bent (1923) noted that this duck lingers wherever it can find open water near its summer home and that its migration is one of the shortest.

The first sightings of common mergansers were made on the mornings of November 12 and 13; three were seen on both of these mornings. An increase in the common merganser population was noted the third week end in November. On the morning of November 19, 18 were counted. On the morning of November 20, 11 were observed and on that evening seven were seen. Another increase in the population was noted the last week in November. On the morning of November 26, 70 common mergansers were counted; however, only five were seen that evening and none the following evening.

On the evening of December 3, 155 common mergansers were observed on the censusing area. During the morning census of December 18, 140 were noted. The final censuses conducted in December were made on December 21. On the morning of December 21, six common mergansers were counted, and on that evening only four were observed.

Evening counts of common mergansers taken in January, February, and March ran higher than morning counts in most instances (Tables 5, 6, and 7). Approximately 600 common mergansers were observed moving onto refuge waters between 9:00 A.M. and 10:00 A.M. on February 26, 1961. It is probable that common mergansers commonly moved onto refuge waters from other parts of Fort Gibson Reservoir during mid-morning or early afternoon.

On the first week end in January the common merganser population was higher than had been noted previously during week ends of the

1960-61 season. On the evening of January 7, 370 were censused, and on the following evening 199 were tallied. Although only one common merganser was seen on the morning of January 15, on that evening 200 were observed. On the third week end in January the population reached the same level that had been noted earlier in January. On the evening of January 22, 312 were censused.

The common merganser population appeared to decline somewhat on the final week end of January; although 125 were noted on the evening of January 28, on the following evening only ten were counted. This decline was probably influenced by the icing over of a large portion of the water area of the refuge on this week end. While mallards moved about the area and sat around on the ice, the common merganser was not abundantly seen. It is thought that it sought open water on the larger waters of the reservoir at this time.

In February, 18.53% of all ducks censused on the refuge were common mergansers. The week end season peak of the common merganser population was reached on the evening of February 4 when 818 were censused. On the morning of February 5, only 12 common mergansers were observed, but on that evening 403 were censused. No common mergansers were seen on the evening of February 18, and only 64 were noted the following morning. During the evening census of February 19, 262 common mergansers were tallied. During the final week end of February the population rose to the level noted on the first and second week end of that month. On the evening of February 25, 695 common mergansers were censused, and on the following evening 755 were censused.

On the evening of March 5, 366 common mergansers were censused. During the morning census of March 12, 243 were noted. After March 12,

the population declined until on the morning of March 27, only 32 common mergansers were seen, and on the evening of the same day only one was observed on the refuge.

Thus, common mergansers were first censused on the second week end in November. Their numbers increased slightly through November and the first week end in December. None were censused the second week end in December, but on the third week end the population rose to the level noted the first week end of that month. Another increase was noted in the population on the first week end in January. The population remained relatively stable in numbers until the first week end in February when a peak level was observed. By the first week end in March the common merganser began to decline steadily until by the last week of that month only a fraction of the former population was on the censusing area.

It appears that the common merganser, overwintering on the refuge, increased in numbers throughout most of the 1960-61 season until it began to move northward again in early spring.

HOODED MERGANSER. Hooded mergansers were first censused at the refuge on the first week end in November. On the evening of November 5, three were seen. The following week end, on the morning of November 13, 22 hooded mergansers were counted. The only ones observed on the censusing area during the third week end in November were 25 that were censused on the morning of November 20 and 17 that were tallied that evening. On the morning of November 26, 18 hooded mergansers were censused, while on that evening 17 were counted. During the morning census of November 27, seven were noted.

On the evenings of both December 3 and 4, 12 hooded mergansers were censused on the censusing area. During the morning census of December 10, six were noted. On the evening of December 21, three were observed.

One hooded merganser was seen on both the evening of January 8 and the morning of January 22. During the evening census of January 29, two were counted.

On the evening of February 4, five hooded mergansers were censused. During both the morning and evening census of February 11, four were noted. On the evening February 12, ten were seen.

Hooded mergansers were observed on the censusing area on both the first and second week ends in March. On the morning of March 5, two of these ducks were counted, while on the evening of March 11 two were also noted.

While the hooded merganser was seen at the refuge in small numbers only, census data gathered during week ends of the 1960-61 season at the refuge do indicate certain migration movements. The hooded merganser was first seen on the first week end in November. By the second week end of that month the population had increased somewhat. The hooded merganser population remained generally stable after that second week end in November until the second week end in December when it declined in numbers. A slight increase in the population was again noted during the first two week ends in February, after which a decrease took place until none were seen during the final two week ends in March. Thus the major fall movement appears to have occurred during November, while the major spring migration took place in early February.

BLACK DUCK. Black ducks were not seen during the course of weekly censusing until the evening of February 19 when two were observed. On the following morning two black ducks were again counted on the refuge. During the final week end of February one black duck was censused, that being on the morning of February 27.

On the morning of March 4, two black ducks were tallied, and on that evening one was counted. A single black duck was censused on both the morning of March 5 and the evening of March 27.

The black duck's winter range is primarily eastern United States (Bent, 1932). Kortright (1942) does not include Oklahoma in the wintering range of this duck; however, Addy (1949) has mapped two flight lines of black ducks into northeastern Oklahoma from the Lake States. Oklahoma is near the western edge of any obvious fall movements of the black duck. This duck is certainly not an abundant one in Oklahoma; it was censused in such limited numbers during the 1960-61 season at the Fort Gibson Refuge that its migration chronology does not seem indicated.

CANADA GOOSE. Canada geese were seen at the refuge on the first week end of censusing during the 1960-61 season. On the evening of October 8, 55 were tallied; however, during both the morning and evening census of October 9, none were seen. On the morning of October 15, 14 Canadas were censused, while on that evening 50 were noted. Only four were counted on both the morning and evening of October 16. Although only ten Canada geese were counted on the morning of October 22, on that evening 70 were censused. On the following morning 27 were seen on the censusing area. A fall seasonal migration peak in Canada goose

numbers was noted on the final week end in October. On the evening of October 28, 70 Canadas were noted, and on the following morning 80 were counted. During the morning census of October 30, 75 were censused, and on that evening 80 were tallied.

On the evening of November 4, 70 Canadas were censused. Although none were seen on the morning of November 5, on that evening 80 were again noted. No Canadas were observed on November 6. The number of Canada geese on the refuge had decreased by the second week end in November; only three Canadas were seen during each of four censuses made on that week end. On the morning of November 19, 35 Canada geese were censused. The population remained almost constant at this level of abundance through December (Tables 3, and 4).

On the morning of January 2, 38 Canadas were censused at the refuge. During the evening of January 7, four were seen, and no more than four were observed during any one census throughout the remainder of January.

Throughout week ends in February, five Canada geese were usually censused, although only one was seen on the evening of February 26 (Table 6).

No Canada geese were observed during the first two week ends in March. On the third week end five Canadas were again consistently noted. A significant increase in the Canada goose population was observed on the final week end in March. On both the morning and evening of March 26, 140 were censused, while on the following day 130 were counted during both the morning and evening census.

While Canada geese were present at the refuge on the first week end in October, their peak fall migration movement was observed third

and fourth week ends of October and the first week end in November. By the second week in November most Canadas were gone from the refuge. On the third week end in November the population increased to about one half the abundance noted during peak movements, and remained stable through January 2. By January 7, the population had again declined, and no further increases were noted until the final week end in March when a sharp rise in numbers was observed. Kortright (1942) noted that the period of greatest fall movement of the common Canada goose is through October and the first half of November, and that in the spring, March is the month of greatest movement. Although this migration chronology is quite general, the migration movements of the Canada goose at the refuge did follow it. Dodson (n.d.), in a 1950-52 study, noted that a peak goose flight in Oklahoma occurred in the latter half of October. Hanson and Smith (1950) found that at Horseshoe Lake during the autumn and winter of the years 1941-1946 the build-up of the Canada goose flock was greatest late in October or during the first two weeks in November. The Canada geese seen at the Fort Gibson Refuge during the 1960-61 season are possibly members of the Eastern Prairie population described by Hanson and Smith.

SNOW GOOSE. On the morning of October 15, 28 snow geese were noted on the censusing area, and on that evening 41 were counted. During the morning census of October 16, 30 were censused, while 38 were noted that evening. The autumn peak of the snow goose population was observed at the refuge during the week end of October 22-23. On the morning of October 22, 200 snows were censused, and on that evening 120 were observed. During the morning census of October 23, 195 snow geese were tallied. During the final week end in October a decline

in the snow goose population took place. On the evening of October 28, 107 were noted, and on the following morning 200 were again censused. On the morning of October 30, however, only 90 snows were observed and only 100 were counted that evening.

During the evening census of November 4, 80 snow geese were estimated to be on the censusing area, and although none were seen the morning of November 5, on that evening 100 were censused. Only 60 snows were noted on the morning of November 6, and none were seen that evening. A decline in the snow goose population was noted the second week end in November. Only 23 snow geese were seen on both the morning and evening of November 12. During the morning census of November 13, 24 were counted, and on that evening 27 were noted. On the last week end in November no snow geese were seen.

The only snows observed on the refuge during week ends in December were six that were censused on the morning of December 11.

Throughout January and the first three week ends of February, 1961, three snow geese were commonly censused (Table 5 and 6).

On the evening of February 25, 200 snow geese were censused, and both the morning and evening of February 26, 120 were counted. During the morning census of February 27, 130 were noted.

The snow goose population at the refuge had declined by the first week end in March (Table 7). On the evening of March 11 and the morning of March 12 no snow geese were seen, while one was observed on the evening of March 12. An increase in the population was noted on the morning of March 13 when 130 snows were censused. Only 34 were counted on the evening of March 18, and on the following morning of March 20, the snow goose population had increased to 122.

During the final week end in March, a major population increase was observed. On the morning of March 26 and the evenings of both March 26 and 27, 1,000 snow geese were censused at the refuge. During the morning census of March 27, 1,150 were recorded.

Although no complete census were made in April, as previously mentioned, field observations were made during that month. On April 1, about 750 snow geese were estimated to be on the refuge and on April 16, 110 were counted. If a large number of snow geese had not left the refuge at this time as a result of human activities and resulting disturbance, it appears that the major spring migration movement of the snow goose passed through the refuge on final week end in March.

The major fall movement of the snow goose through the refuge took place on the week end of October 22-23. Crail (1951) observed that in Missouri a general movement of snow geese takes place around October 20-25.

BLUE GOOSE. Blue geese, censused during week ends of the 1960-61 season at the Fort Gibson Refuge, were, in most instances, seen associating with snow geese. Kortright (1942) comments "the dark bird in snow-white flock is invariably a blue goose." At the refuge, the weekly population fluctuations of the blue goose generally paralleled those of the snow goose.

Blue geese were first observed in the course of weekly censusing on October 15, and 12 were counted on both the morning and evening of that date. On the morning of October 16, eight were seen and on that evening ten were noted. The blue goose population had increased by October 22, for on that morning 50 blues were counted and that evening 40 were noted. During the morning census of October 23, 59 blue geese

were counted. The population remained at about the same level of abundance during the final week end in October as had been noted the previous week end (Table 2).

On the evening of November 4, 30 blue geese were counted and although none were seen on the morning of November 5, 50 were seen on that evening. On the morning of November 6, only 15 blue geese were noted and on that evening none were seen. During both the morning and evening census of November 12, 17 were tallied. On the morning of November 13, 13 were counted, and on that evening 14 were noted. No blue geese were seen during the third week end in November, and no more than one was observed during any one census throughout the final week end in November. Thus the major fall migration movement of blue geese through the refuge took place, as noted on week ends, during the last two week ends in October and the first week end in November. The population declined throughout the reminder of November. Crail (1951) noted that a "general movement" of blue geese through Missouri takes place around October 20-25.

No blue geese were seen on the refuge during week ends in December, 1960 or January, 1961.

During the first two week ends in February it was common to see one blue geese during each censusing period. None were observed on the third week end of February. On the morning of February 25, 130 blue geese were censused. During the morning census of February 26, 60 were counted, and on that evening 85 were observed. On the following morning 95 blue geese were tallied.

A decline in blue goose numbers was noted on the first week end in March. None were seen the morning of March 4 and only 25 were counted that evening. None were observed on the morning of March 5, and only

two were seen that evening. None were seen on either the evening of March 11 or the morning of March 12, and only two were noted on the evening of March 12. An increase in the blue goose population was apparent on the morning of March 13 when 80 were censused. The population, although fluctuating from census to census, generally remained stable through the third week end of February (Table 6). A major increase in blue goose numbers on the refuge was noted during the final week end in March. On the morning of March 26 and 27, 360 blue geese were censused. During the morning census of March 27, 390 were estimated to be on the refuge.

Field observations made in April gave the impression that blue geese were declining in numbers on the refuge during the first two week ends of that month. On April 1, 225 blue geese were seen, and on April 16, 35 were observed.

Assuming that in April, disturbance created by recreational activities permitted on the refuge after April 1, had not caused a large number of blue geese to move to another area, the major spring migration movement of blue geese through the refuge occurred on the final week end in March.

WHITE-FRONTED GOOSE. White-fronted geese, throughout the 1960-61 censusing period, were not seen in as great abundance as were the Canada goose, blue goose, and snow goose.

During October, the only white-fronts seen at the refuge were two which were noted on the morning of October 16.

Not until December was another white-front observed. On the morning of December 4, one was noted.

On the evening of March 11 and both the morning and evening of March 12, six white-fronted geese were observed on the censusing area. None were seen on the morning of March 13, but on the following week end several were censused. On the evening of March 18, the morning of March 19, and morning of March 20, 15 white-fronts were counted. A major increase in the white-front population was noted on the final week end in March when 65 white-fronts were censused on four different censusing periods.

The white-fronted goose, largely a goose of western United States, was certainly not abundant during the fall migration period at the refuge.

A noticeable spring migration movement occurred on the final week end of March. Kortright (1942) stated that the white-front begins moving in early March, but that April is usually the month of heaviest flight.

WHISTLING SWAN. The whistling swan is a very rare migrant and winter resident in Oklahoma. On the evening of November 20, 1960, three whistling swans, were observed on the Fort Gibson Refuge. They alighted in a shallow water area in which they were able to stand without having their legs completely submerged. It was interesting to observe their reaction to a group of Canada geese also resting in this area. The swans seemed to resent the presence of the geese and with one or two offensive movements conveyed this "feeling" to the Canadas, for they soon moved away from the larger swans.

Field Feeding of Ducks at the Refuge and in Its Vicinity

During the 1960-61 season, field crops available on the refuge for waterfowl usage included 125 acres of grain sorghum alternated in double rows with red ripper peas, 52 acres of corn, 25 acres of German, Japanese, and pearl millet, and 222 acres of winter wheat.

Observations of use made of these plantings by various waterfowl species were made on week ends, concurrently with censusing. All conclusions that may be drawn from the data here presented are based solely on feeding activities observed on these week ends. Certainly waterfowl feeding activities could have changed during each week, but, week end observations do provide an index of the relative use made of the field crops provided.

Field feeding activities of the mallard, snow goose, blue goose, and Canada goose are presented in Tables 8, 9, 10, and 11, respectively.

MALLARD. Mallards were seen apparently feeding in grain sorghum-pea plantings on the refuge on ten occasions. These fields contained dorset maize alternated in double rows with red ripper peas, and varied in size from 74 acres to ten acres. Mallards used all six fields on the refuge in which these crops were available.

On the evening of November 20, 1960, almost all mallards censused were seen feeding on two fields containing grain sorghum and peas. One of these fields was 15 acres in area, the other ten. During the morning census of November 26, 1,900 mallards were estimated to be feeding in a 74 acre grain sorghum-pea field. On this

TABLE 8

NUMBERS OF MALLARDS FIELD FEEDING - FT. GIBSON REFUGE, OKLAHOMA, 1960-61 SEASON

Date	Grain Sorghum & Peas 74 Acres	Grain Sorghum & Peas 15 Acres	Grain Sorghum & Peas 10 Acres	Grain Sorghum & Peas 11 Acres	Grain Sorghum & Peas 18 Acres	Grain Sorghum & Peas 40 Acres	Japanese Millet 8 Acres	Plowed 24 Acres	Corn 6 Acres
Oct. 30, 1960 AM							150		
Oct. 30, 1960 PM							300-400		
Nov. 20, 1960 PM		2700 Mallards							
Nov. 26, 1960 AM	1900								
Nov. 27, 1960 AM		All Mallard Activity							
Nov. 27, 1960 PM		All Mallard Activity							
Dec. 3, 1960 PM	Mallards Utilized	Mallards Utilized							
Dec. 11, 1960 PM						500	400		
Jan. 8, 1961 AM				All Mallard Feeding Activity					
Jan. 21, 1961 PM	300	5							550
Mar. 12, 1961 PM								400	
Mar. 13, 1961 PM								All Mallard Activity	

morning 2,200 mallards were censused; thus, 86% of the mallard population was using the 74 acre field on the morning of November 26 (Table 8).

The 15-acre grain sorghum-pea field, previously mentioned, was mowed on November 25. On November 27 all mallards on the refuge appeared to concentrate their feeding activity on this field. Mallards appeared to confine their feeding to the center portion of this field that was within a 100 foot wide buffer zone, away from cover along the field edge. Mallards were seen feeding in the 74 acre and 15 acre grain sorghum-pea fields on the evening of December 3. On the morning of December 11, one third of the mallard population censused, was seen landing in a 40 acre grain sorghum-pea field. On the morning of January 8, all mallard feeding activity observed was restricted to two grain sorghum-pea fields, one 11 acres in size, the other 18 acres in size. On the evening of January 21, 305 mallards were seen feeding in two grain sorghum-pea fields, 74 and 15 acres in size.

Mallards during censusing week ends were observed feeding on fields not containing grain sorghum and peas on only five occasions.

During three censusing periods they were seen feeding in an eight acre strip of Japanese millet, adjacent to which was a 12 acre field of wheat. On the morning of October 30, 150 mallards were observed feeding in this millet strip and on that evening 300 to 400 were seen feeding there. About 400 mallards landed to feed on the millet on the evening of December 11.

About 550 mallards were seen landing in a six acre field of standing corn on the evening of January 21.

On the evening of December 17, approximately 600 mallards left the refuge and flew to outlying corn fields which had been harvested and disked, thereby exposing a limited amount of waste grain. These fields, located not more than three miles from the refuge, were essentially bare ground at this time. A local farm resident reported having seen this feeding activity from about December 10 through December 18. On the evenings of December 17 and 18, three hunters bagged a total of four mallards on one such corn field located about 1.5 miles west of the refuge. After a large group of mallards was fired upon by these hunters, it was noted that most of the mallard group moved off not more than one mile to apparently land in another outlying field. Thus it seems that mallards did tolerate limited hunting pressure in seeking exposed waste corn in such open areas, and that many mallards apparently prefer feeding under such conditions rather than in the refuge corn fields of standing or partially standing grain with some weedy ground cover.

Although on December 17 and 18, many mallards did visit outlying fields containing exposed corn in preference to fields of standing corn within the refuge, it does not necessarily follow that the majority of mallard population left the refuge to feed in such fields. On the contrary, on the evening of December 11, 900 of a total 1,500 mallards censused, utilized a grain sorghum-pea field and the eight acre Japanese millet strip on the refuge. Now a local resident reported seeing several hundred mallards leave the refuge on that evening and watching them land in the harvested corn fields west of the refuge. Assuming all mallards not feeding on the grain sorghum-pea field and millet field left the refuge that evening and did move to the harvested corn fields, it is still apparent that most mallards remained that evening on the refuge to feed on crops other than standing corn.

On the evenings of March 12 and 13, about 400 mallards, six green-winged teal, and two pintails were observed landing on a recently plowed, 24 acre field which had formerly contained grain sorghum and peas. Adjoining this plowed area was a smaller area of partially standing corn. It was estimated that more than half of these ducks walked from the plowed area into the corn field where they apparently fed on corn accessible to them there. Those ducks that remained in the plowed area appeared to be feeding on some food items available there, possibly the remnants of the grain sorghum-pea crop present before the area was plowed. This observation further suggests that mallards may prefer to land in open, bare areas where a food supply is available, even if they must walk a short distance to that supply, rather than alight directly in an area containing food yet also having a weedy ground cover.

Mallards were seen using grain sorghum-pea fields on the refuge during week ends of the 1960-61 season more than any other crop available; however, a larger acreage of grain sorghum-peas was available. Hancock (1953) found during two seasons that mallard crops contained more sorghum than other field crops in Payne County, Oklahoma. Corn was found to be secondary to sorghum in use by the mallard in that county; however, the relative abundance of these two field crops in that county at that time was not compared.

The only other duck species observed feeding in fields on the refuge was the American widgeon. On the week end of March 26-27 a large number of geese were on the refuge and they restricted their feeding activities to wheat fields on the refuge. Although other duck species were censused on the refuge during that week end, the only ducks seen feeding on these wheat fields with the geese were American widgeons.

A total of 36 American widgeon were seen grazing with these geese during the four censusing periods of the March 26-27 week end. Delacour (1956) described the American widgeon as having a small, compressed bill adapted to grazing. He pointed out that they do graze frequently on land.

Feeding Activities of Geese at the Refuge

Field feeding activities of the snow goose, blue goose, and Canada goose, as seen on week ends of the 1960-61 season at the Fort Gibson Refuge, are presented in Tables 9, 10, and 11.

Throughout this study snow geese were seen in greater abundance than other geese. The blue goose was seen next in overall abundance, followed by the Canada goose and white-fronted goose (Table 1).

SNOW GOOSE. Snow geese were seen feeding on five different fields within the refuge.

Throughout October their field feeding was noted only on a 12 acre field of German millet. A strip of this millet about 25 yards wide was mowed along the western edge of the field early in October. This mowed area was used by snow geese in their feeding activities until practically all grain there was consumed. On the evening of October 22, snow geese began landing in the unmowed section of the field and proceeded to consume the grain there. Snow geese were seen feeding in this field on the mornings of October 15, 16, 22, 23, 29, and 30, and on the evenings of October 15, 16, 22, 23, 28, and 30 (Table 9).

On the morning of November 12 and the evenings of November 12 and 13, snow geese were noted only on an eight acre strip of Japanese millet which adjoined a 12-acre wheat field.

TABLE 9

NUMBERS OF SNOW GEESE FIELD FEEDING, FT. GIBSON REFUGE, OKLAHOMA, 1960-61 SEASON

Date	German Millet 12 Acres	Japanese Millet 8 Acres	Wheat 60 Acres	Wheat 24 Acres	Wheat 41 Acres
Oct. 15, 1960 AM	28				
Oct. 15, 1960 PM	41				
Oct. 16, 1960 AM	31				
Oct. 16, 1960 PM	38				
Oct. 22, 1960 AM	200				
Oct. 22, 1960 PM	120				
Oct. 23, 1960 AM	195				
Oct. 28, 1960 PM	107				
Oct. 29, 1960 AM	200				
Oct. 30, 1960 AM	90				
Oct. 30, 1960 PM	100				
Nov. 12, 1960 AM		23			
Nov. 12, 1960 PM		23			
Nov. 13, 1960 PM		27			
Dec. 11, 1960 AM					6
Jan. 21, 1961 PM			1		
Jan. 22, 1961 AM			3		
Jan. 28, 1961 AM				3	
Feb. 4, 1961 PM			3		
Feb. 12, 1961 AM				3	
Feb. 18, 1961 PM				3	
Feb. 25, 1961 PM				200	
Feb. 26, 1961 PM				120	
Feb. 27, 1961 AM				130	
Mar. 18, 1961 PM			34		
Mar. 19, 1961 AM			35		
Mar. 19, 1961 PM			77		
Mar. 26, 1961 AM				1000	
Mar. 26, 1961 PM				1000	
Mar. 20, 1961 AM			122		
Mar. 27, 1961 AM				1150	
Mar. 27, 1961 PM				1000	

The only field feeding by snow geese that was noted on week ends in December was observed on a 41-acre wheat field on the morning of December 11.

Throughout week ends of January, February, and March of 1961, snow geese were seen feeding only on three wheat fields on the refuge. These fields were 24, 41, and 60 acres in size.

The 24-acre wheat field was utilized by snow geese on six occasions. They were observed there on the mornings of January 28, February 12, and February 27. They were seen there also on the evenings of February 18, February 25, and February 26.

A major increase in the snow goose population was noted on the final week end in March (Table 7). Almost all snow geese that were seen that week end were observed on a 41-acre wheat field. A brief journey to a 60-acre wheat field from the 41-acre wheat field was observed on the evening of March 27, but the snow geese soon returned to the 41-acre field on that same evening.

Snow geese were seen on a 60-acre wheat field on nine occasions. They were observed there on the mornings of January 22, February 27, March 19, and March 20. They were also noted there on the evenings of January 21, February 4, March 18, March 19, and March 27.

Throughout the fall season snow geese were seen only on millet fields. During week ends in October a total of 1,012 snow geese were censused on seven occasions in a 12-acre German millet field. They fed in a mowed section of this field until the grain there was consumed, then proceeded to use the grain available in the unmowed section of the field.

During November a total of 73 snow geese were seen on three occasions feeding in an eight acre strip of Japanese millet. No other feeding activity by snow geese was recorded that month.

The remainder of the snow geese that were seen feeding in refuge fields on week ends of the 1960-61 season were observed in three wheat fields.

A total of 1,275 snow geese were seen utilizing a 60-acre wheat field on the refuge. This total was the combined number of snow geese noted on this particular field on eight occasions.

A great majority of the snow geese observed on the refuge were seen during the final week end in March. Combining the numbers of snows seen on each of five occasions, a total of 4,156 snow geese were seen on a 41-acre wheat field on the refuge.

The third wheat field on which snows were observed during 1961 was 24 acres in size. A total of 459 snow geese were observed throughout the course of six observation periods at this field.

BLUE GOOSE. Table 10 presents the field feeding activities of blue geese at the refuge during week ends of the 1960-61 season.

During October field feeding was observed only on a 12-acre German millet field. A total of 294 blue geese were counted on this field during October. This was the total number that were seen there on 11 occasions.

Early in October a strip of this millet approximately 25 yards wide was mowed along the western edge of the field. Blue geese used this mowed area until practically all grain there was consumed. On the evening of October 22, blue geese began landing with snow geese in the unmowed section of this millet field and proceeded to consume the grain

TABLE 10

NUMBERS OF BLUE GEESE FIELD FEEDING, FT. GIBSON REFUGE, OKLAHOMA, 1960-61 SEASON

Date	German Millet 12 Acres	Japanese Millet 8 Acres	Wheat 60 Acres	Wheat 24 Acres	Wheat 41 Acres	Grain Sorghum & Peas 15 Acres (Just mowed)
Oct. 15, 1960 AM	12					
Oct. 15, 1960 PM	12					
Oct. 16, 1960 AM	8					
Oct. 16, 1960 PM	10					
Oct. 22, 1960 AM	50					
Oct. 22, 1960 PM	40					
Oct. 23, 1960 PM	27					
Oct. 28, 1960 PM	45					
Oct. 29, 1960 AM	70					
Oct. 30, 1960 AM	12					
Oct. 30, 1960 PM	50					
Nov. 12, 1960 AM		17				
Nov. 12, 1960 PM		17				
Nov. 13, 1960 PM		14				
Nov. 26, 1960 AM		1				
Nov. 26, 1960 PM						1
Nov. 27, 1960 PM		1				
Feb. 4, 1960 PM			1			
Feb. 12, 1961 AM				1		
Feb. 25, 1961 PM				130		
Feb. 26, 1961 PM				85		
Feb. 27, 1961 AM				95		
Mar. 18, 1961 PM			38			
Mar. 19, 1961 AM			35			
Mar. 19, 1961 PM			63			
Mar. 26, 1961 AM					360	
Mar. 20, 1961 AM			10			
Mar. 26, 1961 PM					360	
Mar. 27, 1961 AM					390	
Mar. 27, 1961 PM					360	

there. By early November most of the millet in this field was consumed.

Blue geese were seen using this German millet field on the morning of October 15, 16, 22, 28, and 30.

In November a total of 50 blue geese were seen on an eight acre strip of Japanese millet which was adjacent to a 12-acre wheat field.

Blue geese were seen on three wheat fields during February and March. They were observed on four occasions on a 24-acre wheat field, on four occasions on a 41-acre wheat field, and on six occasions on a 60-acre one.

A total of 311 blue geese were seen on the 24-acre field, while 1,470 were noted on the 41-acre one and 567 were seen on the 60-acre one.

Thus throughout the fall of 1960 blue geese, along with snow geese, were seen only in millet fields. During October they were observed only in a German millet field and fed upon a mowed section of that field before using the remaining unmowed part. During November blue geese were seen only on a Japanese millet field.

No blue geese were seen on grain fields on the refuge during week ends of December or January.

During February and March they were seen on three wheat fields. A total of 1,470 blues were observed on a 41-acre field during four censuses, while 567 were seen on a 60-acre field during six censuses. Only 311 blue geese were noted during four censusing periods on a 24-acre wheat field.

CANADA GOOSE. In Table 11 is presented the field feeding activities of Canada geese as observed during week ends of the 1960-61 season.

While snow geese and blue geese were seen more often in a 12-acre German millet field during October, November, and December of 1960,

TABLE 11

NUMBERS OF CANADA GEESE FIELD FEEDING, FT. GIBSON REFUGE, OKLAHOMA, 1960-61 SEASON

Date	German Millet 12 Acres	Japanese Millet 8 Acres	Wheat 12 Acres	Wheat 25 Acres	Wheat 60 Acres	Wheat 24 Acres	Wheat 41 Acres	Grain Sorghum & Peas 15 Acres (Mowed)
Oct. 15, 1960 AM	14							
Oct. 15, 1960 PM	15							
Oct. 16, 1960 AM	4							
Oct. 16, 1960 PM	4							
Oct. 22, 1960 AM	10							
Oct. 22, 1960 PM	70							
Oct. 23, 1960 AM		27						
Oct. 28, 1960 PM			70					
Oct. 29, 1960 AM		80						
Oct. 30, 1960 AM		75						
Oct. 30, 1960 PM		80						
Nov. 4, 1960 PM		70						
Nov. 12, 1960 AM		3						
Nov. 26, 1960 AM		37						
Nov. 26, 1960 PM								37
Nov. 27, 1960 AM		36						
Dec. 4, 1960 AM		37						
Dec. 11, 1960 AM		34						
Feb. 4, 1961 PM				5				
Feb. 6, 1961 AM					5			
Feb. 11, 1961 AM					5			
Feb. 12, 1961 AM					5			
Feb. 26, 1961 PM						1		
Mar. 18, 1961 PM					5			
Mar. 19, 1961 AM					5			
Mar. 19, 1961 PM					5			
Mar. 20, 1961 AM					5			
Mar. 26, 1961 AM							140	
Mar. 26, 1961 PM							140	
Mar. 27, 1961 AM							130	
Mar. 27, 1961 PM					130		130	

Canada geese seemed to prefer an eight acre strip of Japanese millet. A total of 152 Canadas were seen during October on the German millet field while 262 were observed during that month on the smaller Japanese millet field. Canada geese were noted on the Japanese millet field on ten occasions during October, November, and December, while during this period, they were seen on six occasions on the German millet field. Canada geese, snow geese, and blue geese had apparently cleaned up grain available in the German millet field by the first of November.

Canada geese were seen once in November on a 12-acre wheat field. They were also seen once during that month feeding in a 15-acre grain sorghum-pea field which had been recently mowed.

No field feeding by Canada geese was seen during week ends in January.

All field feeding of Canadas that was observed on week ends of February and March was confined to four wheat fields which were 60, 41, 25, and 24 acres in size.

One Canada goose was seen on the 24-acre field, while five were seen during a single census on the 25-acre wheat field.

A total of 540 Canadas were counted during four censuses on the 41-acre field.

Observed in the 60-acre wheat field during eight censuses were 165 Canada geese.

Early in the 1960-61 season when millets were available to geese, Canada geese used German and Japanese millet rather than wheat; however, as spring approached four wheat fields were used. Almost all week end feeding activity of Canada geese observed during February and March was noted on two wheat fields. These were the largest wheat fields on the refuge.

WHITE-FRONTED GOOSE. White fronted geese were seen feeding in grain fields on the refuge during week ends of the 1960-61 season on twelve occasions.

On December 4, a single white-front was observed on an eight acre strip of Japanese millet.

All other observed feeding activity of white-fronted geese was noted on week ends in March. During the second week end in March six white-fronts were seen during each of three censusing periods. They were seen during that second week end only in a 60-acre wheat field.

On the final week end in March a sharp increase in all goose populations on the refuge was noted (Table 7). On that week end all white-fronted geese were seen feeding in a 41-acre wheat field.

During seven census periods in which white-fronted were observed, a total of 76 of these geese were seen feeding on a 60-acre wheat field, while on four occasions a total of 260 white-fronts were observed on a 41-acre wheat field.

Waterfowl Use Of Certain Water Areas And Ecologic Factors That May Have Influenced Such Use

During week ends of February and March, record was made of the number of each waterfowl species observed in each of seven water areas under study. These areas were visible from the seven observation stations used in censusing throughout this study. Figure 1 illustrates the location and acreages of these areas and shows the location of the seven observation stations on the refuge.

Three factors, amount of shoreline cover, degree of protection from north and northwesterly winds, and relative water depth, were

considered in evaluating waterfowl use of each area.

Shoreline cover was measured by ocular estimation as described in the methods section. Although this method is extensive in nature and somewhat unrefined due to time limitation, an index of the abundance and density of tree and shrub cover along the shoreline of each study area was obtained. Only two types of shoreline cover were considered; these were designated "open" type and persimmon-willow type. The open type contained no tree or shrub growth, while persimmon-willow type included shoreline along which persimmon, willow, button-bush or other shrub or tree growth was present in any combination. As outlined in the methods section, the linear distance of each of these types of cover was recorded while pacing the shoreline of each study area. Only vegetation within 50 feet of the waterline was considered. Four density ratings were assigned the persimmon-willow type; these ratings were based on area occupied by plant structure.

While evaluating overstory and understory cover along the shoreline, it was noted that smartweeds, (Polygonum Spp.), were present along much of the shoreline. The use that waterfowl made of this plant is not known, but it is a potential duck food and could have affected duck usage of the areas (Hancock, 1953). The linear distance in which smartweed was noted along the shoreline was recorded along with tree and shrub cover. Three density ratings were used in estimating shoreline cover. These ratings were based upon area occupied by plant structure.

Table 12 presents the per cent of each cover type included in the total shoreline of each study area. Smartweed abundance and density is also listed for each area.

Of the total shoreline in area one, 62.12% was classified as "open" type. About 12% of the shoreline in this area was rated density I in

TABLE 12

PER CENT THAT EACH COVER TYPE MAKES UP OF THE TOTAL SHORELINE OF EACH STUDY AREA AT THE FORT GIBSON REFUGE, OKLAHOMA, 1960-61.

Cover Type	Area Number 1	2	3	4	5	6	7
Open	62.12	40.66	48.33	31.14	32.29	52.37	22.25
Persimmon-Willow Density I	12.18	28.16	41.25	20.61	24.48	40.44	43.39
Persimmon-Willow Density II	16.57	19.92	6.67	29.55	22.66	1.09	20.58
Persimmon-Willow Density III	8.12	11.26	1.56	17.52	20.57	6.10	13.78
Persimmon-Willow Density IV	1.00	-	2.19	1.18	-	-	-
Per cent of shore line, in each area, in which smartweed is present							
Smartweed Density I	2.78	12.09	27.19	27.54	13.54	49.64	17.50
Smartweed Density II	3.89	-	1.98	28.73	5.21	33.88	40.75
Smartweed Density III	2.22	12.64	1.70	-	-	-	-

the persimmon-willow type.

Of the total shoreline in area two, 40.66% was classed as "open" type, while about 28% was rated density I in the persimmon-willow type.

In area three 48.33% of the total shoreline was classified "open" type, while about 41% was rated density I in the persimmon-willow type.

Of the total shoreline in area four, 31.14% was classified "open" type, while about 21% was rated density I in the persimmon-willow type.

Of the total shoreline in area five 32.29% of the total shoreline was classified "open" type. About 24% was rated density I in the persimmon-willow type.

Only 22.25% of the shoreline in area seven was classified "open" type. About 43% of the shoreline was rated density I in the persimmon-willow type.

Ranking the seven waterfowl resting and dabbling areas in order of the per cent of the shoreline in each which was classified open, and listing them in order of the most open to the least open, it is found that area 1 has the greatest per cent of open shoreline followed by areas 6, 3, 2, 5, 4, and 7.

Ranking the seven areas in order of the relative amount of shoreline in each which contains persimmon-willow type in density I, and listing them in order from the area with the greatest amount of this cover type to the lowest, it is found that area seven has the largest per cent of persimmon-willow type, density I, followed by areas 3, 6, 2, 5, 4, and 1.

In many instances, the persimmon-willow type of density I was almost an "open" type, except for the presence of some scattered trees or shrubs. To obtain an index of the amount of shoreline in each area containing open and almost open shoreline combined, the

per cents of open and persimmon-willow, density I, of each area were combined. It was found that area six has the greatest percent of open and almost open shoreline, followed by areas 3, 1, 2, 7, 5, and 4. By reversing the sequence of this listing of the areas, areas will be ranked from the area having the greatest per cent of persimmon-willow type densities 2, 3, 4, to areas of lowest per cent of these ratings. This logically follows; the area having the greatest per cent of its shoreline open or almost open would necessarily have the lowest per cent of the denser persimmon-willow ratings.

Combining all density ratings of smartweed, it was found that 88.5% of the total shoreline of area six had smartweeds along it. Area seven followed with 58.3% of its shoreline having smartweeds in all densities. Next comes area four with 58.0% of its shoreline having smartweeds. It was followed by areas 3, 2, 5, and 1 with 29.2%, 24.7%, 18.8%, and 8.9%, respectively, of their shorelines having smartweeds along them.

The relative water depth of each area was determined to see if any correlation exists between waterfowl use of the various areas and their relative depth. Eight depth ranges were used in analyzing each area; these ranges were obtained from a contour map of the area, as explained in methods. Table 13 lists the per cent which each depth range makes up of the total area of each of the seven study areas.

Davison and Neely (1959) pointed out that for the mallard, pintail, widgeon, gadwall, teal, and shoveler a feeding water depth of from one to 15 inches is correct. Thus the depth range of 0-4 feet was an important factor to these species in selecting an area in which to dabble. After calculating the per cent that this depth range made of the total surface area of each study area, it was found that area three had the

TABLE 13

THE PER CENTS THAT ACREAGES OF VARIOUS DEPTH RANGES MAKE UP OF THE TOTAL AREA OF EACH OF THE SEVEN STUDY AREAS AT FORT GIBSON REFUGE, OKLAHOMA, 1960-61.

Depth Range In Feet	Area Number						
	1	2	3	4	5	6	7
0-4	33.74	3.82	66.93	37.07	12.97	48.36	27.57
4-9	26.83	5.19	26.38	25.34	42.31	51.64	35.10
9-14	20.22	40.21	6.30	23.98	43.28	-	35.32
14-19	9.57	20.31	.4	12.08	1.45	-	1.57
19-24	5.72	11.84	-	1.53	-	-	.45
24-29	2.96	8.97	-	-	-	-	-
29-34	.96	6.87	-	-	-	-	-
34+	-	2.79	-	-	-	-	-

largest per cent of its area in the depth range 0-4 feet. Following area three were areas 6, 4, 1, 7, 5, and 2, respectively.

Kortright (1942) states that diving ducks, including scaups, redhead, ring-necked duck, canvasback, and mergansers, commonly feed in deeper water than the puddle ducks do. The ring-necked duck does have a tendency to avoid the broad, open water areas. Thus, one would expect divers to use the deeper, more open water areas on the refuge than the puddle ducks do. Area two has a greater per cent of its water area having a depth greater than four feet than do the other study areas. Following area two, in order of the area with the greater per cent of water area over four feet in depth to the area of least deep water, are areas 5, 1, 4, 7, 3, and 6.

A third consideration used in evaluating the use made of each study area by certain waterfowl species was the protection from severe north and northwesterly winds. Figure 2 illustrates the position of each study area in relation to such winds. Area one affords almost no protection from north winds; it does provide some protection from northwesterly winds. Area two provides very little protection from winds, except south winds. Area three affords little protection from north winds, but provides a little protection from westerly winds. Area four has good protection from north and northwesterly winds along about half of its shoreline. Area five is exposed to all northerly winds. Area six offers excellent protection from all winds except easterly winds. Area seven provides complete protection from north winds.

Results of censuses made of the seven study areas during February and March are presented in Table 14. The number of censuses, of the total 31 made, in which each species was seen in each study area are

TABLE 14

FREQUENCY AND DENSITY OF WATERFOWL BASED ON 31 CENSUSES MADE IN FEBRUARY AND MARCH, 1961 AT THE FORT GIBSON REFUGE, OKLAHOMA.

Species	Study Area 1		2		3		4		5		6		7	
	Freq.*	Dens.**	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.
Mallard	25	.27	20	.14	23	1.34	25	1.99	8	.15	24	8.44	20	2.03
Pintail	1	.00+	5	.00+	0	0	3	.00+	2	.01	3	.02	12	.03
Green-winged teal	4	.01	1	.00+	1	.02	4	.07	0	0	8	.08	2	.00+
American Widgeon	1	.02	4	.10	1	.97	4	.25	0	0	4	1.44	2	.16
Ring-necked Duck	0	0	11	.05	0	0	1	.00+	1	.01	4	.11	2	.01
Scaup	0	0	9	.02	0	0	2	.02	1	.03	2	.10	0	0
Common Merganser	17	.03	28	.59	7	.15	4	.03	1	.05	7	.15	8	.05

* Freq. - Number of censuses of the total 31, in which species was seen.
** Dens. - Number observed per census per acre.

listed under columns labeled "frequency," while, the number of each species seen per census per acre are listed under the "density" column.

As was previously pointed out, the mallard was the most abundant waterfowl species observed during the 1960-61 season. During February and March mallards were noted about the same number of times in each study area, but, its density was greatest in area six where an average per census per acre of 8.4 mallards were seen. Area seven was next with 2.03 mallards per census per acre. The remaining areas in order of the next highest density to the lowest are areas 4, 3, 1, 5, and 2.

On the basis of the 31 censuses made during February and March, pintails were observed in greatest density in area seven. This area also had the highest frequency of observation of pintails. Pintails were seen in second greatest density in area six, where .02 pintail per census per acre was seen. Following area six in pintail density is area five. Areas 4, 3, 2, and 1, had no measurable number of pintails per census per acre.

Green-winged teal, on the basis of the 31 censuses made in February and March, were most abundant per census per acre in area six. Areas 4, 3, and 1 followed respectively in density. No measurable number of green-winged teal were seen in areas 2, 5, and 7, per census per acre.

American widgeon, on a per census per acre basis, were most abundant in February and March in area six. They were found in next greatest density in area three, followed by areas 4, 7, 2, and 1.

Ring-necked ducks and scaups were found to be most abundant per census per acre in area six; however, these two species were observed most often on area two. Ring-necked ducks were seen during 19 of the total 31 censuses, while scaups were noted during 14 of the total 31.

Of the 19 censuses in which ring-necked ducks were seen, 11 ring-necked duck sightings were made in only area two. On nine of the 14 occasions on which scaups were censused, they were observed only in area two. Now, area two has a much greater area than does study area six (Figure 2), consequently, when a moderate number of these divers were seen on only four occasions in area six, the average number seen per acre for that relatively small acreage is greater than that calculated for area two. Scaups and ring-necked ducks were seen in area two more than twice as many times as in area six, but they were not seen in proportionately large enough flocks to offset the acreage differences between areas two and six. These acreage differences greatly effect average figures of duck numbers on an acre basis, while flock size did not seem to vary greatly in the different sized areas. Thus frequency of observation is probably a better index of relative use made of the seven areas by these ducks than is density per census per acre, since scaup and ring-necked ducks were never seen in large flock sizes and were seen most often in the broad, open water area of study area two.

Area two was used more by the common merganser than any of the other study areas during February and March. It had the greatest density and frequency of observation of all the areas. Area two was followed in common merganser density by areas three and six, with the same density, areas five and seven, with the same density, and one and four, also with the same density.

Comparative Abundance of Waterfowl at Fort Gibson Refuge and at Other Locations.

Presented in Table 15 are waterfowl densities per acre observed weekly during October, November, December and January at three locations, including Fort Gibson Refuge. Besides Fort Gibson Refuge, data are presented which were collected at North Bay on Fort Gibson Reservoir and in the Illinois River Valley (Bellrose, 1944).

During the fall and winter of the 1960-61 season censuses were made on five days at both the Fort Gibson Refuge and at North Bay. It was necessary to conduct one census earlier than the other, since obviously censuses could not be conducted concurrently at both locations. Thus, an early morning census was made at North Bay while a later morning census was conducted at the refuge. Since waterfowl were being hunted at North Bay during most of these censusing periods, ducks entering that bay were generally kept on the move and it was difficult to determine how many birds were actually using the bay and how many were merely circling about or flying over the bay. For this reason, waterfowl censuses recorded at North Bay could easily indicate somewhat higher duck densities than were actually present. On the other hand, some birds were frightened away from this bay by hunters, whereas, few were disturbed at the refuge.

Bellrose (1944) calculated weekly the number of certain waterfowl species noted per acre in the Illinois River Valley during October, November, December, and January of 1938, 1939, 1940, 1941, and 1942; these data have been presented in Table 15.

In order to evaluate the use certain waterfowl species made of Fort Gibson Refuge during the 1960-61 season, the density of five duck species per acre, noted weekly in each of the areas, have been compared (Table 15).

TABLE 15

COMPARATIVE ABUNDANCE OF WATERFOWL AT FORT GIBSON REFUGE AND OTHER LOCATIONS

Location	Waterfowl Species	Waterfowl Per Weekly Census Per Acre: October 1	October 2	October 3	October 4	November 1	November 2	November 3	November 4	December 1	December 2	December 3	December 4	January 1	January 2	January 3	January 4
Fort Gibson Refuge	Mallard	0	.03	.42	.9	2.2	3.4	2.6	2.3	3.4	1.6	3.9	-	3.6	2.2	3.9	2.4
	Common Merganser	0	0	0	0	0	0	.02	.07	.16	0	.15	-	.4	.2	.3	.1
	Scaup	0	0	.01	.74	.9	0	0	0	0	0	.02	-	0	0	0	0
	Green-Winged Teal	0	.02	.02	.02	.2	.1	0	.05	0	0	.03	-	0	0	0	0
	Pintail	0	0	.02	.03	.04	0	0	.01	0	0	0	-	0	0	0	0
North Bay	Mallard	-	.27	-	.3	1.0	-	-	-	.17	-	-	-	-	-	-	0
	Common Merganser	-	0	-	0	0	-	-	-	.01	-	-	-	-	-	-	0
	Scaup	-	.2	-	.3	1.33	-	-	-	.01	-	-	-	-	-	-	0
	Green-Winged Teal	-	.01	-	.13	.33	-	-	-	0	-	-	-	-	-	-	0
	Pintail	-	0	-	0	0	-	-	-	0	-	-	-	-	-	-	0
Illinois River Valley 1938	Mallard	0	0	5	15	20	35	60	70	65	40	35	40	35	25	20	15
	Common Merganser	No Data															
	Scaup	0	0	0	.75	2.3	4.	3.3	2.	.5	0	0	0	0	0	0	0
	Green-Winged Teal	.02	.01	.01	.01	.01	0	0	0	0	0	0	0	0	0	0	0
	Pintail	.06	1.5	.4	.75	.7	.65	.2	.1	.05	0	0	0	0	0	0	0
Illinois River Valley 1939	Mallard	2	4	20	27	25	27	25	35	30	18	20	10	9	5	0	0
	Common Merganser	No Data															
	Scaup	0	.05	.1	.2	.6	1.0	1.6	1.3	.3	.1	.1	.1	0	0	0	0
	Green-Winged Teal	.09	.19	.17	.17	.03	.02	.03	.01	0	0	0	0	0	0	0	0
	Pintail	.05	.6	.9	.8	.55	.4	.35	.37	.1	.1	0	0	0	0	0	0
Illinois River Valley 1940	Mallard	2	8	9	18	35	40	42	29	20	19	21	30	15	10	0	0
	Common Merganser	No Data															
	Scaup	0	.5	.4	.5	.7	1.0	1.0	.2	.2	.2	0	0	0	0	0	0
	Green-Winged Teal	.02	.03	.04	.06	.05	.03	.02	.01	0	0	0	0	0	0	0	0
	Pintail	1.6	1.3	1.1	1.5	1.3	1.0	.3	.1	0	0	0	0	0	0	0	0
Illinois River Valley 1941	Mallard	0	5	10	23	25	30	30	70	75	55	-	-	-	-	-	-
	Common Merganser	No Data															
	Scaup	.5	.4	1.0	1.1	4.5	6.5	5.5	4.0	3.5	3.0	1.5	0	0	0	0	0
	Green-Winged Teal	.14	.06	.01	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pintail	2.2	1.3	.8	.4	.2	.3	.4	.5	.2	.1	0	0	0	0	0	0
Illinois River Valley 1942	Mallard	0	2	15	23	40	50	59	42	26	9	10	-	-	-	-	-
	Common Merganser	No Data															
	Scaup	0	0	7	10.5	11	14	11.5	10	4	0	0	0	0	0	0	0
	Green-Winged Teal	.01	.01	.02	.01	.01	0	0	0	0	0	0	0	0	0	0	0
	Pintail	.35	.5	.65	.6	.4	.3	.2	.2	.1	0	0	0	0	0	0	0

It is apparent that mallard abundance per acre was much greater in the Illinois River Valley in 1938, 1939, 1940, 1941 and 1942 than it was at the Fort Gibson Refuge and at North Bay during the 1960-61 season (Table 15). While as many as 75 mallards per acre were noted in the Illinois River Valley during the peak fall migration period in that area in 1941, only 3.9 mallards per acre were observed during the peak fall migration noted at the refuge. Higher mallard densities were consistently found in central Illinois (Table 15); however, mallards did overwinter at the refuge while they migrated on through central Illinois, which is at a greater latitude than the refuge.

Only on the morning of October 15, before duck season opened, were mallards more abundant at North Bay than at the refuge (Table 15).

Common mergansers were seen in greater abundance at the refuge than at North Bay (Table 15). This species was not listed in censuses conducted in the Illinois River Valley.

Except on October 29, scaups appeared to be more abundant on North Bay than at the refuge; however it should be kept in mind that many scaup were flying about during the early morning censusing periods at North Bay, whereas on the refuge, early morning flights had ceased by the time of censusing. Scaups were seen in greater density in the Illinois River Valley, especially during November and December, than they were at either Fort Gibson refuge and North Bay (Table 15). While scaups had apparently migrated through the refuge by mid-November, they were relatively abundant in the Illinois River Valley throughout November and early December. Their density at both the refuge and North Bay did approximate the density noted for that species in Illinois on week ends in October, except in 1942 a considerably greater scaup

density was noted in the Illinois River Valley. Overall, scaups were more abundant per acre in the Illinois River Valley than at the refuge.

Green-winged teal density was greater at Fort Gibson Refuge in November, 1960 than it was in the Illinois River Valley in that month in 1938, 1939, 1940, 1941, and 1942. It was also greater at the refuge in October, except in October of 1939 and 1940 slightly higher densities were censused in Illinois (Table 15).

On the basis of the five censuses made at North Bay, green-winged teal were more abundant there per acre than they were at the refuge; however, it is difficult to evaluate the effect that different times of censusing may have on census data obtained from both areas.

Pintail density was consistently greater in Illinois River Valley in 1938, 1939, 1940, 1941, and 1942 than at the Fort Gibson Refuge in 1960-61 (Table 15). When peak populations were recorded, from 2.2 to .65 pintails were noted in the Illinois River Valley, while the peak pintail density noted at Fort Gibson during the fall of 1960 was .04 pintail per acre. No pintails were seen in North Bay during the five censusing periods there.

CHAPTER V

DISCUSSION AND CONCLUSIONS

On the basis of relative abundance and tenure of use of the refuge, the mallard was undoubtedly the most important waterfowl species using the Fort Gibson Refuge during the 1960-61 season. Its overall and monthly densities were much greater than those of any other species. During both December and January the mallard comprised about 95% of the total waterfowl censused (Table 1). The largest mallard populations were also noted during December and January.

The common merganser, while only about one thirteenth as abundant as the mallard, was second in overall abundance of all waterfowl species noted. This overwintering species did not arrive at the refuge until mid-November, and was noted in greatest abundance during February.

The scaup followed the common merganser in overall abundance, but unlike the mallard and common merganser, it did not overwinter at the refuge. Instead, scaups moved rapidly through the refuge in the fall after having been seen in greatest abundance in late October and early November.

The redhead, whose overall relative abundance followed that of the scaup's was important at the refuge only during the first days in November.

Although the green-winged teal ranked behind the redhead in overall abundance, it was more important, on the basis of relative abundance, during the months of October, December, January, and March than

was the redhead. Some green-winged teal apparently overwintered at the refuge.

The ring-necked duck, not an important species in overall relative abundance and far less important than the mallard at the refuge, was present in relatively large numbers only during March.

The American widgeon, shoveler, and gadwall, although unimportant in overall abundance, were present in moderate numbers at the refuge during the latter part of October (Table 1). These ducks rapidly migrated through the refuge. In March the American widgeon ranked sixth in relative abundance among the duck species censused that month.

The pintail was slightly more important that the gadwall in overall relative abundance; however, pintails were never seen in moderate abundance as was the gadwall at its peak migration movement period. The pintail did not, in any month, remotely compare in abundance with the mallard.

Other duck species censused at the refuge, including the blue-winged teal, canvasback, bufflehead, common goldeneye, ruddy duck, hooded merganser, and black duck, were unimportant during the 1960-61 season at the refuge because they were seen in such small numbers or remained at the refuge for such a short time. The blue-winged teal, an especially early fall migrant and late spring migrant, was only seen in October and late March. Some hooded mergansers apparently overwintered at the refuge, but they were seen in such small number that they were insignificant in comparison with the abundance of some other ducks.

Among the geese on the basis of overall relative abundance, the snow goose was the most important goose species at the refuge during the 1960-61 season. Although a few snow geese remained on the refuge

throughout the winter, peak populations were noted in October and March (Tables 2, 3, 4, 5, 6, and 7).

A frequent companion of the snow goose, the blue goose was second in relative abundance of geese using the refuge; however, blue geese did not overwinter at the refuge.

Although the Canada goose was not as abundant as either the snow goose or blue goose in overall numbers, it was more important than either of these geese during the winter months of December and January.

The white-fronted goose was seen in such small numbers during the 1960-61 season that it might be considered unimportant at the refuge during that time.

On a per census basis, more waterfowl were present at the refuge during December than during any other month of this study. January followed December in relative monthly waterfowl abundance, after which came November, February, March, and October. Assuming that waterfowl censused during December and January consisted largely of overwintering species, this study corroborates a conclusion reached in an earlier Oklahoma study (Dodson, n.d.).

On the basis of observed frequency of field use, mallards favored grain sorghum-pea fields above standing corn, millet, or wheat fields at the refuge.

Japanese millet was used by mallards apparently in preference to German millet or standing corn.

Mallards tolerated some hunting pressure in seeking exposed waste corn in open fields near the refuge. They appeared to prefer landing in open, bare fields where a food supply was available, even if they had to walk a short distance to that supply, rather than alighting in

fields of standing corn where weedy ground cover was present. Madson (1960) states "mallards seem to prefer big, open fields with little cover and plenty of waste corn."

Mallards fed in mowed parts of grain fields in preference to areas of standing crops.

American widgeon grazed in wheat fields at the refuge; these fields are, apparently, an important food source to this duck.

On the basis of week end observations Canada, snow, and blue geese, during October, favored German millet in their field feeding activities. Millet that had been mowed was utilized by geese before that which was unmowed.

During the fall Japanese millet followed German millet in importance to geese; it was favored by all geese during November.

Geese moving through the refuge in early spring apparently utilized only wheat fields. Wheat fields which were as large as 40 acres or more were favored over smaller fields; and, no apparent differences in cover density around these fields were detected.

An analysis of waterfowl use of seven study areas at the refuge during February and March suggests certain preferences in selection of resting areas.

Mallards favored areas that contained the highest per cent of shallow water, that afforded the greatest protection from north and northwesterly winds, and where smartweeds covered the greatest per cent of their shorelines. An abundance of smartweed usually indicates areas of shallow water. Such areas are favored by mallards for "dabbling". Other aquatic plants, quite possibly, were also important in attracting mallards and other ducks to shallow water areas. No correlation between mallard abundance and tree and shrub cover along the shoreline of certain areas was recognized.

Shaw and Fredine (1956) state that various marshes and open waters with emergent non-woody vegetation are far more valuable to waterfowl than areas characterized by tree and shrub growth. Tree and shrub growth at intervals along a shoreline does not apparently constitute a limiting factor in mallard selection of resting areas. Water depth and wind protection apparently influence use of certain areas more than does tree and shrub growth along shorelines.

The area which was used least by mallards as a resting place, or "dabbling" area, was characterized by its open, relatively deep waters with very little protection from winds. This area had about average tree and shrub growth along its shoreline, and ranked low in per cent of its shoreline having smartweeds.

Pintails were found in greatest abundance in the same areas as were mallards. They favored areas having relatively shallow water and adquate wind protection. Pintails did, in significant abundance, use an area which afforded protection from only southerly winds; but, a check of field notes reveals that each time pintails were seen in this area there was either no wind or it was from a southerly direction.

Protection from north winds, which ordinarily have accompanying cold temperatures, appeared to be sought more by waterfowl than protection from south winds, which usually had milder temperatures accompanying them. Mallards did, during February and March at the refuge, favor those areas that afforded good protection from northerly winds.

Green-winged teal made greatest use of areas which were protected from northerly winds; however, the correlation between their use of an area and its relative water depth is even more evident than their selection of sheltered areas. Their relative use of resting areas was greatest in four areas where water not exceeding four feet in depth

was most extensive. Thus, the selection of a resting or "dabbling" area by green-winged teal apparently is strongly influenced by the amount of shallow water in that area. This selection of shallow water might be expected of this teal, since it is a duck of inland sloughs and marshes (Kortright, 1942).

American widgeon also favored shallow areas where protection from winds was good. They were noted in relatively high density in an area that was near a wheat field in which they had been seen grazing, suggesting that their use of that area was influenced by its proximity to feeding fields.

Ring-necked ducks and scaups, on the basis of frequency of observation, favored a large, open water area, which offered little protection from winds (Table 14). Ring-necked ducks were seen more often in shallower water than were scaups. This is characteristic of the ring-necked duck (Kortright, 1942).

Common mergansers used a large, open water area on the refuge far more than other areas, suggesting that they do prefer such broad, open water areas and are little influenced by winds and accompanying wave action.

In order to measure the value of Fort Gibson Refuge to waterfowl in relation to other waterfowl areas, an effort was made to compare the relative abundance of waterfowl at the refuge with that of other areas (Table 15). A comparison of such abundances is limited by the variations in censusing the areas; however, some relative values of the refuge are suggested.

Mallards were more abundant on the refuge than at North Bay after the duck season opened; however, it is possible that North Bay was favored by mallards before the season opened.

Mallard density in the Illinois River Valley in 1938, 1939, 1940, 1941, and 1942, was much greater than that at the refuge during the 1960-61 season; however, an overwintering population remained at the refuge, while mallards migrated on through the Illinois River Valley. The value of a refuge to waterfowl is determined by whether it is within the breeding, migration, or wintering grounds of the birds under consideration (Bellrose, 1954). Fort Gibson Refuge is within the wintering range of the Canada goose, mallard, and common merganser (Kortright, 1942). Thus, although mallard density per acre may be lower than populations noted in Illinois, the refuge is of definite value as an overwintering area to these species.

Several species used the refuge in limited numbers while migrating through. Scaups and pintails were noted in relatively low numbers at the refuge during 1960-61 season.

Waterfowl densities suggest that North Bay was used in preference to the refuge by scaup and green-winged teal; however, as previously mentioned, certain factors, such as differences in censusing times, could have influenced the censusing of these areas. A more equitable censusing technique for each area would provide a better basis for comparing the relative value of the refuge.

CHAPTER VI

MANAGEMENT IMPLICATIONS OF THIS STUDY

On the basis of the migration phenology indicated for certain waterfowl species at the Fort Gibson Refuge during the 1960-61 season, certain annual migrations may be expected. Depending upon the population status of each waterfowl species in a given year, it may be desirable to adjust hunting seasons in order to manipulate the harvest of each species in a local area.

If a maximum waterfowl harvest was possible in the vicinity of Fort Gibson Refuge, the following periods in the fall should, on the basis of week end censusing in 1960-61, be included in the hunting season for the various species.

	Species	Period to be included in season
1.	Mallard	First three weeks in November, omit final week, then include all December, and first three weeks in January.
2.	Green-winged Teal	First and second week in November.
3.	Blue-winged Teal	End season by second week in October; major migration probably prior to October 8.
4.	Pintail	Last week in October and first week in November.
5.	American Widgeon	Last week in October.
6.	Shoveler	Last week in October.
7.	Gadwall	Last week in October.
8.	Scaup	Last week in October and first week in November.
9.	Redhead	First week in November.
10.	Canvasback	First week in November.
11.	Ring-necked Duck	First week in November.

12.	Bufflehead	First and second week in November.
13.	Common Goldeneye	Last week in November.
14.	Ruddy Duck	Last week in October and first week in November.
15.	Common Merganser	Increased in numbers throughout most of the 1960-61 season; a peak population was noted the first week in February, after which a decline began.
16.	Hooded Merganser	Major movement in November.
17.	Canada Goose	Third and fourth week in October and first week in November.
18.	Snow Goose	Third and fourth week in October.
19.	Blue Goose	Third and fourth week in October.

Since the mallard was the most important species using the refuge, management practices that might affect it are particularly important.

Grain sorghum-pea fields, which were favored by mallards, should be adequately provided at the refuge.

Although mallards may range from the refuge regardless of food supplies available within the refuge, it appears that more mallards could be held on the refuge by systematically knocking down standing corn and other grain crops, thereby providing feeding areas somewhat similar to outlying harvested corn fields which mallards did heavily use.

Establishment of wheat fields as close as possible to a shallow water area should provide useful grazing areas for American widgeon.

During the fall season of 1960, all geese favored a field of German millet before using other millets, grains, or winter wheat. Thus, during the fall season it appears that German millet should be provided in large acreages for geese. Mowed millet attracts geese before unmowed sections of fields containing this grain do.

Wheat fields, provided for Canada, snow, and blue geese in the spring migration period should be no less than 40 acres in area to induce greatest useage by geese. The highest optimum field area is not known, but fields as large as 60 acres were used in preference to those smaller than 40 acres.

An analysis of use made of certain water areas on the refuge suggests some management practices which would possibly make the refuge more attractive to certain waterfowl species. If the refuge is to be managed primarily for mallards and other pond and slough ducks, an increase in shallow water area on the refuge would be desirable. Since mallards favored areas affording good protection from northerly winds, provision for such protection should be considered in planning new impoundments. Narrow, slough-like impoundments which are constructed with their longest dimension perpendicular to northerly winds would probably be desirable. It might be necessary to construct earthen windbreaks along the north side of such impoundments.

An analysis of smartweed abundance in various areas used by mallards suggests that the presence of this one plant may be an important factor in waterfowl use of water areas.

When acquiring new water areas for use by diving ducks, provision of broad, open, deeper areas should be considered. Ring-necked ducks may use shallower areas, but divers on the whole used open, deep waters at the refuge in preference to small, shallow areas.

Field crops at the refuge appeared to be quantitatively adequate for the waterfowl numbers using the refuge. It is not thought that a shortage of planted foods limited waterfowl numbers at the refuge. The ecologic make-up of the refuge, characterized as it is by a savannah type plant association was probably not as attractive to ducks as a more marsh-like

area, rich in aquatic duck foods. Siegler (1945) noted that provision of grain fields did not prove successful in attempts to attract waterfowl to refuges in eastern Texas. Provision of grain fields alone apparently is not sufficient to attract large waterfowl numbers. Shallow water areas with an abundance of aquatics which would provide choice duck foods during the fall season probably would attract a large waterfowl population to an area. Whether or not grain crops would hold large populations throughout the wintering period, even if they were attracted initially by aquatic food items, is not known.

TABLE VII

SUMMARY

1. This study was concerned with the migration phenology of waterfowl species using the Fort Gibson Refuge during the 1960-61 season. A second concern of the problem was the study of the ecologic relationships existing between waterfowl species and their use of available feeding and resting areas at the refuge or in its vicinity.

2. Censusing of waterfowl and field observation of the use made of feeding areas were conducted from October, 1960, through March, 1961. Certain resting areas were studied ecologically during February and March, 1961.

3. On the basis of relative abundance and tenure of use, the mallard was the most important waterfowl species using the refuge during the 1960-61 season.

4. The 1960-61 migration phenology of several waterfowl species using the refuge was indicated by weekly censusing.

5. Mallards apparently favored grain sorghum-pea fields above other grain crops at the refuge. Open, bare fields containing waste corn were used by mallards even though they were located outside the refuge where some hunting pressure was present.

6. Wheat fields are apparently an important source of food to the American widgeon in early spring.

7. Geese favored German millet in early fall, and the larger wheat wheat fields at the refuge in the spring.

8. Mallards favored shallow water areas which offered protection from northerly winds. They also used those areas having the greatest amount of smartweeds along their shoreline.

9. On the basis of census data collected at other locations, waterfowl abundance at the Fort Gibson Refuge during the 1960-61 season was relatively low.

10. During the latter part of October and first weeks in November, the greatest movement of many waterfowl species through the refuge was noted. For maximum harvest of several of the species in this area, these periods should continue to be included in the fall hunting season.

11. The refuge would probably be more attractive to waterfowl if more marsh-like, shallow water areas were available to waterfowl.

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