

UTILIZATION OF TISHOMINGO WILDLIFE MANAGEMENT

UNIT BY WATERFOWL AND HUNTERS

By

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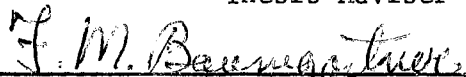
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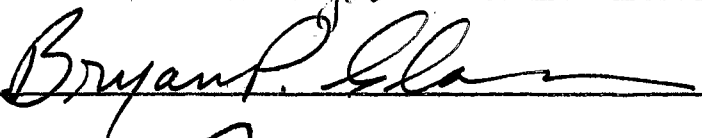
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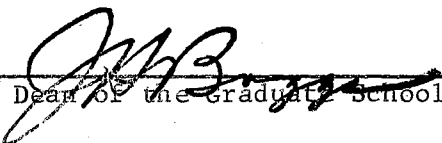
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PREFACE

The Tishomingo Wildlife Management Unit is a unique public hunting area. It is managed cooperatively by the Bureau of Sports Fisheries and Wildlife and the Oklahoma Department of Wildlife Conservation. No fee is charged for hunting there in the Management Unit. Goose blinds are assigned on a first-come basis.

The aim of this study was to determine effectiveness of waterfowl management practices employed on the Management Unit. Waterfowl and hunter use of this area was selected as evaluative criteria.

Support for this study was provided by the Oklahoma Cooperative Wildlife Research Unit, sponsored cooperatively by the Oklahoma Department of Wildlife Conservation, Oklahoma State University, U. S. Fish and Wildlife Service, and Wildlife Management Institute.

Gratitude is expressed to the members of my committee, Dr. F. M. Baumgartner and Dr. B. P. Glass for their interest in and critical evaluation of my work and, in particular, to Dr. A. M. Stebler, major adviser, who has given unstintingly of his time, effort, and counsel throughout the course of this research project.

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Indebtedness is expressed to the following business establishments of Tishomingo for obtaining records of hunter expense: B. and E. Sporting Goods, Kimborough's Cafe, Palace Cafe, Rainbo Courts, and Stamps Phillips 66 Service Station.

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CHAPTER I

INTRODUCTION

The Tishomingo Management Unit was established in 1958 by a cooperative agreement between the Tishomingo National Wildlife Refuge, the Oklahoma Department of Wildlife Conservation, and the U. S. Army Corps of Engineers. Development of this Unit began in 1959.

The present evaluation was initiated to determine effectiveness of management practices employed on this Management Unit. Use of the Tishomingo Management Unit by waterfowl provided the central problem. This was selected as the primary objective for the following reasons:

1. The area was a waterfowl area.
2. Most of the management practices were oriented toward waterfowl.
3. The hunters were primarily interested in waterfowl.
4. There is annually a large congregation of waterfowl on the Refuge adjacent to the Management Unit.

Secondary objectives were concerned with waterfowl use of the adjacent Refuge, hunter use of the Management Unit, and the economic effect of an influx of hunters upon the local community.

Field study was conducted at the Tishomingo Wildlife Management Unit and Tishomingo National Wildlife Refuge during the migration and wintering of waterfowl in the 1964-1965 season.

CHAPTER II

DESCRIPTION OF STUDY AREA

The Tishomingo Wildlife Management Unit is located one mile south of Tishomingo, Johnston County, Oklahoma, with 40 acres extending into Marshall County, Oklahoma (Fig. 1).

In 1946, the U. S. Army Corps of Engineers transferred perimeter lands of Lake Texoma, that had been acquired for flood water storage, to the Bureau of Sports Fisheries and Wildlife for establishment of the Tishomingo National Wildlife Refuge. Waterfowl were attracted and waterfowl hunting became a major sport in this area. No hunting has ever been permitted on the original 13,449-acre Refuge. There was hunting, however, on private land surrounding the Refuge. In 1957, the Bureau of Sports Fisheries and Wildlife, by a cooperative agreement with the U. S. Army Corps of Engineers, annexed 3,170 additional flood water storage acres into the Refuge. The Oklahoma Department of Wildlife Conservation entered into a cooperative agreement with the Tishomingo National Wildlife Refuge, in 1958, for establishing this area as a public hunting area. The area was designated Tishomingo Wildlife Management Unit.

Tishomingo Wildlife Management Unit, hereafter referred to as the Unit, was a diversified tract of land. It was traversed by the Washita River which flowed diagonally from northwest to southeast across the Unit. The flood plain of the river was approximately three miles long

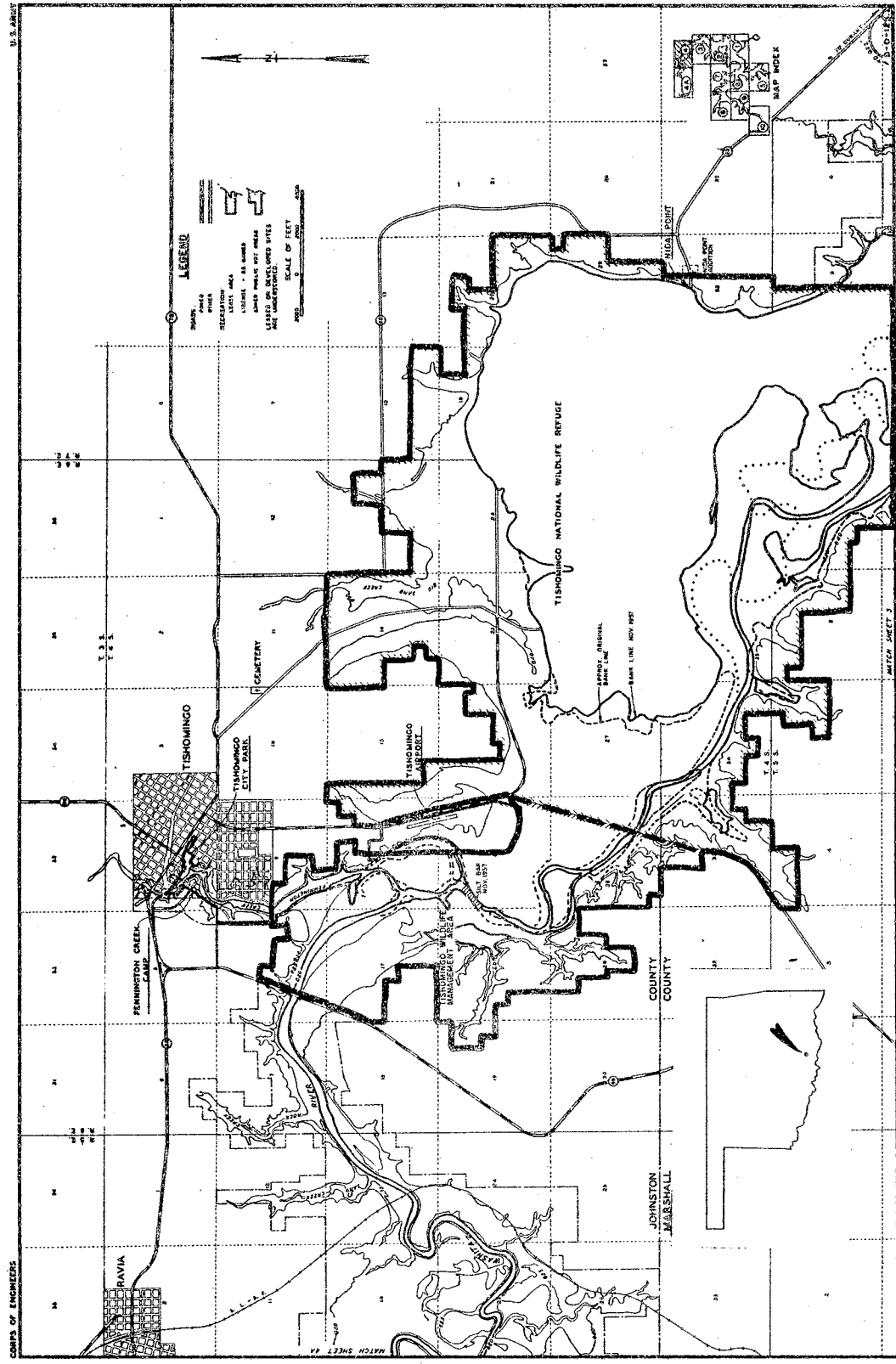


Fig. 1. Tishomingo National Wildlife Refuge

and one-half mile wide and thus occupied a large portion of the Unit. It was estimated that the flood plain of the river occupied two-thirds of the area of the Unit.

The vegetation of the flood plain was characterized by black willow (Salix nigra), cottonwood (Populus deltoides), and ash (Fraxinus americana). The understory vegetation was dominated by poison ivy (Rhus radicans), giant ragweed (Ambrosia trifida), and pokeberry (Phytolacca americana).

Uplands on both sides of the river flood plain comprised an estimated one-third of the area of the Unit. The topography of the uplands was generally rough. Timbered ravines were interspersed between small areas of tall grass prairie, abandoned fields and fields currently in cultivation.

The upland timber areas were dominated by a blackjack oak (Quercus marilandica) and post oak (Quercus stellata) association. Less abundant species include osage orange (Maclura pomifera), roughleaf dogwood (Cornus drummondii), redbud (Cercis canadensis), hackberry (Celtis occidentalis), and pecan (Carya illinoensis).

Indiangrass (Sorghastrum nutans), big bluestem (Andropogon gerardi), little bluestem (Andropogon scoparius), and switchgrass (Panicum virgatum) were the dominant species of grass in the tall grass prairie areas.

At the time of the study abandoned fields were primarily in early stages of succession. Persimmon (Diospyros virginiana) and winged elm (Ulmus alata) were the two most common woody species invading the fields. The invading grasses were predominantly annual threeawn (Aristida oligantha), splitbeard bluestem (Andropogon ternarius),

silver bluestem (Andropogon saccharoides), and Japanese brome (Bromus japonicus). Western ragweed (Ambrosia psilostachya), Baldwin ironweed (Vernonia baldwini), bitter sneezeweed (Helenium amarum), and camphorweed (Heterotheca subaxillaris) were some of the more abundant forbs invading the abandoned fields.

There were four cultivated fields on the Unit. Each field has been named by the Unit personnel. These names will be used in referring to a specific field. The symbols designating each field (Fig. 2) names, and acreages are: (A) Big Bottom, 230 acres; (B) Pennington Bottom, 60 acres; (C) Check Station Field, 50 acres; and (D) Whiskey Creek Field, 60 acres. In the fall of 1964, there were 80 acres of corn and 150 acres of wheat planted in the Big Bottom field. The remaining three fields were planted with wheat only.

Oxbows and depressions in the flood plain were filled periodically by floods forming natural sloughs that were attractive to waterfowl. In 1957, Lake Texoma, with a normal power pool level of 612 feet, was filled to flood stage at 644 feet. This large rise flooded most of the Refuge and Management Unit, as can be seen by observing the 640 foot contour line (Figs. 1 and 2). Water remained high for several weeks during the spring, killing much vegetation. Many invaders replaced the climax species in the flooded areas. A wheat field situated in the flood plain west of the lake, was inundated and remained too muddy to farm for several months. This permitted invasion by willows. The field was abandoned due to the expense of clearing this brush and the uncertainty of reflooding once the area had been cleared.

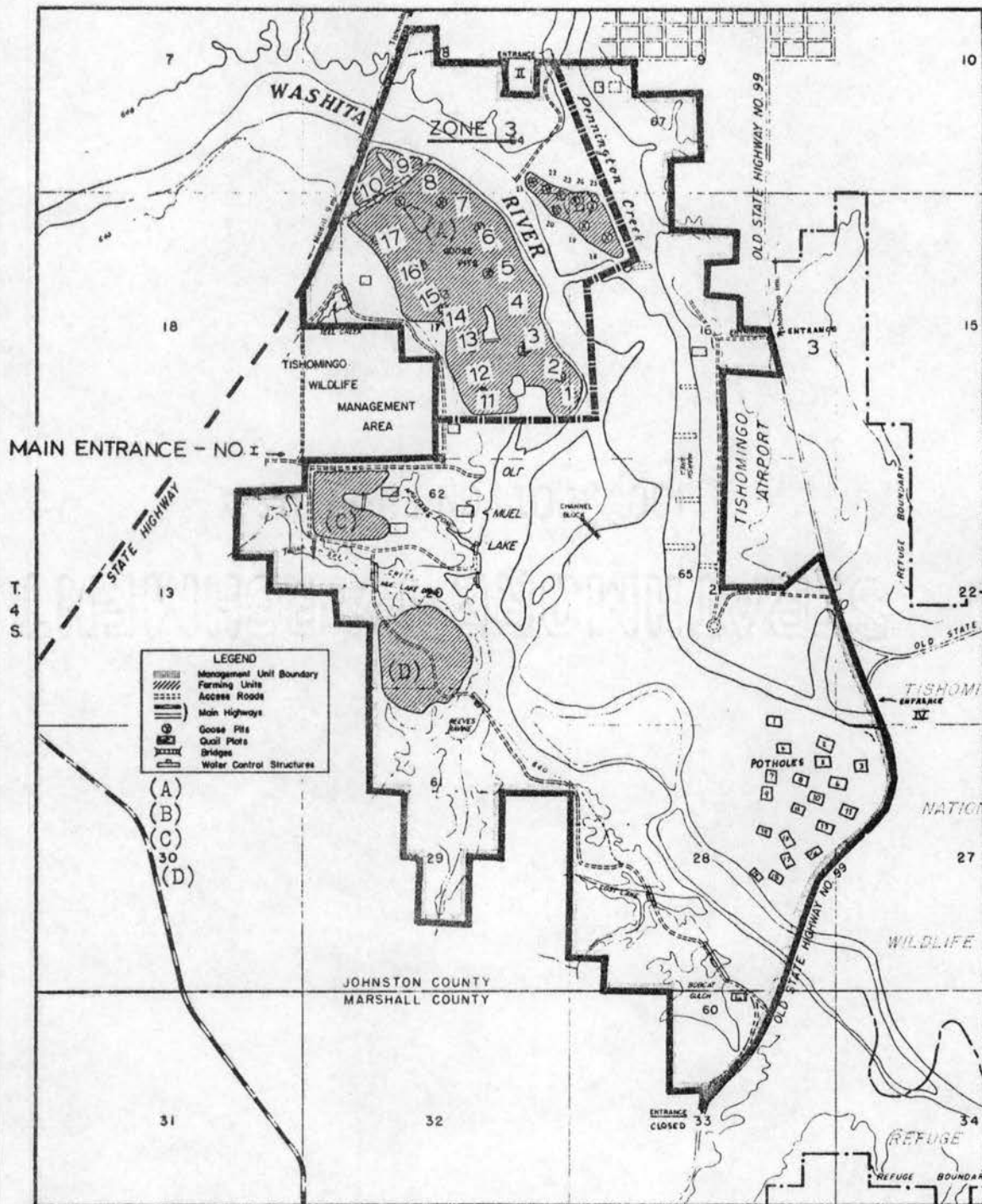


Fig. 2. Tishomingo Wildlife Management Unit

Management Practices and Developments

Development of the Unit began in 1958. Nine fresh water ponds have been constructed and planted with sago pondweed (Potamogeton pectinatus). Strips were cleared through dense brush to create "edges" for upland game species. The strips were planted to sericea (Lespedeza cuneata). During 1963 and 1964, 27 "potholes" have been constructed in the bottomland brush. A diversion canal from Pennington Creek (Fig. 2) furnished water to fill the "potholes." The "potholes" were three to five feet deep and had approximately one acre of surface area. They were completed and filled with water 1 October 1964.

In 1960, 25 concrete-block bunker-type blinds were constructed for the goose hunters. The blinds, 17 in the Big Bottom and eight in the Pennington Bottom (Fig. 2), were placed approximately 125 yards apart.

Entrance via the Main Check Station, located at Entrance Number 1, was required of all hunters entering Zone 3 (Fig. 2) and areas south of the Main Check Station. The Main Check Station was manned every hunting day and records were obtained from each hunter entering through Entrances 1 and 2.

The check station at Entrance 3, designated Pothole Check Station, was manned part of each hunting day, 6:00 a.m. to 9:00 a.m. and 3:00 p.m. to 6:00 p.m. The check-out time and bag of hunters leaving the Unit between 9:00 a.m. to 3:00 p.m. were not complete.

In addition to state and federal regulations, special hunting regulations were in effect on the Unit. The regulations were intended to reduce: crippling of waterfowl, extreme hunting pressure, and

accidental shooting of fellow hunters. (See Rules and Regulations for Tishomingo Wildlife Management Unit in appendix.)

CHAPTER III

METHODS

Waterfowl use of the Management Unit was determined by census when possible and relative abundance when it was not possible to make a census. Censuses and/or relative abundance of waterfowl using the Refuge were also determined. In addition, Refuge personnel cooperated in making available waterfowl-use data.

A wheat forage consumption study was conducted on Tishomingo National Wildlife Refuge from October, 1964 to January 4, 1965 to determine the amount of wheat foliage consumed by the geese feeding on the Refuge. Twenty-five exclosures, cylinders thirty inches in diameter and twenty-four in height, were constructed from one-inch mesh poultry wire. These exclosures were placed in the Refuge wheat field prior to the arrival of the geese. Bias was eliminated by random selection of sites for the placement of the exclosures.

On January 4, 1965 a quadrat ($11\frac{1}{2}$ inches by 24 inches) was clipped from the exclosures and from the grazed areas. Each grazed area was clipped at a distance of five paces east from each exclosure. Due to accidents, three of the exclosures did not protect the wheat, thus quadrats were clipped from twenty-two exclosures and twenty-two grazed areas. The vegetation from the exclosures was kept separate from that of the grazed areas.

This vegetation was oven-dried, at 80 degrees Celsius for 48 hours, and then weighed in grams. This weight was then used to calculate the pounds of foliage per acre. The weight of the clipped vegetation multiplied by fifty yielded pounds per acre. The number of quadrats divided into the calculated pounds per acre yielded the average pounds per acre for the entire field. The difference between the pounds of foliage per acre in the exclosed and that of the grazed areas was used as an index to the amount of foliage per acre consumed by the geese. The number of acres in the wheat field times the foliage consumed per acre yielded the total pounds consumed.

Total goose-days of use was calculated from the weekly census of geese on the wheat field. This figure divided into the total consumption figure yielded an estimate of the amount of dry wheat foliage consumed by a single goose in one day.

Hunter use was determined from records obtained at the Main and the Pothole Check Stations. Each hunter's name, address, license number, check-in time, check-out time, and bag were obtained. In addition, local expenses of visiting hunters were obtained from questionnaires. The questionnaires sought information concerning the following items of expense: lodging, food, transportation, shells, guns, clothing, decoys, calling devices, and photography.

Local merchants in Tishomingo assisted in gathering information relative to the local expenses of visiting hunters. Two restaurants, a sporting goods store, a motel, and a service station kept records of expenses of visiting hunters. It was difficult to differentiate between local and visiting hunters, and thus the expense data obtained were probably exaggerated.

Wings were collected from the ducks bagged by the hunters. The species, sex, and age of the ducks was determined by plumage characteristics of the wings (Carney, 1964). The geese killed were sexed by cloacal examination and aged by the presence of the notched tip in the tail feathers of immatures or absence of the notched tip in the tail feathers of adults (Elder, 1946; Hanson, 1949; Hanson, 1962).

CHAPTER IV

RESULTS

The results of the censuses of the Management Unit are presented in Fig. 3. The numbers plotted are actually indices of relative abundance since the topography and vegetation of the Unit made it impossible to obtain a census of all the waterfowl using the areas. Waterfowl use of the Refuge is summarized in Fig. 4.

Wheat foliage production in the exclosed areas was calculated to be 1,986.1 pounds per acre, in contrast the grazed areas yielded only 293.3 pounds per acre. The difference was 1,688.8 pounds per acre. This difference of 1,688.8 pounds per acre times the total acreage of the field (175) yielded an estimated total consumption of 295,540 pounds. There were 2,158,086 goose-days of use of the wheat field. Estimated daily consumption in pounds per goose was calculated by dividing the total goose-days use (2,158,086) into total wheat foliage consumption (295,540 pounds). The quotient was an estimate of the average amount of dry wheat foliage consumed by one goose in a single day, 0.131 pounds per goose per day.

The total waterfowl kill recorded for the Unit was 204 geese and 313 ducks, (Fig. 3 and Table I). There were 2,216 hunters checked during the 1964-1965 hunting season, 1,791 at Main Check Station and 425 at Pothole Check Station. The greater number of hunters checked

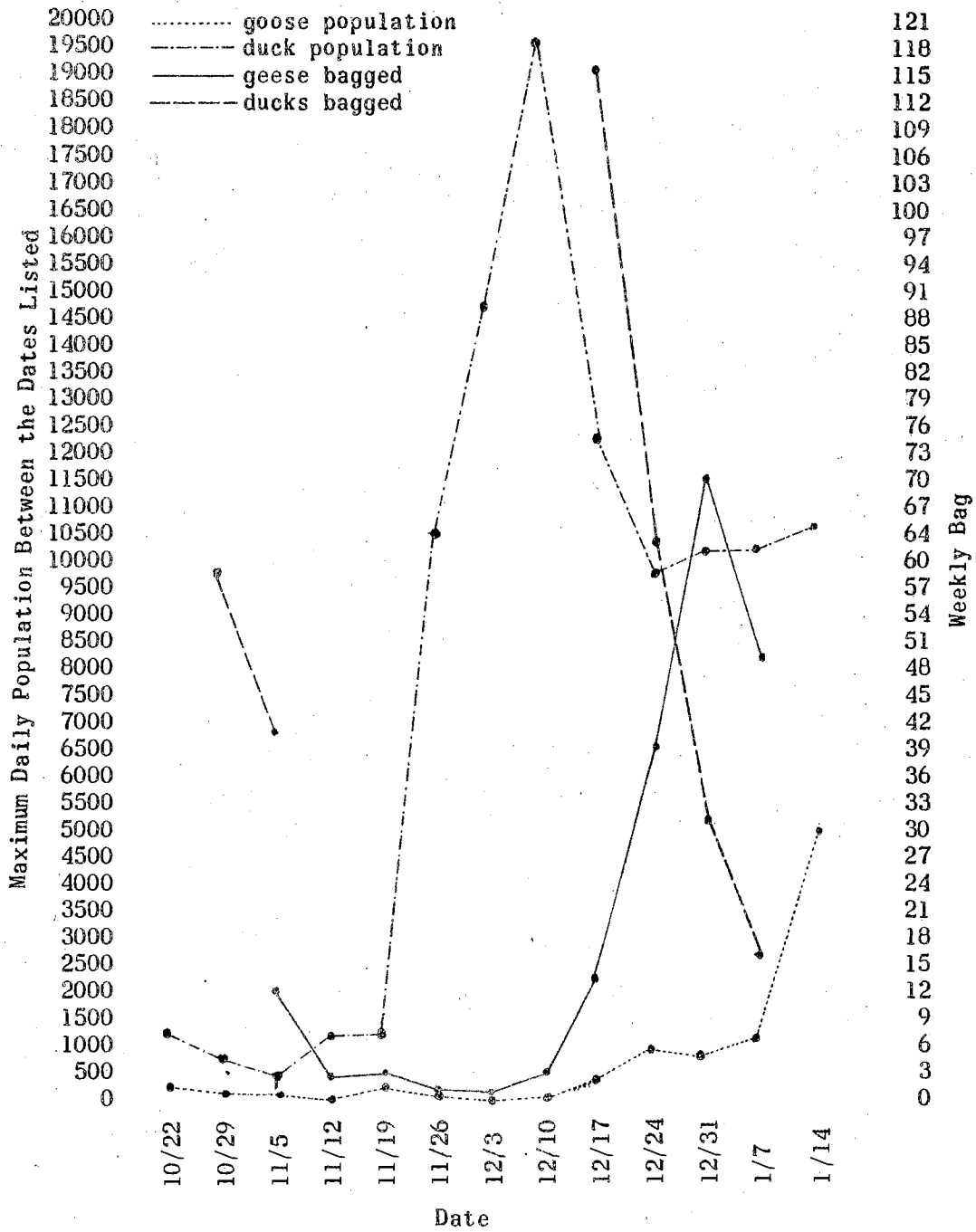


Fig. 3. Comparison of Waterfowl Populations and Waterfowl Bag on Tishomingo Wildlife Management Unit.

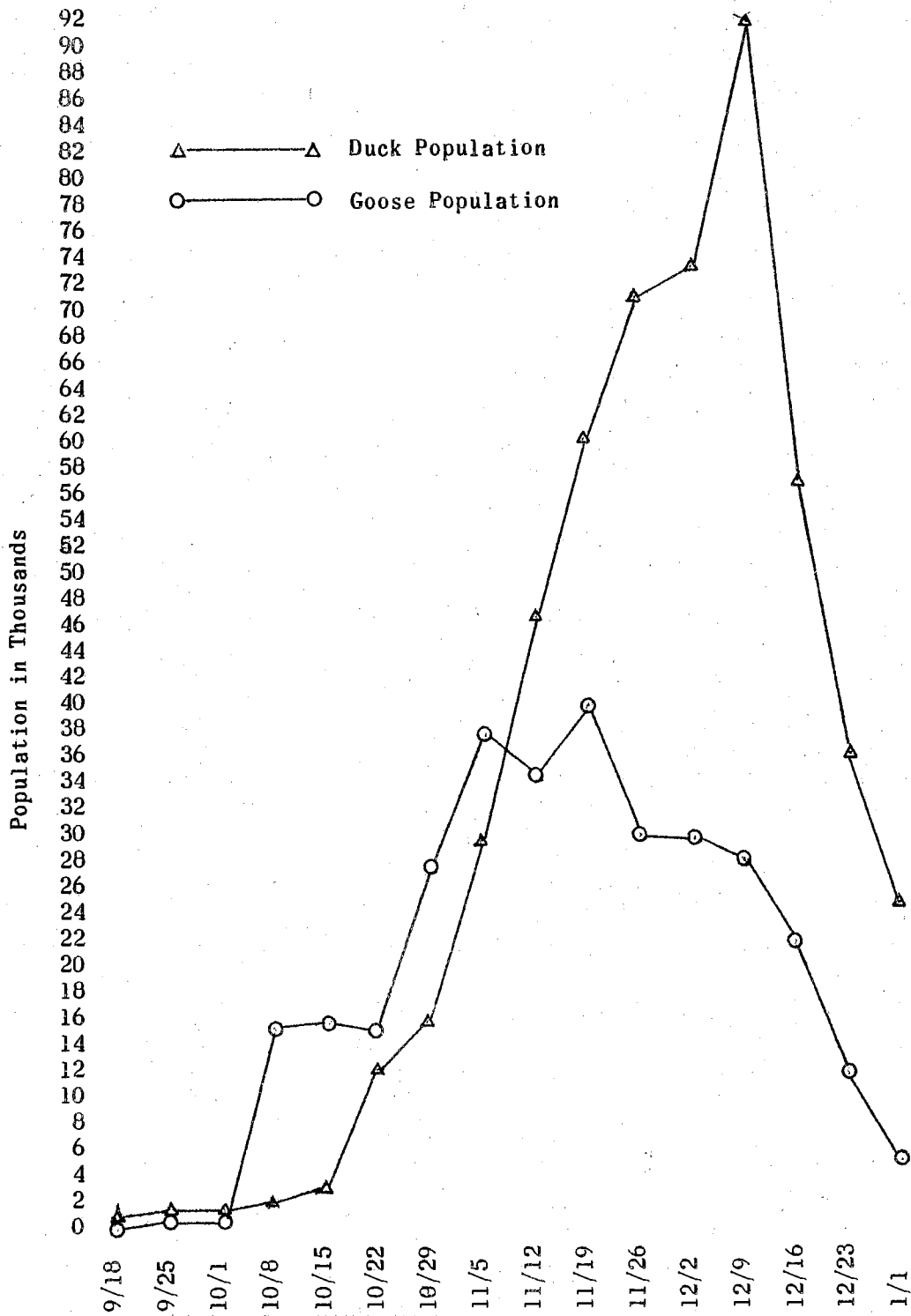


Fig. 4. Waterfowl Populations of Tishomingo National Wildlife Refuge, Fall and Winter 1964-65.

TABLE I
HUNTER USE OF THE MANAGEMENT UNIT

Date	Main Check Station			Pothole Check Station		
	No. of Hunters	Geese	Bag Ducks Quail	No. of Hunters	Geese	Bag Ducks Quail
10/24	25		4	12		14
10/25	30		5	13		4
10/27	8			9		11
10/29	3		4	3		7
10/31	10		2	13		17
11/1	38		6	32		11
11/3	10			7		5
11/5	65	10				
11/7	75			8		
11/8	69	3		8		
11/10	20			2		
11/11	7			1		
11/12	20	1		1		
11/14	54	3		4		
11/15	45			3		
11/17	8			1		
11/19	10	1				
11/21	60	1		8		9
11/22	43			3		
11/24	5					
11/26	44			6		7
11/28	29			4		1
11/29	20			2		
12/1	8					
12/3	13			2		
12/5	35			3		6
12/6	25	1		2		
12/8	10	3		3		
12/10	13					
12/12	80	3	37	50		22
12/13	63	1	10	33		11
12/15	35	4	10	9		5
12/17	45	7	18	8		3
12/19	68	16	9	6	22	11
12/20	82	12	4	29		8
12/22	70	3	18	6	20	7
12/24	76	8	5	8	11	
12/25	45		2	4	24	2
12/26	72	23	6	1	13	4
12/27	70	6	4		18	1
12/29	60	15	3		7	6
12/31	55	27	3		5	4
1/1	78	19	10	1	10	
1/2	43	21	2		8	
1/3	44	10	1		8	
Totals	1,791	199	163	53	425	5
						150
						25

at the Main Check Station was reflective of the type of hunting preferred by hunters at the Unit. The majority of the hunters came to the Unit to hunt Canada geese. Duck hunting was secondary to most hunters.

The species, sex, and age of the ducks from which wings were taken is presented in Table II. Wings were not collected from all the ducks checked out, since some hunters wished to mount their bag. The wing collection (290) does represent a high percentage (91.8%) of all ducks bagged by the hunters.

TABLE II
SPECIES, SEX, AND AGE OF DUCKS KILLED ON THE
TISHOMINGO MANAGEMENT UNIT

Species	Adult Male	Immature Male	Adult Female	Immature Female
Mallard	33	44	15	59
G.-w. Teal	15	33	7	26
Wood	3	3	5	3
Lesser Scaup	3	1	0	4
Shoveller	0	2	0	5
Gadwall	5	2	1	2
Pintail	0	4	0	3
Baldpate	0	1	0	6
Ring-necked	1	1	1	2
Totals	60	91	29	110

The sex and age groups of the bagged geese checked were: 26 adult males, 5 immature males, 27 adult females, and 8 immature females. The

high ratio of adult to young birds can be explained by the fact that only birds of the year were classed as immatures.

Expense questionnaires were filled out by 644 visiting hunters. Hunters residing in Tishomingo were not asked to fill out a questionnaire, since the objective was to determine the expenses of out-of-town hunters. Visiting hunters were contacted at the Main Check Station only. The average reported expenditure was \$4.97. The number of visiting hunters at the Main Check Station (1,607) times \$4.97 yielded an estimated total local expenditure of \$7,986.80. Visiting hunters at the Pothole Check Station were not included in the estimate of total expenditure. They were primarily local hunters or from nearby communities and probably did not spend as much money in Tishomingo. Table III presents a summary of the economic data of the hunters.

TABLE III
LOCAL EXPENDITURE OF VISITING HUNTERS

Item	Amount \$ Reported	Number Reporting	Ave. Cost \$ Per Hunter	Estimated Total \$ for All Visiting Hunters
Lodg.	68.00	15	4.53	167.72
Food	919.22	417	2.20	2,292.21
Trans.	1,030.26	336	3.06	2,571.75
Shells	427.05	155	2.75	1,062.24
Cloth.	240.54	29	8.29	599.01
Calls	145.08	29	5.00	359.41
Decoys	370.00	10	37.00	918.49
Photo.	4.19	2	2.10	15.97
Totals	3,204.34			7,986.80

The total expense for each item was estimated by assuming that the ratio between the amount reported (A') for each item over the total expenditure reported (T') was directly proportional to the amount spent by all visiting hunters on this item (A'') over the estimated total expenditure of all visiting hunters (T'').

$$\frac{A'}{T'} = \frac{A''}{T''}$$

Table IV shows a summary of the records kept by the merchants of Tishomingo. A comparison of average cost per item as reported by the hunters and by the merchants shows some discrepancy. The largest variation was between the costs for food.

TABLE IV
LOCAL EXPENDITURE OF VISITING HUNTERS AS REPORTED BY
TISHOMINGO MERCHANTS

Item	Total Reported \$	No. of Entries	Average Cost Per Entry \$
Lodging	99.00	29	3.41
Food	1,854.90	2,797	.66
Trans.	20.92	7	2.98
Shells	379.85	104	3.65
Misc.	149.89	53	2.82
Calls	95.85	22	4.35
Decoys	0	0	0
Photo.	0	0	0

It appears that the hunters had a tendency to overestimate the amount spent for each item. This was difficult to evaluate, but may have been due to the small amounts of data available on such items as: transportation, lodging, clothing, decoys, and photography. The lower cost per entry for food as reported by Tishomingo restaurants was explained by the fact that they reported only the amount spent for breakfast. The breakfast expense could be limited almost entirely to hunters since they ate very early in the morning (4:00 to 6:00 a.m.). The expense by hunters for noon or evening meals could not be readily determined and thus was not reported.

The hunters came from 82 towns in Oklahoma (Fig. 5 and Table V). Local hunters from Tishomingo comprised only 14 percent of the total. Among the larger communities from which hunters came from were: Ada, Ardmore, Madill, Oklahoma City, and Duncan.

TABLE V
GEOGRAPHIC POINT OF ORIGIN OF HUNTERS.

County	Town	Distance Traveled	Hunting Trips
Atoka	Stringtown	45	1
Bryan	Durant	34	7
	Kenefick	20	2
Caddo	Anadardo	121	2
	Apache	141	4
	Cyril	143	1
Canadian	El Reno	145	7
	Yukon	126	13
Carter	Ardmore	31	360
	Healdton	57	14
	Lone Grove	38	8
	Ratliff City	68	2
	Wilson	47	1
Choctaw	Hugo	87	1
Cleveland	Blanchard	104	4
	Lexington	81	4
	Norman	100	19
Comanche	Elgin	133	2
	Lawton	122	17
Creek	Bristow	130	6
	Drumright	131	3
Dewey	Vici	245	1
Garvin	Elmore City	64	1
	Lindsay	83	2
	Pauls Valley	59	14
	Stratford	50	4
	Wynnewood	49	8
Grady	Chickasha	109	2
Hughes	Holdenville	74	17
	Wetumka	93	3
	Altus	178	1
Jackson	Ringling	59	2
Jefferson	Coleman	16	11
Johnston	Mansville	16	3
	Milburn	7	6
	Ravia	5	5
	Tishomingo	1	412
	Ponca City	194	1
Kiowa	Hobart	184	6
Lincoln	Meeker	102	1
Logan	Guthrie	148	4
Love	Marietta	40	2
Marshall	Madill	14	215
	Kingston	21	35
	Lebanon	38	4
	Purcell	83	1
	Wright City	114	1
McClain	Sulphur	30	28
McCurtain	Arcadia	116	4
Murray	Edmond	120	3
	Bethany	116	1
	Del City	116	6
	Oklahoma City	116	236
	Henryetta	115	2
Okmulgee	Okmulgee	129	1
	Stillwater	154	9
Payne	Krebs	88	1
Pittsburg	McAlister	86	1
	Ada	38	428
Pontotoc	Fittstown	26	2
	Fitzhugh	32	11
	Roff	26	1
	Stonewall	35	25
	Shawnee	88	8
Pottawatomie	Oleta	87	4
Pushmataha	Seminole	74	7
Seminole	Comanche	88	14
Stephens	Duncan	91	106
	Marlowe	102	17
	Velma	78	2
	Frederick	154	10
Tillman	Collinsville	182	3
	Tulsa	165	18
	Bartlesville	214	2

CHAPTER V

DISCUSSION

The Tishomingo National Wildlife Refuge is a stopover site for migrating geese. The fall migration begins to arrive at the Refuge in late September and October, with the peak population usually reached by mid-November. Cultivated wheat and corn, lake resting sites, and sanctuary presumably entice many geese to remain on the Refuge for several weeks. The geese do not have to leave the confines of the Refuge to find food and resting sites. Thus very few geese flew off the Refuge as long as food was plentiful. When food was depleted on the Refuge, the geese then moved to distant areas or made short feeding flights to other areas in the vicinity. Marquardt (1962) observed,

During the hunting season, most of the geese are congregated on the state and federal refuges or on private ranches which offer complete or partial protection from human molestation . . . Following the close of the hunting season, geese disperse from the refuges over much of the farm land in winter grain crops, pasture, or the standing or cut grain fields of the previous harvest season."

Migrating geese first arrived at Tishomingo National Wildlife Refuge in early September, 1964. The population remained low until early October, 1964, when it reached 15,000. A few geese, up to 100, fed on the Management Unit wheat fields prior to opening of duck season (October 24, 1964). The number feeding on the Unit decreased during duck season due to disturbance by hunting. The majority of the geese

restricted their activities to the Refuge. They rested on that portion of Lake Texoma included within the confines of the Refuge (Fig. 1). Feeding flights were made morning and afternoon to the Refuge wheat and corn field (Fig. 1; T4S-R6E-Sec. 24). The geese would feed for two to four hours in the morning and return to the lake to rest at around 11:00 a.m. to 2:00 p.m. every day. After resting, the geese would return to the field in the afternoon, feed until dusk, then return to the lake to roost.

Study of wheat foliage consumption on the Tishomingo National Wildlife Refuge during the fall of 1964 indicated that the geese consumed considerable quantities of foliage. Although not actually measured, it was estimated that the geese also consumed 80 acres of 60 bushels per acre corn. The calculated 0.131 pounds (dry weight) of wheat foliage consumed per goose-day compares favorably with the figure estimated by John L. Sincock (1962). Sincock estimated that Canada geese of the Back Bay-Currituck Sound area consumed 0.12 pounds of dry matter per day.

The preferred food of the geese at Tishomingo National Wildlife Refuge appeared to be correlated with temperature to a certain extent. It was observed that the geese fed primarily on green wheat foliage during warm weather and only fed occasionally on corn. Conversely during cold weather, the geese fed intensively on the corn augmenting it with a small amount of wheat foliage. Emergent aquatic vegetation appeared to be a supplemental food compared to wheat and corn.

The geese showed a definite preference in selecting feeding sites in the Refuge wheat field. Sites preferred were close to the middle of the field and away from human disturbance. This part of the wheat

field was completely denuded by the geese. The geese depleted the corn patch the first week of December, 1964. Following this, they flew off the Refuge in search of food.

With the depletion of the corn, the Refuge population steadily declined as many geese moved to distant areas, (Fig. 4). Some birds made short feeding flights off the Refuge to other feeding areas nearby, returning to the Refuge again to rest.

The Management Unit, by virtue of its position in the Washita River valley, lies in the path of a major flight lane for waterfowl flying west to feed on cultivated crops. Geese moving off the Refuge to feed were attracted to the wheat and corn fields of the Unit. Only a few flocks ventured off at first and they soon met with hunting pressure forcing them back to the Refuge. Eventually, the geese were able to feed on the Unit during the off days when no hunting was allowed, namely: Monday, Wednesday, and Friday. Once the geese had fed undisturbed, they would attempt to return to the Unit. Weekend hunting pressure was usually high and would result in a decline in the movement of the geese to the Unit, at least for two to three days.

Ducks used the Unit very lightly in early fall. The potholes (Fig. 2) were filled 20 September 1964. Some potholes were flooded and water spread out into the willow timber. Green-winged teal and wood ducks found this area attractive. It was difficult to census this area due to restricted visibility, but an estimate of ducks was made 20 October 1964. There were about 600 green-winged teal and 35 wood ducks feeding in the pothole area. Wood ducks seemed to prefer the flooded areas among the willow trees. Green-winged teal frequented the open, shallow water of potholes.

Duck use of the other areas in the Unit was limited. Four ponds; a small pond southeast of the Main Check Station, Teller Pond, Lost Lake, and Bobcat Gulch were used more than the other ponds on the Unit.

The first half of the split duck season opened 24 October 1964. Hunter success for ducks was fairly good in the pothole area, with green-winged teal providing the greater part of the bag. The pothole area was difficult to hunt due to water standing among the willows over much of the area. The first half of the split season on ducks closed 3 November 1964, and remained closed until 12 December 1964, when the second half opened.

In the interval between November 3 and December 12, the duck population on the Refuge increased from 29,000 to 92,000 (Fig. 4). Although the Refuge population increased threefold, the Unit population did not increase accordingly until after November 19. On that date, general rains in southern Oklahoma resulted in the Washita River rising out of its channel and flooding most of the flood plain. When the flood waters receded, many depressions, some of which contained cultivated crops, were filled with water. The Unit's wheat and corn in the Big Bottom (Fig. 2, A) had been flooded and water stood in depressions in the field. There were two corn patches in the Big Bottom, one 70 acres in area, the other 10 acres, respectively. The small ten-acre patch was inundated by flood waters, while the larger patch had water standing in portions of it. Mallards began to feed intensively in the small corn patch around 22 November 1964 and had depleted the corn by 10 December 1964. Up to 20,000 mallards fed in the corn patches. They would light in the flooded depressions and then walk into the corn. The same

general pattern was noted for geese later on in the season, namely: December 12 through January 3.

The second half of duck season opened December 12, 1964. Hunter success was very good (Fig. 3) the first day, but fell off rapidly on succeeding days. The ducks, due to hunting pressure, changed their feeding hours. Many continued to feed in the corn patch after shooting hours and on Monday, Wednesday, and Friday when hunting was not allowed. Approximately 10,000 mallards were roosting in a slough bordering the northeast edge of the Big Bottom (Fig. 2, A). This large slough had been filled when the Washita River overflowed. A few large Canada geese rested in this area prior to close of hunting season.

Hunter use of the Unit was variable with peaks occurring on opening days of seasons and weekends (Table I and Fig. 3). Low hunter success in mid-November was associated with a decline in the number of hunters using the Unit. The total number of hunter trips exceeded previous years, but this might be due to a more complete record of hunters checked in and out than previous years when fewer personnel manned the check stations. Table VI presents a comparison of 1964 hunter use with that of 1960-1963. 1960-1963 data from Copelin, et al. (1964).

The number of hunter trips and ducks bagged in 1964 increased considerably, but the number of geese bagged decreased by one-third, when compared to 1962 and 1963 figures.

The decreased bag of geese was due primarily to the lack of movement of geese off the Refuge. During the fall of 1964, sufficient moisture fell to initiate good growth of wheat foliage on the Refuge. This attracted and held the geese through most of the fall.

TABLE VI
TOTAL USE DAYS, HOURS HUNTED AND HARVEST, 1960-1964

Year	Total Hunting Trips	Hours Visit	Total Kill	
			Ducks*	Geese
1960	900	--	--	64
1961	1,033	3.1	173	61
1962	1,480	3.8	30	355
1963	1,290	4.4	131	335
1964	2,216	3.9	313	204

* Perhaps some hunters were not checked.

Several factors were involved in the increased number of ducks bagged. A few discernable were: a large local population, flooded potholes and depressions, and increased availability of food due to the flooding. The potholes and flooded depressions in the cultivated fields were definitely responsible for the high duck use of the Unit. Both areas offered plenty of food. The flooded oxbows and backwater areas also contributed to the heavy duck use. Many of these areas had been dry in the summer allowing emergent vegetation and forbs to form a lush growth. After the flood, these made attractive feeding sites.

The species composition of the duck bag was predominantly mallard and green-winged teal (Table II). The small size of the bag (290) limits the conclusions that could be drawn in regard to the status of the central flyway duck population. The overall age ratio of adult to young was 1:2.4, the sex ratio was 151 males to 139 females.

There were 204 geese bagged during the 1964 hunting season on the Unit. Canada geese comprised 96.5% of the kill. There were six

white-fronted geese and one snow goose killed there. The sex ratio was: 31 males to 37 females; and the age ratio; 53 adults to 13 immatures. Young of the year were classed as immatures, and all others as adults. This possibly explains the high adult to immature ratio.

The local economic impact of the visiting hunters was nominal to most business establishments but of considerable consequence to the restaurants, sporting goods stores, and service stations, (Tables III and IV). Motels did not benefit much from the hunters. This was due primarily to the method of blind assignment. Hunters lined up in their cars prior to 4:00 a.m. The blinds were assigned at 4:00 a.m., on a first-come basis. Many hunters would park their cars first in line the previous evening and spend the night in the car. Other hunters arrived around midnight to get in line. After the blinds were assigned at 4:00 a.m., the hunters would travel to Tishomingo for breakfast. The gates of the Unit were opened at 6:00 a.m., so the hunters would usually have approximately one hour to eat breakfast and return prior to shooting time. This method of blind assignment favored the hunters who were willing to withstand a little discomfort to secure a choice blind location.

The geographic point of origin of the hunters (Table V, Fig. 5), suggested that the Unit had become widely known over the state. The majority of the hunters traveled less than 150 miles to hunt on the Unit. Hunters from the communities of Ada, Ardmore, Duncan, Madill, and Oklahoma City comprised a majority of all hunters entering the Unit.

CHAPTER VI

MANAGEMENT IMPLICATIONS

Waterfowl use of the Unit was light in the early fall. It was evident that duck use increased after the crops and dry depressions in the flood plain were inundated. Geese did not use the Unit until after food was exhausted on the Refuge.

Management practices might be initiated to increase waterfowl use. The fall flood of November 19, 1964 offered a unique situation, in that as a result of this flood, some management practices were suggested. Factors other than the flood were certainly involved, but it was evident that the flood played a major part in stimulating waterfowl use of the Unit during late November and December.

Most attractive to the ducks were the flooded corn patches in the Unit wheat field (Fig. 2, A). Mallards, and later on, geese used these patches heavily. Flooding of the cultivated corn on the Unit would be difficult and expensive. It might be possible to install an irrigation system in the Big Bottom (Fig. 2, A). This could serve two functions, namely: furnishing water to the cultivated crops during periods of dry weather, and secondarily the excess irrigation water could be drained into depressions in the field simulating natural conditions which occurred during the fall of 1964, that were so attractive to waterfowl.

Heavy use by ducks indicated that pothole construction program

should be continued. Aquatic and emergent vegetation should be planted to increase the attractiveness of the potholes. Since the water level of the potholes can be controlled, controlled regulation of water levels in this area could also be helpful. The potholes could be held at low levels in the early spring. This would stimulate the growth of emergent vegetation. Water could be diverted into the potholes during early fall, thus flooding the emergent vegetation and creating attractive feeding areas for ducks. Observations of wood ducks and mallards feeding among the flooded willow trees suggests that a dike to retain overflow water from the potholes would create attractive feeding areas also. Possibly continuous flooding of the willows could be used as a device for thinning the brush. The dense brush prevented good hunting and the development of open marsh habitat.

The fresh-water ponds were used lightly. This aquatic and emergent vegetative growth was not satisfactory. The presence of decaying timber and a brown color to the water suggests that the pH of the water may be low and not conducive to good aquatic growth. The ponds should be tested by a limnologist to determine measures needed to improve conditions for aquatic and emergent vegetation. Most of the ponds do not have enough shallow littoral area to support a heavy growth of submerged vegetation.

Fig. 6 shows the relationship between the daily bag of ducks, number of hunters, and duck population. The graph suggests that high hunting pressure may cause a decline in the duck population. Some method of reducing this hunting pressure is needed. Half-day hunting is recommended as an alternative to the present hunting schedule.

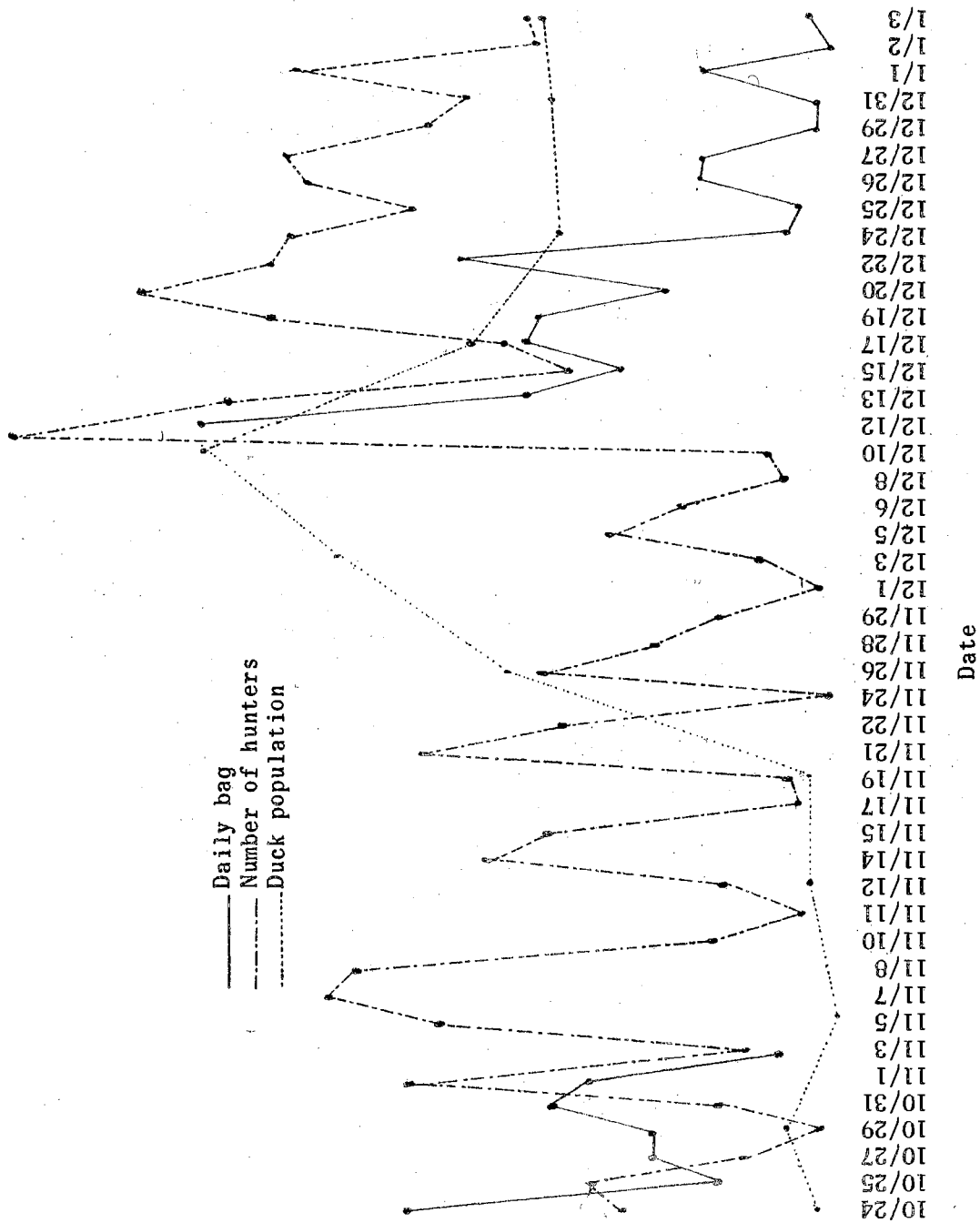


Fig. 6. Comparative Curves Showing Relationships Between Daily Number of Hunters, Daily Total Kill, and Tishomingo Wildlife Management Unit Duck Population.

In 1957-58, the North Dakota Department of Wildlife Conservation established an area to test half-day hunting on geese. The test was considered a success due to its acceptance by the hunters and landowners (Adams, 1957; Adams, 1958).

The Horicon Marsh, Wisconsin had a 2:00 p.m. closing time for part of their public hunting area, "designed to encourage some geese to leave the Refuge in the afternoon feeding periods" Hunt, et al. (1962).

Mr. Adam Diel owns and operates one of the successful hunting leases in Oklahoma. This lease is located near the northern perimeter of Salt Plains National Wildlife Refuge near Jet, Oklahoma. Mr. Diel allows the hunters to hunt from sunrise until noon. The geese are thus able to feed on the lease undisturbed during the afternoon. The continued success of the lease as a private hunting area does illustrate that half-day hunting is acceptable to the hunters.

Most hunters at Tishomingo Management Unit checked out prior to 1:00 p.m. The percentage of hunters checking out before 1:00 p.m. was 61.7 percent. At the Main Check Station, 51 percent of the total successful hunters checked out prior to 1:00 p.m., while at the Pothole Check Station, 64.9 percent checked out prior to 1:00 p.m.

This information suggests half-day hunting should be tried on the Management Unit. A test area could be established to determine the effects on waterfowl use and hunter success. Hunter response would also be a critical factor in evaluating this type of hunting schedule.

A comparison of Tishomingo Wildlife Management Unit with other public hunting areas (Table VII) shows that Tishomingo ranked fifth in average kill per hunting trip, when compared to six other public

TABLE VII

COMPARATIVE AVERAGE KILL DATA ON PUBLIC WATERFOWL HUNTING GROUNDS

Area and Reference	Species	Year	No. of Hunters	Total Kill		Average Kill Per Hunting Trip
				Ducks	Geese	
Tishomingo Wildlife Management Unit, Oklahoma. 1963 data (Copelin, <u>et al.</u> , 1964)	Ducks	1963	1,290	131	335	0.36
	and Geese	1964	2,216	313	204	0.23
Bear River, Utah (Goddard, 1962)	Ducks	1960	3,405	7,763		2.28
		1961	2,465	4,338		1.76
Horicon Marsh Wisconsin. (Hunt, <u>et al.</u> , 1962)	Geese	1960	4,921		3,002	0.61
		1961	5,118		2,453	0.48
Swan Creek, Highbank, Michigan. (Friley, 1959)	Geese	1957	14,004		1,629	0.11
Pymatuning, Pennsylvania (Sickles, 1964)	Geese		3,002		1,383	0.46
Upper Mississippi, Minn. Wisc., Iowa & Ill. (Green, 1963)	Ducks	1960	36,423	37,573		1.04

hunting areas. The comparison may not be valid due to the difference in size of the areas and the number of hunting trips to each area. The comparison does illustrate that the Tishomingo Wildlife Management Unit could benefit from intensive management practices. New practices must be innovated to increase waterfowl use of the Unit. The largest improvement could be made in improving duck habitat on the Unit. The goose habitat on the Unit was satisfactory, but was dependent upon the movement of geese out of the refuge, which could not be readily controlled. Reduction of hunting pressure on geese during the early part of the season should help increase the movement of geese to the Unit.

The most frequently-voiced objection by hunters was against "sky-busters," hunters who fired at high-flying geese. This type of shooting scared many geese away before they were in effective killing range. The Unit has a regulation designed to reduce the amount of wild shooting or sky-busting, namely: hunters entering Zone 3 (Fig. 2) are limited to eight shells apiece. Complete elimination of sky-busting would be difficult but it needs further curtailment. Eviction of sky-busters would possibly reduce repetitious wild shooting. It has been the policy of the Wildlife Commission not to allow state or federal Wildlife Conservation employees to hunt on the Unit. Since the presence of state or federal enforcement agents would perhaps curtail the number of violations and aid in enforcement of hunting regulations, it would be desirable to review this policy and consider the desirability of changing it.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Waterfowl use of the Tishomingo Wildlife Management Unit was light in early fall, 1964. General rains 19 November 1964 forced the Washita River out of its banks. Cultivated crops, dry oxbows, and sloughs were filled by the flood waters. A large immigration of ducks into the Tishomingo National Wildlife Refuge occurred between the 19th of November and December 9, 1964. Many ducks were attracted to the Unit. The flooded corn and closed period of hunting on ducks were responsible for the increase. Maximum population reached 20,000. Mallards were the predominant species.

Goose use of the Unit fields during November and early part of December was limited to small occasional flocks. Goose movement to the Unit was heaviest from December 12 through end of hunting season, January 3, 1965. This was attributed to the depletion of corn and wheat on the Refuge.

The number of hunter trips to the Unit increased 71% over 1963. Duck hunters bagged 139% more ducks but goose hunters bagged 39% fewer geese than in 1963.

Economic data from the hunters revealed that 1,607 visiting hunters spent an average of \$4.97 in Tishomingo. The estimated total expenditure in Tishomingo was \$7,986.79.

The hunters traveled from 82 towns in Oklahoma to hunt in the Unit. Local hunters comprised 14% of the total number of hunting trips. Five non-resident hunters from Texas and one from Maryland hunted in the Unit.

Hunting pressure on the Unit was excessive on weekends and opening days. The waterfowl appeared to be frightened off as a result of excessive hunting pressure. As a consequence, hunter success is low during the majority of the season. This suggests a change in hunting schedule is needed to reduce the hunting pressure on opening days and weekends. Half-day hunting is suggested as a possible remedy.

Waterfowl use of the Unit might be increased by increasing the number of potholes, constructing a dike to form a semi-marsh area below the potholes, and installing an irrigation system in the Big Bottom to water crops and flood corn prior to duck season.

Management practices and developments on Tishomingo Wildlife Management Unit were effective but need to be expanded and accelerated to accommodate the increasing number of hunters. Also new management practices need to be innovated to maintain the Tishomingo Wildlife Management Unit as an attractive public shooting area.

LITERATURE CITED

- Adams, Arthur W. 1958. Half-day season improves goose hunting. North Dakota Outdoors, 20(13): 4-5.
- Adams, Bud. 1957. Will half-day shooting aid goose hunting? North Dakota Outdoors, 19(8): 10-11.
- Carney, Samuel N. 1964. Preliminary keys to waterfowl age and sex identification by means of wing plumage. U. S. Fish and Wildlife Service Special Scientific Report (Wildlife) No. 82, Washington, D. C. 47 p.
- Copelin, Farrell F., Earl Craven, Charles O. Gilliam, and Jim Adcock. 1964. Waterfowl hunting activities and harvest on the Tishomingo National Wildlife Refuge, Oklahoma, 1960-1963. 18th Ann. Conf. Southeastern Assn. Game and Fish Comm. 7 p.
- Elder, William H. 1946. Age and sex criteria and weights of Canada Geese. Jour. Wildl. Mgmt. 10(2): 93-111.
- Friley, Charles E. 1959. Controlled goose shooting at Michigan's Swan Creek Highbanks. Trans. N. Amer. Wildl. Conf. 24: 245-260.
- Goddard, Stephen V. 1962. Factors affecting the waterfowl hunter utilization and the waterfowl kill at the Bear River Migratory Bird Refuge, 1960-61. Utah State University, Logan. Unpub. M.S. thesis. 107 p.
- Green, William E. 1963. Waterfowl utilization and hunting kill 1946 through 1960. Upper Mississippi River Wildlife and Fish Refuge and Mark Twain National Wildlife Refuge. U. S. Fish and Wildlife Service Special Scientific Report (Wildlife) No. 71, Washington, D. C. 61 p.
- Hanson, Harold C. 1949. Methods of determining age in Canada geese and other waterfowl. Jour. Wildl. Mgmt. 13(2): 177-183.
- _____. 1962. Characters of age, sex, and sexual maturity in Canada geese. Ill. Nat. Hist. Surv., Biol. Notes No. 49. 15 p.
- Hunt, R. A., J. G. Bell and L. R. Jahn. 1962. Managed goose hunting at Horicon Marsh. Trans. N. Amer. Wildl. Conf. 27: 91-106.

- Marquardt, Richard E. 1962. Ecology of the migrating and wintering flocks of the small white-cheeked geese within the South Central United States. Oklahoma State University, Stillwater. Unpub. Ph.D. thesis. 179 p.
- Sickles, Raymond M. 1964. Pymatuning wrapup/1963. Pa. Game News. 35(3): 12-15.
- Sincock, John L. 1962. Estimating consumption of food by wintering waterfowl populations. Sixteenth Ann. Conf. Southeastern Assn. Game and Fish Comm. 10 p.

APPENDIX

RULES AND REGULATIONS FOR TISHOMINGO WILDLIFE MANAGEMENT UNIT

October 1, 1964 to January 3, 1965

1. The Wildlife Management Unit will be closed to all public use from October 1, 1964 until January 3, 1965, inclusive, except duck hunting will be permitted from October 24, 1964 to November 3, 1964, excluding Zone 3, and from December 12, 1964 to January 3, 1965, including Zone 3. Goose hunting will be permitted November 5, 1964 to January 3, 1965. No hunting will be permitted on Mondays, Wednesdays and Fridays, excepting National Holidays.
2. Each hunter shall be limited to eight (8) shells in possession when entering Zone 3 of the Management Unit; and may fire only eight (8) shells during any one day in Zone 3.
3. All hunters must enter and leave the Wildlife Management Unit at marked entrances and must be checked in and out by an attendant when an attendant is present.
4. Ducks and geese may be hunted only from blinds; "Jump" or "Sneak" hunting is prohibited.
5. In Zone 3 blinds are provided and hunters will be assigned to blinds on a first come first choice basis. Temporary blinds or open field hunting is prohibited in this area. In other areas, where blinds are not provided, hunters may construct temporary blinds. These blinds may be placed where desired after giving due consideration to safety and hunting opportunities of other sportsmen, but blinds must be at least 80 yards apart.
6. All hunters must comply with State and Federal hunting regulations. Those found in violation will be prosecuted. In addition, failure to comply with any State or Federal regulation will be deemed sufficient cause to prohibit further entry on or expulsion from the area.
7. All hunters must enter the area at their own risk, and are liable for any damage they may do to any real, public, or personal property.
8. All hunters must be out of the Management Unit not later than 6:00 p.m. daily.
9. No open fires may be built. However, heaters, including charcoal heaters, may be used.
10. Duck and goose picking or cleaning in the Management Unit is prohibited.
11. Cars may not be driven on crops. Cars may be parked only in designated areas, or in places of suitable concealment from waterfowl.

12. The consumption of alcoholic beverage of any kind is prohibited on this area.

All persons hunting on this area will be requested to open their vehicles for inspection on leaving the area.

These rules and regulations were proclaimed by the Oklahoma Wildlife Conservation Commission on August 25, 1964.

VITA

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