FEEDING ACTIVITIES OF CANADA GEESE IN SOUTHERN ILLINOIS

R. Q. BELL and W. D. KLIMSTRA
Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, 62901

ABSTRACT. — Feeding activity of Canada geese correlated with low light intensity being greatest during early morning, late afternoon, moonlight nights and the entire day if the sky was overcast. Observations in the Crab Orchard Refuge area during October-March showed cornfields to contain 41% of feeding geese, small grains 24%, pasture 22%, soybeans 9% and wheat stubble and lespedeza fields 4%. There was increased use of forage crops with an increase in the moisture on the foliage. With one exception, grazed wheat fields showed decreased yields of 54 to 79% due to reduction in culm density and height, spike and seed numbers and weight of above-ground parts. One field, which showed a 13% greater yield for grazed sites, exhibited increased floristic production attributable to improved soil conditions due to decomposing geese feces. Major foods utilized by Canada geese in the Horshoe Lake area were soybean, corn, Johnson grass, various aquatics and wheat.

In recent years, Canada geese, *Branta canadensis interior* Todd, which previously wintered as scattered flocks along the Mississippi River have been attracted to a series of refuges in southern Illinois. Waste grains from the fall harvests, as well as crops provided on refuges, comprise a large percentage of the food utilized by these geese. However, forage available in fields of small grains and pastures is also important. This paper reflects various aspects of the foods and feeding habits of the Canada goose in southern Illinois during fall and winter of 1953-55.

Canada geese begin to arrive at southern Illinois refuges around September 15 with a steady increase in numbers through November. In the fall of 1954, the peak concentration of geese at Crab Orchard National Wildlife Refuge occurred during the week ending November 19, with an estimated 47,000 Canada geese, 1,910 blue geese, *Chen caerulescens*, and 5,390 snow geese, *Chen hyperborea*. In 1953, the population at Crab Orchard Lake peaked at 40,000 geese. In late December or early January populations of Illinois refuges frequently decline as geese disperse southward as a result of shortages of food related largely to inclement weather. The northward migration of these birds begins in February and is completed early in March; hence, 5 to 6 months are spent in the southern Illinois region.

FEEDING ACTIVITIES AT CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Studies of the feeding activities of Canada geese were made at the Crab Orchard National Wildlife Refuge during October through March of 1953-54 and 1954-55. During this period observations were made daily from before sunrise to shortly after sunset; some time was also spent in the field at night.

Feeding Flight—Feeding flights of geese appeared to be correlated with light intensity. Flights to fields began about sunrise and after 1 or 2 hours, the geese would return to resting and loafing sites on the refuge. When skies were overcast, morning flights were delayed 30 minutes to 1 hour. A second feeding flight began about 2 hours before sunset and the return to roosting sites occurred at dusk. When the sky was heavily overcast flight activity tended to be dispersed throughout the day. Some feeding flights also took place on bright moonlight nights.

Field Utilization — From October 1954 to March 1955, goose utilization of agricultural lands was determined by counting the number of geese observed along a census route which was driven biweekly between 8 and 9 a.m. Along this route, corn, soybean, small grain and fallow acreages were approximately equal; pasture was about twice that of other categories.

Corn fields contained 41 percent of the geese observed in the fields and hence, probably constituted the most important food item at Crab Orchard National Wildlife Refuge. One-third of the corn acreage was left standing by the private farmers as rent for the use of refuge land. Waste grain left by mechanical harvesters and ears of corn low enough to be reached on the standing stalks were consumed by the geese during the fall. During the winter the standing corn was knocked down by Refuge personnel so that geese would have easier access to this grain. This practice has been discontinued as it was determined that geese can utilize standing corn.

Fields of small grain yielded 24 percent of the geese recorded. Large open fields with little plant cover, such as fall-planted small grains or soybean stubble, were preferred by feeding geese in the early fall. As the number of geese increased during October and November, the wariness of the birds declined resulting in the utilization of pastures with tall, dense stands of forage; also, small-grain stubble with growths of weeds 3 to 4 feet high were utilized.

Pastures of timothy, redtop, bromegrass and bluegrass provided 22 percent of the feeding geese. Utilization of pastures increased as availability of corn, soybeans and small-grain forage declined.

Soybean fields harvested by mechanical pickers contained 9 percent of the feeding geese; heaviest usage was early in the fall, prior to the harvest of corn. Weed-infested wheat stubble and Korean lespedeza fields yielded 4 percent of the feeding geese. Adventitious wheat, cheat and broad-leaved weeds were the food items utilized.

A combination planting of wheat, barley, oats and rye was evaluated for grazing by geese. Based on time and intensity of grazing, the preferences by geese were in decreasing order: wheat, rye, barley and oats. The production of forage, which was primarily determined by rate of growth in the fall, was in decreasing order of bulk: rye, oats, barley and wheat. The recovery of the grazed stands in decreasing degree was rye, wheat, barley and oats. The grazed stands of barley and oats suffered severe frost damage because goose

grazing of foliage and erosion which exposed roots.

The utilization of forage seemed dependent upon the amount of moisture on the foliage (Fig. 1). Heavy dew, frost, light rain or light snow resulted in geese concentrating in pastures or small-grain fields rather than in corn or soybean fields. Helm (1951) reported a similar shift in field utilization under varying moisture conditions.

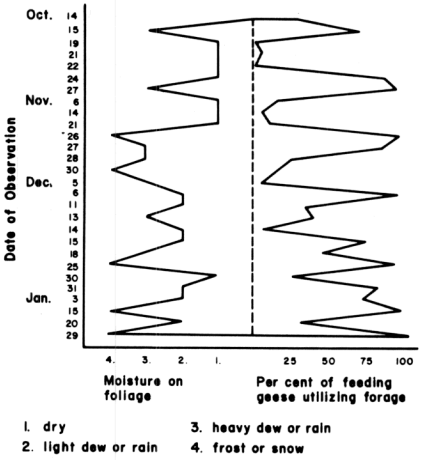

FIGURE 1. Relationship of goose utilization of forage with extent of moisture.

Effects of Geese Grazing Winter Wheat—During the fall of 1953, 11 wheat fields on or in the vicinity of Crab Orchard National Wildlife Refuge and 5 on the Union County Wildlife Refuge were selected for study. One or two exclosures, constructed of 1-inch mesh poultry netting and protecting an area of 36 square feet, were erected in each field. These provided ungrazed plots for comparison with the remainder of the fields which was available to geese. Four of the five study fields on the Union County Wildlife Refuge were not utilized by geese. In the fifth field grazing reduced seedling density to the extent that the field was disced and samples for productivity estimates were unavailable. Six of the 11 fields in the vicinity of Crab Orchard Lake were grazed by geese.

When the wheat in fields used by geese matured in June, 1954, five samples, each comprising an area of 2 square feet, were collected from each exclosure and from grazed sites in the field. The morphometric features of each sample including number, weight and height of culms; number, size, volume and weight of seeds; average length and number of roots; and average photosynthetic area of leaves were recorded. Data from Field VI were not used as rodents damaged the samples.

The topography of wheat fields was gently rolling with slopes of 2 to 4 percent which were subject to sheet and rill erosion; soybean debris gave some protection in Field I. Soil type included Hosmer Silt Loam in fields II-V and Stoy Silt Loam in Field I; both soils have impervious subsoils which permit little or no internal drainage. Characteristically the soils are low in calcium, phosphorus, potassium, nitrogen and organic matter except where improvements have been made. In all fields, wheat was seeded by drill during the week of October 12-19 following a previous crop of soybeans or red clover. Seeding depth varied from 1 to 3 inches, seeding densities from 149 to 225/sq. yd.

In 1953, October and November were drier than the 10-year average, receiving 0.92 and 2.23 inches of

TABLE 1. Morphometry and yield of wheat from ungrazed and grazed sites in five fields near Crab Orchard Lake, 1954.

Items	Fields										
	I		II		III		IV			V	
	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed	Grazed 2% Slope	Grazed 4% Slope	Ungrazed	Grazed
Calculated yields (bu/ac)	18	5	37	17	30	11	39	11	8	30	34
Avg culms/sample	50.2	42.5	66.4	56.0	57.8	41.5	55.7	36.0	21.6	65.4	67.0
Avg culm height (in)	35	16	41	28	33	21	38	25	19	38	31
Avg no. spikes/sample	43.0	19.5	56.6	50.3	48.7	30.3	49.7	35.3	22.3	60.4	64.2
Avg wt of above-ground parts/sample (g)	105	53	152	97	132	64	84	43	23	148	108
Avg no. seeds/sample											
0-1mm dia	0	16	0	1	0	0	0	0	0	0	0
1-2mm dia	32	143	18	315	27	236	81	103	77	33	16
2-3mm dia	690	145	1,260	651	1,059	383	1,175	409	302	1,115	1,266
Avg seed wt/sample (g)	23	4	48	24	40	14	46	13	10	44	46
Avg net seed vol/sample (cm^2)	20	4	42	21	34	13	45	12	1	35	38
Avg photosynthetic area/sample (sq in)	340	159	237	140	.....	.....	508	.....	.....	696	409

precipitation, respectively. Following a dry hot summer, this resulted in low soil moisture and limited wheat growth from the time of germination until late November. During November, temperatures averaged 1.6 degrees lower than normal, further restricting fall growth of wheat. Mild weather and adequate precipitation favored good growth of wheat during the spring of 1954.

Pattern of Goose Utilization

Fields in the inviolate portion of Crab Orchard National Wildlife Refuge were utilized from October to March; the specific dates depended upon proximity to Crab Orchard Lake. Fields I, II, III and IV were approximately ½ mile from the lake and received the heaviest use during November and December; Field V was grazed primarily during February and early March. Hunters prevented geese from feeding in privately-owned fields until the waterfowl season closed in December. Following this date geese fed on farmlands bordering the Refuge with increasing frequency until late February, when the population declined as the northward migration got underway.

Generally, geese grazed first the crests and then the slopes, working from the center of a field toward the borders. Fecal-dropping density was not an accurate index of the extent of goose usage or amount of forage consumed because it also reflected the amount of time the geese spent loafing in the field. This time varied with the location of the field, being greatest in fields I and II and least in fields III, IV and V.

Yield of Wheat

In all fields except one, grazing by geese resulted in a 54 to 79 percent loss in yield of wheat (Table 1). Generally reductions in productivity could be associated with less weight of above ground parts (Fig. 2), decreased photosynthetic area (Fig. 3) and fewer spikes (Fig. 4).

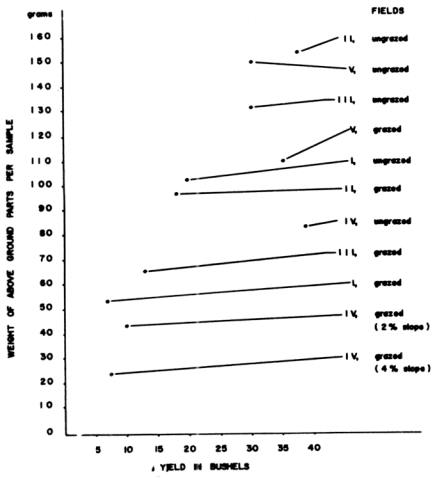

FIGURE 2. Relationship of weight of above ground parts per sample to yield of wheat.

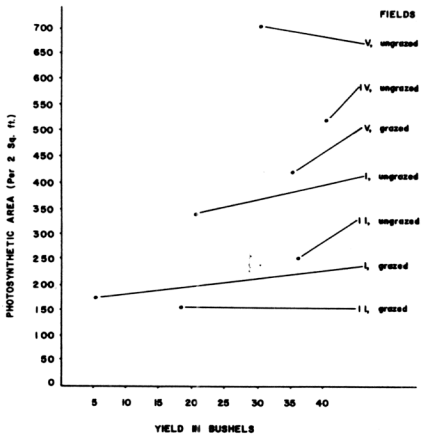

FIGURE 3. Relationship of photosynthetic area per sample to yield of wheat.

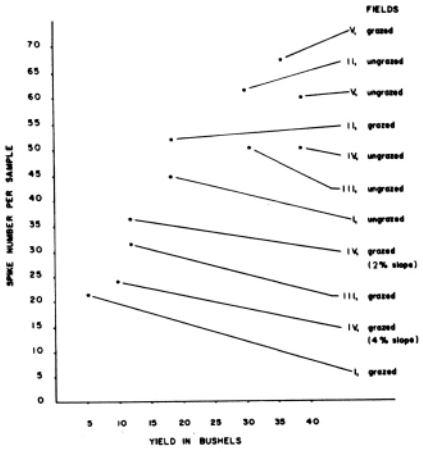

FIGURE 4. Relationship of average spike number per sample to yield of wheat.

Field V was distinctive in that yields from stands grazed by geese were 13 percent greater than the ungrazed stands (Table 1). In this field, wheat followed red clover, which left the soil higher in organic matter, moisture and nitrates than contributed by soybeans. Deeper drilling of the wheat further enhanced moisture conditions. The wheat responded to these favorable moisture conditions with rapid fall growth, producing a seedling which in March had three times the photosynthetic area and twice the tiller number of seedlings in any other field. Even after moderate grazing these seedlings still retained one-half the photosynthetic area of that of ungrazed seedlings in any of the other fields. This remaining foliage modified the adverse erosional effects associated with goose grazing. Also, Field V was exposed to erosion for a shorter period of time as it was grazed only in early spring; the wheat showed a rapid resumption of growth. An increase in soil fertility due to the deposition of goose feces was undetermined; however, the density of the feces was twice the average for other fields. Height, weight of above-ground parts and photosynthetic area were greater for samples from ungrazed sites than those grazed (Table 1); average culm number increased slightly on the latter site.

Previous reports on the effects of geese grazing small grains reflect no damage (Pirnie, 1954), serious damage (Atkeson and Givens, 1952; Biehn, 1951; Helm, 1951) and beneficial (Quinn, 1952; Washington State Game Department, 1953). Biehn (1951) reported that grazing by waterfowl, when the soil was not saturated, increased production of small grains by causing the formation of stools. In Field V culm densities and correspondingly, yields increased slightly as a result of grazing by geese; in the other fields these were depressed by grazing.

The direct effects of defoliation of the wheat seedling by geese varied widely with the time of grazing. Early fall grazing reduced potential fall growth, root development and food storage. This resulted in low resistance to frost damage during the winter, a slow resumption of growth in the spring, a decrease in culm density and cumulative growth and a drop in seed production. Late-winter or early-spring grazing did not materially restrict accumulation of food reserves in Field V as spring growth was not noticeably retarded. The over-wintering foliage apparently reached its peak photosynthetic activity during the fall, slowing with lower temperatures and frost injur-

ies during the winter, and being replaced early in the spring with new growth of leaves and an elongation of internodes. The value of the overwintered foliage to plants in the spring was dependent upon the amount of food reserves in rootstocks and roots. These food reserves determined the capability of plants to produce new spring growth; the smaller the food reserves the more dependent plants were upon photosynthesis in the old foliage to produce the new spring growth. Thus the size of seedlings seemed to determine the degree of injury resulting from defoliation by geese and the time of grazing became an indirect effect.

The time of grazing also determined the period grazed fields were exposed to accelerated erosion; unfortunately, quantitative data were not collected. Stall, et al. (1954) calculated the soil loss from 2 to 3 percent slopes with clean-tilled crops at 2 to 5 tons per acre annually for fields in the Crab Orchard Lake watershed. The insidious effects of erosion seemed aptly demonstrated on grazed sites in Field IV where a 2 percent steeper slope showed a 27 percent lower yield (Table 1).

In Field V yields increased 13 percent as a result of grazing by geese while culm densities increased only 2 percent (Table 1). Influential in this yield increase was the 6 percent increase in average number of spikes and the 12 percent increase in average seed number. This increase in floristic production was attributed to changes in soil fertility due to decomposing geese feces. Quinn (1952) reported that extensive use of wheat in winter months by geese improved the final yield through the addition of fertility to the soil by the droppings. Cited as an example were three comparable fields which had been subjected to varying intensities of grazing. The heavily-grazed field yielded 33 bushels per acre, the lightly-grazed 25 and the ungrazed 18.

That the deposition of fecal material did affect soil fertility was indicated by the average decrease in pH of 0.7 on grazed sites in fields I, II, III and IV. On the basis of calculations by Helm (1951), a density of 2 to 5 fecal droppings per square yard contributed 1 to 2 lb of nitrogen per acre. Potassium values increased slightly in fields III and IV but had such a high availability that small additions from goose droppings probably had little effect. Available phosphate also increased slightly in fields III and IV on sites grazed by geese and probably was the cause of increased floristic production on the grazed sites in Field V. Phosphate was probably the key nutrient in Field V; because phosphate availability was low, small additions possibly had far-reaching effects. Seemingly, additions of phosphates would have produced the higher-grain production despite the decrease in weight of vegetative parts.

Food Utilization at Horseshoe Lake

Specific foods utilized by Canada geese (Table 2) were determined from an examination of 561 "crops" collected during November and December of 1953 and 1954, at a goose-picking station near Horseshoe Lake Refuge. Thirty-four percent (142)

TABLE 2. Fall foods of Canada geese harvested in the vicinity of Horseshoe Lake State Game Refuge, 1953 and 1954.

Food Items	Periods of Crop Collection													
	Nov. 1 to Nov. 7 (11 Crops)		Nov. 8 to Nov. 14 (55 Crops)		Nov. 15 to Nov. 21 (70 Crops)		Nov. 22 to Nov. 28 (51 Crops)		Nov. 29 to Dec. 5 (152 Crops)		Dec. 6 to Dec. 15 (80 Crops)		Totals (419 Crops)	
	Percent Volume 55cc	Percent Frequency of Occurrence	Percent Volume 758cc	Percent Frequency of Occurrence	Percent Volume 1,103 cc	Percent Frequency of Occurrence	Percent Volume 974cc	Percent Frequency of Occurrence	Percent Volume 2,510 cc	Percent Frequency of Occurrence	Percent Volume 847cc	Percent Frequency of Occurrence	Percent Volume 6,247 cc	Percent Frequency of Occurrence
PLANT	100.0	100.0	98.2	100.0	98.3	100.0	97.2	100.0	92.2	100.0	95.4	100.0	96.1	100.0
Glycine max	92.7	50.0	86.0	48.3	45.3	37.8	31.2	41.9	21.0	31.6	13.8	7.1	34.5	29.6
Zea mays	7.3	50.0	10.1	24.1	3.6	13.3	8.6	19.4	32.9	40.8	61.8	30.0	25.6	29.6
Sorghum halepense	.....	.....	.....	.....	4.3	8.9	27.6	41.9	16.7	23.5	3.3	14.3	12.3	18.1
Polygonum pennsylvanicum	.....	.....	Trace	6.9	3.5	28.9	5.9	25.8	4.8	23.5	9.9	52.9	4.8	29.9
Taxodium distichum	.....	.....	.....	.....	13.2	3.3	1.9	3.2	1.0	1.0	.....	.....	3.0	1.8
Eleocharis acicularis	.....	.....	.....	.....	.....	.....	.....	.....	3.9	4.1	3.8	1.4	2.4	1.8
Lemna minor	.....	.....	0.4	6.9	5.4	15.6	6.9	19.4	0.7	3.1	.....	.....	2.1	6.5
Triticum aestivum	.....	.....	.....	.....	0.1	1.1	.....	.....	4.5	12.2	0.1	1.4	1.8	5.1
Eragrostic hypnoides	.....	.....	0.1	6.9	3.1	4.4	4.0	12.9	Trace	2.0	0.9	2.9	1.7	5.1
Cyperus erythrorhizos	.....	.....	.....	.....	4.6	6.7	4.9	6.5	.....	.....	.....	.....	1.5	1.8
Eleusine indica	.....	.....	.....	.....	4.2	8.9	2.3	3.2	0.2	3.1	.....	.....	1.2	2.9
Polygonum lapathifolium	.....	.....	.....	.....	.....	.....	.....	.....	2.9	3.1	.....	.....	1.2	1.1
Cyperus ferruginescens	.....	.....	.....	.....	3.6	6.7	.....	.....	0.7	3.1	.....	.....	0.9	2.2
Digitaria sanguinalis	.....	.....	0.9	17.2	1.8	1.1	2.3	16.5	0.1	1.0	.....	.....	0.9	3.3
Jussiaea diffusa	.....	.....	.....	.....	2.7	4.4	0.5	3.2	.....	.....	0.6	1.4	0.6	1.4

TABLE 2. — (Continued)

Food Items	Periods of Crop Collection													
	Nov. 1 to Nov. 7 (11 Crops)		Nov. 8 to Nov. 14 (55 Crops)		Nov. 15 to Nov. 21 (70 Crops)		Nov. 22 to Nov. 28 (51 Crops)		Nov. 29 to Dec. 5 (152 Crops)		Dec. 6 to Dec. 15 (80 Crops)		Totals (419 Crops)	
	Percent Volume 55cc	Percent Frequency of Occurrence	Percent Volume 758cc	Percent Frequency of Occurrence	Percent Volume 1,103 cc	Percent Frequency of Occurrence	Percent Volume 974cc	Percent Frequency of Occurrence	Percent Volume 2,510 cc	Percent Frequency of Occurrence	Percent Volume 847cc	Percent Frequency of Occurrence	Percent Volume 6,247 cc	Percent Frequency of Occurrence
Polygonum punctatum									0.9	7.1			0.4	2.5
Echinochloa crusgalli					1.4	2.2	0.3	3.2	0.2	1.0			0.4	1.4
Quercus palustris									0.2	1.0	1.2	2.9	0.6	1.1
Panicum dichotomiflorum			Trace	3.5	0.5	1.1							0.1	0.7
Spirogyra sp.			Trace	3.5	0.6	2.2							0.1	0.7
Celtis laevigata							0.8	3.2	Trace	2.0			0.1	1.1
Ambrosia trifida									0.2	2.0			0.1	0.7
Amaranthus retroflexus									1.3	2.0			Trace	11.6
Nyssa aquatica			0.1	3.5	0.1	1.1							Trace	0.7
Ambrosia elatior					0.2	1.1							Trace	0.4
Setaria lutescens			0.1	6.9					Trace	1.0			Trace	1.1
Bidens sp.					Trace	1.1							Trace	0.4
Lepidium virginicum									Trace	1.0			Trace	0.4
ANIMAL									0.2		Trace		0.1	0.6
UNDETERMINED			1.8	24.1	1.7	2.2	2.8	6.5	7.6	21.4	4.6	12.9	3.8	14.8

of the crops contained no food items; unidentifiable debris represented 3.8 percent of the total volume. Twenty-eight plants contributed 96.1 percent by volume and had a 100 percent frequency of occurrence whereas animal matter yielded 0.1 percent by volume and was recorded in 0.6 percent of the crops. The latter was represented by Gastropoda, Coleoptera, Orthoptera and Diplopoda; these did not appear in the diet until late November.

By volume 14 plant foods yielded approximately 94 percent of the diet (Table 2); agricultural crops (61.9%) included soybeans (34.5%), corn (25.6%) and wheat (1.8%). The use of agricultural crops was generally in accordance with acreage availability (Illinois Cooperative Crop Reporting Service, 1953); as well as the timing of soybean and corn harvests and winter wheat growth. Fourteen weed species associated with agricutural lands contributed 23.1 percent of the diet; Johnson grass (12.3%), a troublesome grass in the intertilled crops, was especially prominent. Several items of relatively minor volume, such as cypress, duckweed, rushes and sedges, reflected utilization of Horseshoe Lake.

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