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Food Plants Utilized by Migratory Waterfowl at Cheyenne Bottoms Waterfowl Refuge

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FOOD PLANTS UTILIZED BY MIGRATORY
WATERFOWL AT CHEYENNE BOTTOMS WATERFOWL REFUGE

being

A Thesis Presented to the Graduate Faculty
of Fort Hays Kansas State College in
Partial Fulfillment of the Requirements for
the Degree of Master of Science

by

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Date

May 15, 1962

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ABSTRACT OF THESIS

Schlegel, Stanley E. 1962. Food Plants Utilized by Migratory Waterfowl at Cheyenne Bottoms Waterfowl Refuge.

The purpose of this problem was to gather information on food habits of migratory waterfowl using Cheyenne Bottoms Waterfowl Refuge, and to determine the most important duck-food species. Ducks were examined as hunters checked through the headquarters building. Food samples were removed from the crops of these birds and numbered. The species of duck, age, sex, plumage, and date of collection were recorded. Contents of the samples were examined and identified. Plant species represented in the crop samples were tabulated by the percent frequency method, and the most important plant species determined. Food preferred by each species of duck were determined by this method. Grain sorghum (Sorghum vulgare), spikerush (Fleocharis palustris), sprangletop (Leptochloa fascicularis), barnyard grass (Echinochloa crusgalli), and purple ammannia (Ammannia coccinea) were the most important plant species.

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INTRODUCTION

Cheyenne Bottoms is a state-owned waterfowl area located in Barton County, Kansas and was originally a large natural basin in which marshy conditions attracted large numbers of waterfowl. This area was purchased by the Kansas Forestry, Fish, and Game Commission in 1941. In 1949 work was started to improve the area as a waterfowl refuge. Improvements consisted of constructing a central lake or pool known as Pool 1. Around this central pool, four radiating dikes were constructed, forming four perimeter pools designated Pools 2, 3, 4, and 5. An inlet canal was built from the Arkansas River into Dry Walnut Creek and then to the southwest corner of the Bottoms. An outlet channel was also constructed running southeast from the south corner of Pool 4. Water-flow structures were built enabling the flow of water to be directed into the center pool, from center to perimeter pools, and between perimeter pools.

Pool 1 and Pool 5, with a few other selected areas, were designated as refuge areas and no hunting was permitted. However, Pools 2, 3, and 4 are open to public hunting. Here 167 concrete, two-man, pit blinds have been located in three rows 300 yards from the dikes and at 300 yard intervals. It is from these blinds and from the "free area" around the perimeters of the pools that waterfowl are hunted. Figures 1, 2, 3, and 4 show general conditions and vegetation found in Pools 2 and 3.

The primary objective in management of Cheyenne Bottoms is to furnish a feeding and resting place for migratory waterfowl.

Uses such as public hunting, fishing, and recreation, production and wintering of waterfowl, although desirable, must be developed only in conjunction with the primary objective (Eggen and Coleman, 1959).

The basin, by its very nature, was an attraction to migratory ducks and geese before construction of the refuge. Swampy conditions encourage the growth of natural duck-food plants. After improvements were made large areas became devoid of vegetation because of continuous flooding, wave action, and most important, turbidity of the water. Management practices should be used to encourage growth of desirable food species (Eggen and Coleman, 1959).

Investigations indicated that some type of draw-down procedure would be best to produce more duck food. Besides increasing desired plant species, draw-down could be used to limit undesirable species. The problem was to encourage desirable plants and eliminate or decrease undesirable ones. Data on life histories of these plants is necessary to utilize time of draw-down successfully.

Ecological investigations are being conducted by the Botany Department of Fort Hays Kansas State College. Desirable and undesirable plant species are being studied and life history data collected. Food habit studies are also important in distinguishing beneficial and "weedy" plants.

The purpose of this study was to analyze food samples taken from ducks killed at Cheyenne Bottoms to determine the plant species preferred.



Fig. 1. View of Pool 2 showing an area of Eleocharis flats with a few scattered plants of Leptochloa fascicularis.



Fig. 2. An Eleocharis flat, in Pool 3.
There was a cover of approximately
six to eight inches of water present.

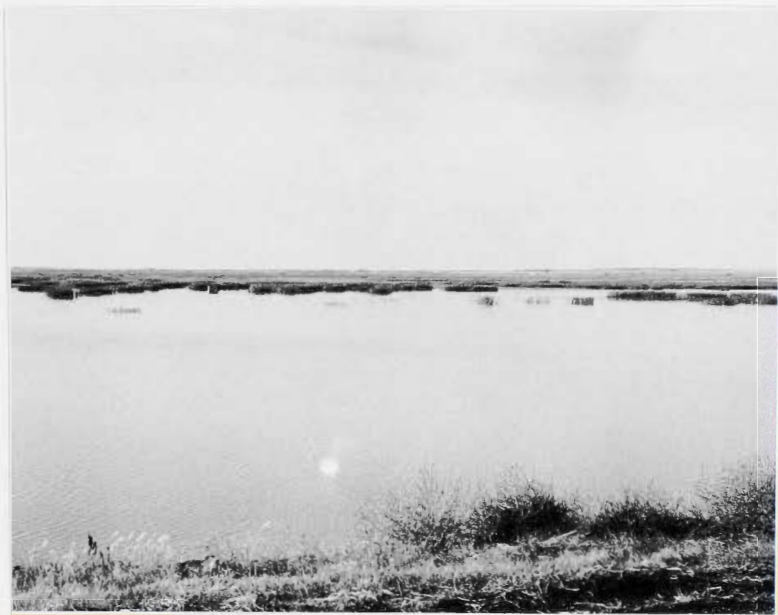


Fig. 3. An area densely covered with bulrushes (Scirpus spp.), interspersed with areas of open water.



Fig. 4. An area of Scirpus spp. damaged by the hail storm of July, 1961.

PROCEDURES

Blinds in the public hunting area of Cheyenne Bottoms are rented to hunters through a central headquarters. When the hunters checked in at the end of their hunting day, permission was requested to examine their kill. When permission was granted the ducks were checked for food. Food samples can be taken from the gizzard or from the crop. Gizzard samples were not taken for two reasons: (1) the time consumed in removal was prohibitive, and (2) data obtained from gizzard samples may be distorted by soft foods passing through the organ rapidly, whereas, hard seeds and shells may remain for a long period of time. This would indicate the apparently greater use of hard foods. Therefore, crop samples were used. Waterfowl do not have a true crop. Food is stored in the enlarged esophagus which is often called a crop in waterfowl food studies.

Food samples were taken during the hunting seasons of 1960 and 1961. On the first day of the 1960 season the birds' throats were examined by touch to determine the presence of food particles. However, this method proved unsatisfactory in detecting small samples. After the first day all birds were opened at the neck so that the crop could be visually examined. If food was present it was removed and placed in a numbered container. Records were kept designating the species, sex, age, plumage, and date of collection for each duck from which a sample was taken.

During the 1960 season food samples were dried and thymol crystals added to prevent fungus growth. During the 1961 season

food samples were preserved with an algal preservative solution consisting of 30% alcohol (50% sol'n), 10% formalin (40% sol'n), 5% glycerine, and 55% water. This was much faster and made possible the preservation of animal matter. Food samples were examined with a binocular microscope and identified to genus and, where possible, species.

A seed collection was made of plants at Cheyenne Bottoms which was used to identify seeds contained in the samples. Seeds not present in this collection and animal matter were identified with the help of other publications (Ohio Dept. of Agr., 1942; Jaques, 1947; Pennak, 1953).

Each sample was considered an entity and was given a total volume of 100 percent. The sum of percentages of items contained in each sample therefore totaled 100 percent.

The number of ducks examined and number of samples taken were tabulated. Frequency tables were set up for each duck species showing how many times each plant species appeared. Results of the analysis were also recorded by duck specimen, listing plants and estimated percentage by volume of each plant species.

RESULTS

In presenting the data obtained during this study a species by species breakdown was attempted, both by duck and plant species to show relationships, food preferences and seasonal changes occurring in food habits of waterfowl at Cheyenne Bottoms. Samples were taken from a total of ten waterfowl species. However, only seven furnished a sufficient number of samples to merit discussion. They are all members of the river or puddle duck group (Anatinae). Diving ducks were examined also but only one sample was obtained, from a bufflehead. Redheads and canvasbacks were protected during the time of this study, and although 41 scaup were examined, no food samples were found.

Sorghum vulgare Pers.

Grain sorghums are grown on state-owned farm lands around the perimeter of the Bottoms, and also on private farm land in the area. Crops standing in the field and waste grain left after harvesting are used by ducks.

This plant species has been the most important and most frequently appearing food of waterfowl at Cheyenne Bottoms during the study. It occurred in 34.5 percent of the samples taken, 40.2 percent in 1960 and 23.9 percent in 1961. Four duck species made use of grain sorghum: mallard, green-winged teal, baldpate, and pintail. Mallards made the most extensive use of this food. In 1960, 73 percent of the mallard food samples contained sorghum, and in 1961, 43 percent. These birds

show a seasonal preference for sorghum, using it more exclusively during November and December. Green-winged teal used sorghum rather heavily in 1961, but ignored it almost entirely in 1960. This could indicate a shortage of more desirable foods during the 1961 season, caused by hail damage. One of the three baldpate samples taken in 1960 contained sorghum but none was found in baldpate samples for 1961. Pintail used sorghum during the 1961 season only, when it occurred in 24 per cent of the samples. Samples containing sorghum had very few other species, indicating that when ducks feed on sorghum it was used exclusively.

Eleocharis spp.

Spikerush was found most commonly where the soil was very wet or submerged during the growing season. Inner portions of pools 2 and 3 were almost entirely spikerush with scattered clumps of bulrush and other aquatic vegetation.

Spikerush was the second most important plant species appearing in the duck crops. During the two seasons spikerush was found in 23.7 percent of the samples. Percent frequency in 1960 was 22.8 percent, and 1961, 25.4 percent. Mallard, green-winged teal, blue-winged teal, and pintail consumed spikerush throughout the hunting season. There were several species of spikerush found at Cheyenne Bottoms, including Eleocharis palustris, E. mammalaria, and E. englemanni. E. palustris was the most common and hence comprised the greatest portion of duck food (Figures 5 and 6).



Fig. 5. Eleocharis palustris growing in Pool 3
Cheyenne Bottoms refuge.



Fig. 6. Seeds of Eleocharis palustris
collected at Cheyenne Bottoms.

Leptochloa fascicularis (Lam.) A. Grey

Sprangletop was found abundantly on the outer portions of the perimeter pools where the soil is fairly dry (Figures 7 and 8). Optimum water content of the surface soil is eight to ten percent. Production of seedlings decreases above and below this point (Sonnenburg, 1961).

Sprangletop was the third most important food plant, as indicated in frequency tabulations, occurring in 22.2 percent of the samples taken. In 1960, it was counted in 23.6 percent of the samples, and in 1961 occurred in 19.4 percent. Sprangletop was found in at least one sample from nine of the ten species of waterfowl studied, and made up an important part of the food in eight of the ten species. This grass was most frequently used by green-winged teal and shovelers.



Fig. 7. Leptochloa fascicularis growing along dike in Pool 3.



Fig. 8. Seeds of Leptochloa fascicularis.

Echinochloa crusgalli (L.) Beauv.

Barnyard grass is widely recognized as a valuable waterfowl food plant, and is native to the Cheyenne Bottoms area (Figures 9 and 10). Two closely related species, Echinochloa crusgalli frumentacea and E. colonum have been seeded in the area. Barnyard grass grows on the elevated portions of the perimeter pools where the soil is moist but not wet. Soil moisture is optimum at 6 to 10 percent, similar to moisture requirements of sprangletop (Sonnenburg, 1961).

Barnyard grass was the fourth most important food plant for waterfowl at Cheyenne Bottoms. It appeared in 16.0 percent of the samples collected during the study. The percentage for 1960 was 18.9 percent and for the 1961 season, 10.4 percent. It was utilized by seven of the ten waterfowl species from which samples were taken. It was an important early season food for mallards, and was also used regularly by green-winged teal, blue-winged teal, pintail, and shovelers.



Fig. 9. Echinochloa crusgalli growing along
the base of the dike, Pool 3.



Fig. 10. Spikelets of Echinochloa crusgalli.

Ammannia coccinea Rottb.

Purple ammannia, or toothcup, was found growing along the base of dikes and in low areas which were covered with water or have a very wet soil during the growing season (figures 11 and 12). It has been found in all the perimeter pools of Cheyenne Bottoms in percentages of 0.62 percent to 1.70 percent, indicating common and wide spread occurrence. Purple ammannia was not overly abundant, however, small, local areas supported a fairly dense growth (Sonnenburg, 1961). Another species, Ammannia auriculata, is also found in the area, but is not common.

Tabulation by frequency of occurrence shows purple ammannia to be the fifth most important food plant used by waterfowl, with occurrence in 14.4 percent of the 194 samples for both years. Purple ammannia was most widely used by green-winged teal during the 1960 season, when it occurred in 68 percent of the samples. Seeds also appeared in samples taken from pintail, gadwall, shoveler, and a bufflehead. However, they were not observed in samples taken during the 1961 season. This may be attributed to the summer destruction of plants by the hail storm of mid-July.

Purple ammannia is a desirable waterfowl food species at Cheyenne Bottoms, of special importance to green-winged teal, who made extensive use of it throughout the 1960 season.



Fig. 11. Ammannia coccinea collected at
Cheyenne Bottoms in the fall of
1960.

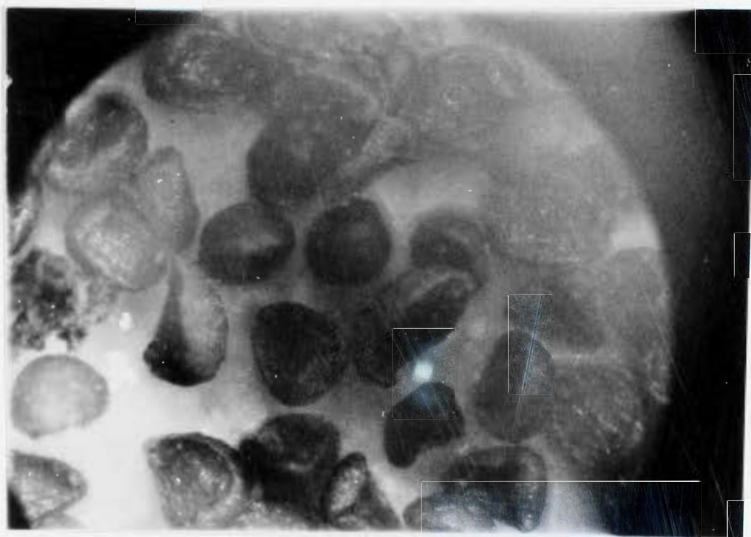


Fig. 12. Seeds of Ammannia coccinea.

Polygonum L.

Several species of smartweed were found at Cheyenne Bottoms; P. aviculare, P. coccineum, P. lapathifolia, and P. pennsylvanicum. These plants were found in areas covered with water, or in depressions which held water for a greater part of the growing season (figure 13).

The seeds of smartweed (figure 14) were used by five duck species, although in small amounts. The frequency was 8.2 percent. The fruits were taken most commonly by green-winged teal, composing 17 percent of the diet in 1960 and seven percent in 1961. Fruits were also found in samples from mallard, shovelers, baldpate, and pintail.



Fig. 13. Polygonum coccineum, one of several species of Polygonum found at Cheyenne Bottoms.



Fig. 14. Fruits of Polygomon spp.

Amaranthus L.

Figweeds were found in all of the perimeter pools. They were very abundant along the dikes and around the blinas where earth mounds had been built. Several species were found in the area including A. retroflexis (figures 15 and 16), A. toreyii, A. blitoides, and A. graecizans. There were several other plants whose seeds are similar to those of Amaranthus, including Chenopodium lanceolatum and Atriplex patula. However, these plants grow on the same area and may be considered as the same general type of food plant.

Figweeds occurred in 4.6 percent of the samples taken, and were eighth on the list of important duck food plants for Cheyenne Bottoms. They were most commonly used by green-winged teal, but were also found in the gadwall sample taken in 1960. Figweed seeds were eaten largely during the early part of the season but no definite seasonal pattern could be established.



Fig. 15. Amaranthus retroflexus, one of the common species of Amaranthus at Cheyenne Bottoms.



Fig. 16. Seeds of Amaranthus retroflexis.

TABLE I. Frequency of occurrence of plant species in duck food samples taken during the 1960 and 1961 hunting seasons

Plant Species	Number		Per cent		Combined	
	1960	1961	1960	1961	Number	Percent
<i>Sorghum vulgare</i>	51	16	40.2	23.9	67	34.5
<i>Eleocharis palustris</i>	29	17	22.8	25.4	46	23.7
<i>Leptochloa fascicularis</i>	30	13	23.6	19.4	43	22.2
<i>Echinochloa crusgalli</i>	24	7	18.9	10.4	31	16.0
<i>Ammannia coccinea</i>	28	--	22.0	----	28	14.4
Green algae	--	20	----	29.8	20	10.3
<i>Polygonum</i> spp.	10	6	7.9	9.0	16	8.2
<i>Amaranthus</i> spp.	8	1	6.3	1.5	9	4.6
<i>Rumex crispus</i>	5	3	3.9	4.5	8	4.1
<i>Acnida tamariscina</i>	5	--	3.9	----	5	2.6
<i>Scirpus</i> spp.	5	--	3.9	----	5	2.6
<i>Aster multiflorus</i>	2	1	1.6	1.5	3	1.5
<i>Chenopodium lanceolatum</i>	3	--	2.4	----	3	1.5
<i>Panicum miliaceum</i>	2	1	1.6	1.5	3	1.5
<i>Iva ciliata</i>	--	2	----	2.4	2	1.0
<i>Setaria italica</i>	1	1	0.8	1.5	2	1.0
<i>Zea mays</i>	1	1	0.8	1.5	2	1.0
<i>Atriplex hastata</i>	1	--	0.8	----	1	0.5
<i>Dondia depressa</i>	--	1	----	1.5	1	0.5
<i>Hordeum jubatum</i>	--	1	----	1.5	1	0.5
<i>Sagittaria</i> spp.	--	1	----	1.5	1	0.5
<i>Spartina pectinata</i>	1	--	0.8	----	1	0.5
<i>Solidago</i> spp.	--	1	----	1.5	1	0.5
Insecta	25	15	19.7	22.4	40	20.6
Gastropoda	6	19	4.7	28.4	24	12.9
Ostracoda	3	2	2.4	3.0	5	2.6
Unknown	39	9	30.7	13.4	48	24.7
Total number of samples	127	67	----	----	194	----

TABLE II. Frequency of occurrence of plant species in food samples of each individual water-fowl species. Samples collected during 1960 and 1961 hunting seasons.

	Mallard		Green-winged teal		Blue-winged teal		Baldpate		Pintail		Shoveler		Gadwall		Coot		Buffle-head		White-fr-Goose	
	1960	1961	'60	'61	'60	'61	'60	'61	'60	'61	'60	'61	'60	'61	'60	'61	'60	'61	'60	'61
<i>Sorghum vulgare</i>	73	43	3	40	--		33	--	--	24	--	--	--	--	--		--			
<i>Eleocharis palustris</i>	12	43	37	--	40		33	9	33	25	18	--	100	--	--		--			
<i>Leptochloa fascicularis</i>	7	7	54	27	20		33	9	--	29	18	50	100	--	100		--			100
<i>Echinochloa crusgalli</i>	13	7	17	13	40		33	9	66	18	27	--	--	--	100		--			
<i>Ammannia coccinea</i>	--	--	68	--	--		--	--	33	--	9	--	100	--	--		100			
Green algae	--	7	--	13	--		--	82	--	6	--	--	--	100	--	--	--			
<i>Polygonum</i> spp.	4	7	17	7	--		--	9	--	18	9	--	--	--	--		--			
<i>Amaranthus</i> spp.	1	--	14	7	20		--	--	--	--	--	--	100	--	--		--			
<i>Rumex crispus</i>	3	--	6	13	2-		--	--	--	6	--	--	--	--	--		--			
<i>Acnida tamariscina</i>	--	--	14	--	--		--	--	--	--	--	--	--	--	--		--			
<i>Scirpus</i> spp.	3	--	6	--	--		--	--	--	--	9	--	--	--	--		--			
<i>Aster multiflorus</i>	--	--	3	7	--		--	--	--	--	9	--	--	--	--		--			
<i>Chenopodium lanceolatum</i>	3	--	3	--	--		--	--	--	--	--	--	--	--	--		--			
<i>Panicum miliaceum</i>	--	--	--	--	--		--	--	33	6	9	--	--	--	--		--			
<i>Iva ciliata</i>	--	7	--	13	--		--	--	--	--	--	--	--	--	--		--			
<i>Setaria italica</i>	1	7	--	--	--		--	--	--	--	--	--	--	--	--		--			
<i>Zea mays</i>	1	7	--	--	--		--	--	--	--	--	--	--	--	--		--			
<i>Atriplex hastata</i>	--	--	3	--	--		--	--	--	--	--	--	--	--	--		--			
<i>Dondia depressa</i>	--	--	--	7	--		--	--	--	--	--	--	--	--	--		--			
<i>Hordeum jubatum</i>	--	--	--	7	--		--	--	--	--	--	--	--	--	--		--			
<i>Sagittaria</i> spp.	--	--	--	--	--		--	--	--	6	--	--	--	--	--		--			
<i>Spartina pectinata</i>	1	--	--	--	--		--	--	--	--	--	--	--	--	--		--			
<i>Solidago</i> spp.	--	--	--	--	--		--	--	--	6	--	--	--	--	--		--			
Insecta	15	21	14	24	40		33	--	33	41	45	50	--	--	100		--			
Gastropoda	6	43	--	7	20		--	9	--	59	9	50	--	--	--		--			
Ostracoda	--	--	6	7	--		--	--	--	--	--	50	100	--	--		--			
Unknown	12	--	57	33	20		33	--	66	12	64	100	--	--	--		--			
Number of samples taken	67	14	35	15	5	0	3	11	3	17	11	2	1	7	1	0	1	0	0	0

Mallard (Anas platyrhynchos L.)

The mallard was one of the more common ducks at Cheyenne Bottoms, and was present during virtually all seasons of the year. However, this species was plentiful only during the spring and fall migrations. When present in any number, these ducks were found in the daily kill for the area because they are considered by hunters to be the most desirable duck species present. A few were killed in October but the bulk of the season's kill occurred during November and December, when season length permitted.

A total of 81 crop samples were collected from mallards during the two seasons of study, 67 in 1960, and 14 during 1961. From these samples 13 different plant foods were identified, in addition to green algae, which due to the strength of the preservative was rendered unidentifiable. Insects and gastropods were also contained in varying amounts.

During 1960 the most important food, appearing in 73 percent of the samples, was sorghum. This grain where present comprised 80 to 100 percent of the sample, but was not taken throughout the season. Sorghum was first found on October 22 in the crop of a mature female mallard. Samples collected on November 5 and 6 indicated that very little other food was being taken. Sorghum continued to make up almost all of the food material throughout the remainder of the season.

Barnyard grass, or wild millet, was second in importance,

occurring in 13 percent of the mallard samples. It occurred regularly only during the first three weeks of the season yielding to sorghum during the first week of November. Barnyard grass did appear in three crops in late November and December.

The third important food, spikerush, occurred in samples throughout the season. Insects were also found in appreciable amounts, appearing in 15 percent of the samples.

Being much shorter, the 1961 season showed a less definite food pattern. However, important foods remained much the same. Use of sorghum and spikerush remained high, with barnyard grass decreasing in importance. Sorghum was found in 43 percent of the crops collected, taken from ducks on October 28 and 29. Spikerush also appeared in 43 percent of the crops. Its use was spread over a larger part of the season, from October 28 to November 12, paralleling the findings of the 1960 season.

The mallard food samples collected during the 1960 season showed a definite change from spikerush, barnyard grass, and other small seeds to a diet made up almost entirely of sorghum. This change occurred during the early part of October. The 1961 season was much shortened, and coupled with the severe hail storm in July distorted the feeding pattern. However, important foods remained much the same. The sex, date of collection, and percentage composition of each sample for mallard ducks are shown in tables III and IV.

TABLE III. Crop analysis of Mallard duck samples during the 1960 season. Figures represent per cent volume of food in each sample

sample number	Sex	Date	Sorghum vulgare	Eleocharis palustris	Leptochloa fascicularis	Echinochloa crusgalli	Polygonum spp.	Amaranthus spp.	Rumex crispus	Scirpus spp.	Chenopodium lanceolatum	Setaria italica	Spartina pectinata	Gastropoda	Insecta	Unknown
8	Male	Oct. 22			100											
9	"	22		5	45										30	20
10	"	22		2	95										3	
13	"	22	100													
25	"	22			90	7			1	1					1	
27	Female	Nov. 4			40											60
28	"	4			99						1					
29	Male	4			1	4						1	20	60	14	
30	"	5	100													
31	"	6	100													
32	"	6	100													
33	Female	6		50					50							
34	Male	6	100													
35	Female	6	100													
36	"	6														100
39	"	12	100													
40	"	12	95												5	
45	Male	12			100											
47	Female	13	100													
49	Male	13	100													
50	Female	13	100													
51	"	13	100													
52	"	13														
53	Male	13	100													
57	Female	19	100													
68	Male	20	100													
69	"	20	100													
78	"	27		10	5		5	5								75
84	Female	Dec. 1		50	5		3			40						
85	Male	3	80	20												
86	"	3	100													
87	Female	3	98												2	
88	"	3	100													
89	Male	3	100													

(Whole grain corn - 100%)

TABLE IV. Crop analysis of mallard duck samples taken during the 1961 season. Figures represent per cent volume of food in each sample.

Sample number	Sex	Date	Sorghum vulgare	Eleocharis palustris	Leptochloa fascicularis	Echinochloa crusgalli	Green algae	Polygonum spp.	Iva ciliata	Setaria italica	Gastropoda	Insecta	Unknown
129	Male	Oct. 28		10	40							50	
135	Female	28	100										
137	"	28	100										
141	Male	28		70							30		
142	"	28				1			85		14		
143	"	28	100										
144	"	28	40	20			30				5	5	
152	Female	28		60							40		
167	"	29	100										
176	Male	29		90				1			9		
179	"	29	100										
180	"	29								100			
187	Female	Nov. 4		(Whole grain corn - 100%)									
189	Male	12		25							40	35	

frequently found plant species was grain sorghum. It occurred in 40 percent of the samples, throughout the hunting season. Sprangletop appeared in 27 percent. Green algae, barnyard grass, curly dock (Rumex crispus), and sumpweed (Iva ciliata) were found in 13 percent of the crops, or in two samples each. Consumption of insects increased to 27 percent. Several other foods were found (Tables V and VI).

From the data collected, sex and age did not appear to influence food habits of green-winged teal. No seasonal change in diet was indicated. The foods taken were evenly distributed over the entire hunting season.

TABLE V. Crop analysis of green-winged teal samples taken during the 1960 season. Figures represent per cent volume of food in each sample.

Sample number	Sex	Date	<i>Sorghum vulgare</i>	<i>Eleocharis palustris</i>	<i>Leptochloa fascicularis</i>	<i>Echinochloa crusgalli</i>	<i>Ammannia coccinea</i>	<i>Polygonum</i> spp.	<i>Rumex crispus</i>	<i>Acrida tamariscina</i>	<i>Scirpus</i> spp.	<i>Chenopodium lanceolatum</i>	<i>Amarantinus</i> spp.	<i>Spartina pectinata</i>	Gastropoda	Insecta	Unknown
2	Male	Oct. 15			30	20							50				
4	Female	22		10			90										
19	"	23															100
22	"	29		5	3		90										2
37	Male	Nov. 11		3			95						2				
38	"	12		10	40		40						10				
46	"	12			15		80						5				
48	"	13			20		60	4		5	1	(Seed shrimp - 10%)					
54	"	13		30			2		8			(Seed shrimp - 60%)					
55	"	13									60						40
56	"	19					100										
58	"	19		5	80			9	1								5
60	"	19					98										2
61	"	19															100
62	Female	19		1	2	2	94										1
63	"	19					100										
64	Male	19		10			90										
65	"	19		50													50
66	"	20		30	10		30										30
67	"	20					100										
70	"	20			14		80									1	5
71	Female	20		10	60											30	
73	Male	26			4		70	(Atriplex hastata - 10%)									15
74	"	26		1		1	95	1									2
76	"	26			1		90									4	5
77	"	26		1			75									22	2
79	Female	27		9	20	20	40		10								1
80	Male	27					98										2
81	"	27		1	5		90			1							3
82	"	27					75	2		2	(Aster multiflorus - 20%)						
83	Female	Dec. 1		45				5									50
95	"	3			90		7										3
96	Male	3			5		90					3					2
110	"	4	100														
112	"	4			1	9				45			45				

TABLE VI. Crop analysis of green-winged teal samples taken during the 1961 season. Figures represent per cent volume of food in each sample.

Sample number	Sex	Date	<i>Sorghum vulgare</i>	<i>Eleocharis palustris</i>	<i>Leptochloa fascicularis</i>	<i>Echinochloa crusgalli</i>	Green algae	<i>Polygonum</i> spp.	<i>Amaranthus</i> spp.	<i>Rumex crispus</i>	<i>Aster multiflorus</i>	<i>Iva ciliata</i>	<i>Setaria italica</i>	<i>Hordeum jubatum</i>	Gastropoda	Insecta	Unknown
158	Male	Oct. 29															100
160	"	29	100														
162	Female	29	100														
163	Male	29					80								20		
165	"	29			70	20				5							5
168	Female	29	90													10	
172	Male	29			85					10							5
173	Female	29	80													20	
174	Male	29										75				25	
175	"	29	75													10	10
181	Female	Nov. 4			5			(Seed Shrimp - 5%)	10	3		75	5	(<i>Dondia depressa</i> - 2%)			100
182	"	4															
183	"	4															
191	Male	19			75	20	100										
194	Female	25	100											5			

Blue-winged Teal (Anas discors L.)

The blue-winged teal is a common early season migrant through the Cheyenne Bottoms area. They were commonly observed throughout September and October but seldom later. They were taken in fairly large numbers during the first two weeks of the hunting season, depending, of course, on the opening date of the season. Because of small size, they are not especially desirable to the majority of hunters.

Five food samples were collected from blue-winged teal, all during the 1960 season. Four birds were checked on October 29 and one on November 4, 1961, but no food samples were collected. The reason for their scarcity was the late, October 28, opening date. By this time most of the blue-wings had moved further south.

Five plant species were found in the crops. Barnyard grass occurred in two samples, spikerush in two, and curly dock, sprangle-top, and pigweed in one crop each. Insect remains were found in two samples, and gastropods in one (Table VII).

All five samples were taken between October 15 and October 23, 1960. Therefore, seasonal changes in the diet could not be observed. Sex and age changes were also impossible to note.

TABLE VII. Crop analysis of blue-winged teal samples taken during the 1960 season. Figures represent per cent volume of food in each sample.

Sample number	Sex	Date	<i>Eleocharis palustris</i>	<i>Leptochloa fascicularis</i>	<i>Echinochloa crusgalli</i>	<i>Amaranthus</i> spp.	<i>Fumex crispus</i>	Gastropoda	Insecta	Unknown
3	Female	Oct. 15		10	70	15			5	
7	"	22					100			
12	"	23	95		5					
15	"	23							40	60
16	"	23	100							

Baldpate (Mareca americana (Gmelin))

Baldpates were found on the refuge during all of the hunting season. They were more plentiful in 1961 than in 1960, and for this reason many more were killed in 1961. Baldpates, being of medium size, were included in the group of "big ducks" by hunters, and were taken regularly. In fact, during the 1961 season the bulk of most day's kills were baldpates.

A total of 14 crops were taken from baldpates during the two seasons studied. Three of these were taken in 1960, and 11 in 1961.

During 1960 only nineteen birds were checked yielding three food samples. These samples included four plant species: barnyard grass, spikerush, sprangletop, and sorghum, each having a frequency of 33 percent. Insects also appeared in one crop for 33 percent frequency.

The bulk of the food found in samples collected in 1961 was filamentous green algae which appeared in 82 percent of the crops. Other plants appeared in single samples (Table VIII.)

TABLE VIII. Crop analysis of baldpate samples taken during the 1960 and 1961 seasons. Figures represent per cent volume of food in each sample.

Sample Number Sex	Date	<i>Sorghum vulgare</i>	<i>Eleocharis palustris</i>	<i>Leptochloa fascicularis</i>	<i>Echinochloa crusgalli</i>	Green algae	<i>Polygonum</i> spp.	Gastropoda	Insecta	Unknown
	<u>1960</u>									
17 Female	Oct. 23			1	96				3	
41 "	Nov. 12		100							
91 Male	Dec. 3	90								10
	<u>1961</u>									
138 Male	Oct. 28					100				
145 "	28					100				
146 Female	28					100				
148 "	28		85					15		
149 Male	28					100				
171 Female	29			60	30		5			5
184 "	Nov. 4					100				
190 "	12					100				
192 Male	19					100				
193 Female	25					100				
195 "	25					100				

Pintail (Anas acuta L.)

The pintail was abundant at Cheyenne Bottoms during the hunting season, and was the most popular early season duck. Being a fairly early migrant, it was present in considerable numbers during the first part of the hunting season. Although the numbers are smaller in December, there were a few taken even then. Due to its medium-large size and good taste, the pintail is ranked only below the mallard by hunters of the area.

Twenty samples were collected from pintails during this study, three during the 1960 season, and 17 in 1961. Only half as many birds were examined in 1960 as in 1961 partially accounting for the greater number of crops obtained during 1961.

Two samples collected in 1960 contained barnyard grass. Spikerush, purple ammannia, and proso (Panicum miliaceum) were found in one sample; insects were also found in one sample. The third sample was very small, and contained only unidentifiable matter (Table IX).

During the 1961 season, 47 pintails were examined from which 11 food samples were obtained. The most important food was spikerush, found in 59 percent of the crops. Other important plant foods were sprangletop, 29 percent, and sorghum, 24 percent. Insects and gastropods were important in the diet, found in 41 and 59 percent of the samples (Table IX).

The three samples obtained in 1960 were insufficient for

observation of any diet change. Samples collected in 1961 were taken during the first two days of the season. Therefore, conclusive indications of a diet change were not evident.

Shoveler (Spatula clypeata (L.))

Shovelers were very abundant during the 1960 season. However, a considerable drop in numbers occurred in 1961. They were generally present throughout October and November. They were frequently taken during the first half of the hunting season, and made up a fair percentage of the daily kill. They are not greatly valued by hunters in the area, but are easily decoyed and were taken in lieu of the larger species.

Thirteen samples were taken during the study. Eleven were obtained in 1960 and two in 1961. Variation in the number of samples obtained was a reflection of the marked change in shoveler populations between the two hunting seasons.

The most important food plant during the 1960 season was barnyard grass, which was found in 27 percent of the samples. Two other plant species of importance were spikerush and sprangletop, each appearing in 18 percent of the crops. During this season insects occurred in 45 percent of the samples.

Foods found in the two crops collected in 1961 included sprangletop, insects, gastropods, and ostracods (seed shrimp).

Varying amounts of unidentifiable vegetable matter were present and can be attributed to the feeding habits of this duck. Shovelers were observed swimming in open water, straining water with their bills (Kortright, 1942). They are aptly equipped for

this type of feeding, and also strain bottom sediments to obtain food. The limited number of food samples obtained show no indication of seasonal food preferences (Table X).

TABLE X. Crop analysis of shoveler samples taken during the 1960 and 1961 seasons. Figures represent per cent volume of food in each sample.

Sample number	Sex	Date	<i>Eleocharis palustris</i>	<i>Leptochloa fascicularis</i>	<i>Echinochloa crusgalli</i>	<i>Ammannia coccinea</i>	<i>Polygonum</i> spp.	<i>Scirpus</i> spp.	<i>Aster multiflorus</i>	<i>Panicum miliaceum</i>	Gastropoda	Insecta	Unknown
<u>1960</u>													
1	Female	Oct. 15			98		1	1					
5	"	22											100
18	"	23										100	
21	"	29	30									30	40
23	"	29	10										90
24	"	29		20	30								50
26	"	Nov. 4		15	5	3			2			40	30
43	Male	12										100	
59	"	19								100			
72	"	26									40		100
75	"	26										30	30
<u>1961</u>													
139	Male	Oct. 28										60	40
159	Female	29		40	(Seed shrimp 2%)						8		50

Gadwall (Anas strepera L.)

Gadwall were common at Cheyenne Bottoms. Thirty were examined in 1960. These ducks were killed throughout the hunting season. A total of eight food samples were collected; one in 1960, and seven in 1961.

The one crop collected in 1960 contained four plant species, spikerush, sprangletop, pigweed, and purple ammannia. Ostracods (seed shrimp) were also present (Table XI).

During the 1961 season seven samples were taken. All were composed of 100 percent filamentous green algae (Table XI).

No seasonal variation in diet was indicated. The curious change in diet from plant seeds in 1960 to filamentous green algae in 1961 was noted, but no explanation can be given.

TABLE XI. Crop analysis of gadwall samples taken during the 1960 and 1961 seasons. Figures represent per cent volume of food in each sample.

Sample Number	Sex	Date	<i>Eleocharis palustris</i>	<i>Leptochloa fascicularis</i>	<i>Ammannia coccinea</i>	Green Algae	<i>Amaranthus</i> spp.
114	Female	<u>1960</u> Oct. 23	1	5	89		4 (Seed shrimp 1%)
		<u>1961</u>					
130	Female	Oct. 28				100	
133	"	28				100	
134	Male	28				100	
150	Female	28				100	
185	"	Nov. 4				100	
186	Male	4				100	
188	Female	5				100	

SUMMARY AND CONCLUSIONS

The purpose of this study was to attempt to determine the plant foods preferred by waterfowl using the Cheyenne Bottoms Waterfowl Refuge. In addition it was desired to obtain data concerning factors determining food preferences, such as: (1) species of duck, (2) season of the year, (3) sex, and (4) age. Many studies have shown that diving ducks and puddlers have different food preferences and feeding habits (Wingard, 1952; Cottam, 1939; Cronan, 1957; Mabbot, 1920; McAtee, 1918; Dillon, 1959; Kortright, 1942). Data obtained during this study is further evidence that species and seasonal variations exist in the diets of waterfowl at Cheyenne Bottoms. Sex and age variations were not apparent. Coulter (1957) states that very young ducklings show different food habits than adults. However, immature birds collected in the present study showed no differences in diet from adult samples.

Lack of sufficient data for this study made it impossible to present any definite conclusions. Therefore, all findings must be referred to as indications. During the first year it became evident that insufficient data would prevent any final conclusions being made. Samples were obtained from only three waterfowl species in sufficient numbers to furnish useful information. After the close of the second season (1961) conclusions still could not be made. This was due to three main factors: (1) hail, (2) a shortened season, and (3) changes in the waterfowl populations.

Damage to vegetation was extensive when a severe hail storm struck the Cheyenne Bottoms area in mid-July, 1961. The vegetation was badly damaged over all of the refuge. This seriously affected seed production and birds may have been forced to utilize some of the less desirable foods that survived the storm.

The shortened 1961 hunting season also affected the data collected. The 1960 hunting season extended from October 15 to December 13, inclusive, whereas the 1961 season was from October 28 to November 26, inclusive. Since the seasons varied, data could not be compared. This difference in opening and closing dates also changed the hunter bag to some extent. By October 28, 1961 the early-migrating blue-winged teal had moved southward. Consequently, few were killed and no food samples were obtained for the 1961 season. The early closing date, November 26, limited the number of late-migrating ruddy ducks and buffleheads killed.

The third factor was a change in the species composition of the duck population from that of the previous year. During the 1960 season shovelers made up a substantial portion of most daily kills. Relatively few baldpate were taken in 1960. A marked change in the populations of the two species occurred in 1961. Relatively few shovelers were seen or killed, whereas baldpate made up the bulk of each day's kill. During the 1960 season 92 shovelers were examined, contributing 11 food samples; 19 baldpate were checked but only three samples were taken. In 1961, 49 shovelers were checked but only two samples taken, and 112 baldpate were checked

furnishing 11 samples.

From the study and tabulation of data collected it was possible to determine the most important food plants during the hunting season. These are, in order of their importance, Sorghum vulgare (grain sorghum), Eleocharis palustris (spikerush), Leptochloa fascicularis (sprangletop), Echinochloa crusgalli (barnyard grass), Ammannia coccinea (purple ammannia), filamentous green algae, Polygonum spp. (smartweeds), and Amaranthus spp. (pigweeds). Fifteen other plant species were found in small amounts.

Insects made up an important part of the diet of most duck species, although percentages varied. Gastropods were important in the diets of mallards, pintails and shovelers. Ostracods, although not regularly eaten, appeared in several food samples.

Seasonal diet changes were apparent only in mallards. They ate seeds of barnyard grass, spikerush, and insects during late October. During the first week of November, a change occurred in their diet when grain sorghum began to be eaten with regularity. This continued throughout the remainder of the season.

Green-winged teal, the only other species about which sufficient data was obtained showed no changes in their diet as the hunting season progressed.

Diets of each duck species were somewhat different from that of other species at Cheyenne Bottoms. Mallards consumed

mostly barnyard grass and sorghum. Green-winged teal fed on small seeds of purple ammannia, sprangletop, and spikerush. Blue-winged teal substituted barnyard grass for ammannia, but otherwise their diet was similar to that of the green-winged teal.

Baldpate used seeds of sorghum, spikerush, sprangletop, and barnyard grass, but also ate large amounts of filamentous green algae. Pintail showed a preference for spikerush, sprangletop, barnyard grass, and smartweed. Shovelers were more partial to insects than other species. Samples from this species also showed a greater percentage of unidentified material. Gadwall used spikerush, sprangletop, ammannia, and pigweed in 1960. However, 1961 found them eating only filamentous green algae.

Only one sample each was taken from coot, bufflehead, and white-fronted goose. The coot sample was a gizzard sample and contained much unidentifiable material as well as seeds of sprangletop and barnyard grass, and insect parts. The bufflehead crop contained a very few seeds of purple ammannia, and that of the white-fronted goose contained vegetation and seeds of sprangletop.

Since the number of samples collected were relatively few, insufficient data were obtained to conclude any affect of age or sex upon the diets of the duck species studied.

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