FOOD HABITS OF THE GREAT-TAILED GRACKLE IN BRAZOS COUNTY, TEXAS

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The only extensive study of the food habits of the genus *Cassidix* is that of Beal (1900) in which he examined 116 stomachs of birds taken in Florida, Georgia, and Texas. All but 13 of these birds were taken in Texas, and results from these samples indicated that the birds consumed 39.8% animal food and 60.2% vegetable matter. Corn, the most important single item, accounted for 46.8% of the total food budget and represented more than 50% of the vegetable food in all months except May and November. No weed seeds were found, but grasshoppers were eaten in July and August, and six Texas birds taken in September had eaten Cotton Bollworms [*Heliothis zea* (Boddie)]. Unfortunately, specific collecting localities were not given, and in light of Selander and Giller's work (1961), it is questionable whether the samples represented *Cassidix mexicanus*, *C. major*, or both.

Many notes based on empirical observation have been published describing foraging sites (Carriker 1910; Skutch *in* Bent 1958; Selander and Giller 1961), feeding methods (Griscom 1932; Lamb 1944; Skutch *in* Bent 1958; Selander and Giller 1961), and food items (Lamb 1944; Skutch *in* Bent 1958; Tutor 1962; Blankinship 1966; Cottam and Trefethen 1968).

This study sampled the diet of Great-tailed Grackles (*Cassidix mexicanus prosopidicola*) from a limited geographic area during the course of one year. The samples were examined for evidence of seasonal variation in the diet, diet differences in the various age and sex classes, and for possible impact of Great-tailed Grackle feeding habits on local agriculture and wildlife.

METHODS

A year of preliminary observation revealed that individuals of *C. mexicanus* remain in the vicinity of the Texas A&M University experimental farms and pastures throughout the year. Most of the birds collected for this study were taken within 1 mile of the university campus. All specimens were collected between 09:00 and sunset, giving each bird a reasonable opportunity to feed before it was collected. No specimen was found with an empty stomach. Those birds collected during the summer were injected with 10% formalin to retard digestion and facilitate identification of ingested food items. The time of day and the locality of each specimen were recorded in the field, and the bird was weighed as soon as it was taken to the lab. In most cases the specimen was dissected the day secured, but if this was not possible, the bird was frozen until it could be examined. Notes were made of the feeding behavior of birds observed, with special attention given to sex- and age-group composition and location of feeding flocks.

The entire alimentary tract was removed from each bird and placed in a vial of 10% formalin. If the remainder of the specimen was not preserved as a study skin, skeleton, or in alcohol, the skull alone was preserved. Notations were made on all birds concerning degree of skull ossification, presence or absence of the bursa of fabricius, condition of the gonads, color of the irides, state of molt, and abnormalities (if any) such as missing extremities or partial blindness.

The contents of each gizzard and proventriculus were flushed into a petri dish and examined under low magnification, with special attention being given to floating particles. The sample was then rinsed by flooding with preservative and decanting the surplus. During the second examination, significant fragments such as mandibles, heads, wings, and seeds were set aside for identification. Confusing fragments were placed in 1-dram vials identified by the specimen number and taken to the appropriate specialist for assistance in identification. Individual food items were counted, and crushed seeds were enumerated by recording the number of hila or by stacking fragments in seed-sized piles and counting the piles. A standard volume was established for each kind of food item by measuring the amount of water an entire specimen displaced in a graduated cylinder. The standard volume was multiplied by the number of such items observed to estimate the total volume originally consumed. These data were recorded along with field data concerning the bird, and a notation was made confirming the presence or absence of gravel in the gizzard.

Data from each gizzard and proventriculus were classified according to the age and sex of the bird; the lowest, identifiable taxon to which the food items belonged; and the month and season during which the sample was collected. These data were converted into percentages and used to construct a model of the annual diet of all birds collected during the month according to the order of the food item (fig. 1) and the family of the food item (table 1). Monthly

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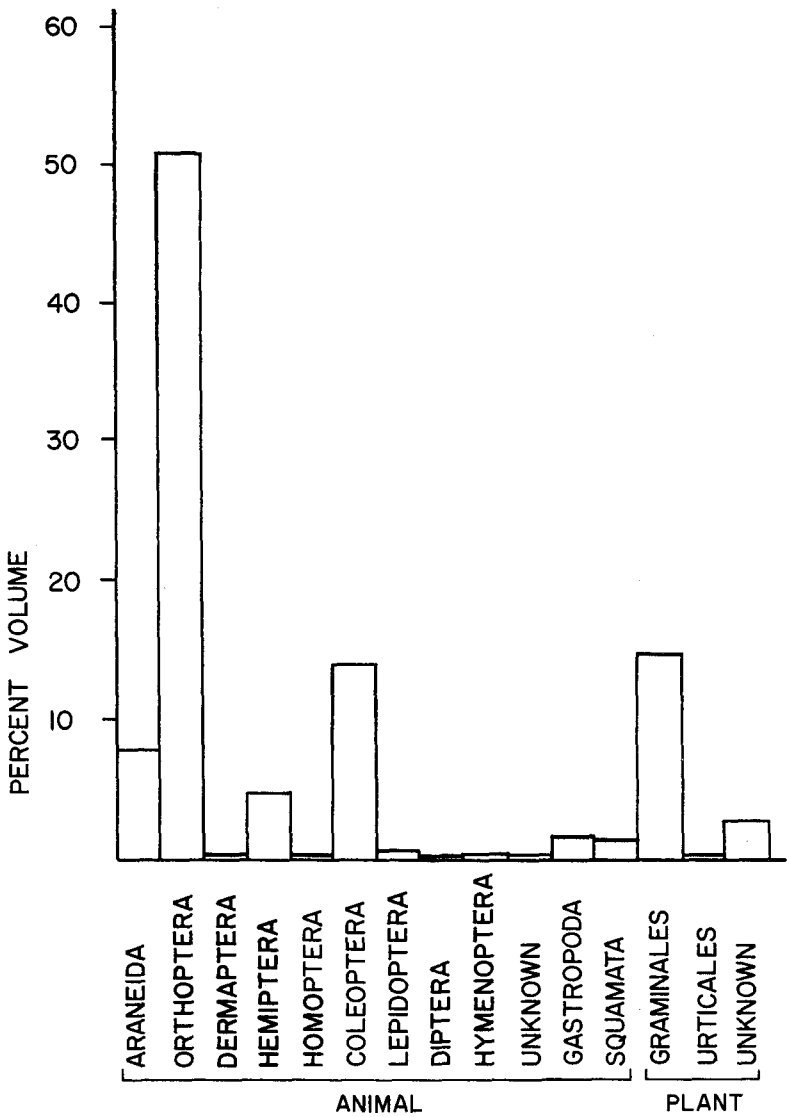

FIGURE 1. Reconstructed annual diet of Great-tailed Grackles based on stomach contents of 129 birds collected in Brazos County, Texas, from June 1968 through July 1969, expressed as relative estimated volume.

changes in the relative volume of plant matter present in all sex and age classes were recorded (fig. 2). The aestival diet (March–October) and the hibernal diet (November–April) of each age and sex class was reconstructed (table 2).

RESULTS

Food samples were collected from the digestive tracts of 129 Great-tailed Grackles. The birds were grouped into adults, immatures, and nestlings for comparison and, within the first two categories, the samples were further segregated by sex.

COMPOSITE DIET FOR ALL AGE AND SEX CLASSES

Great-tailed Grackles consumed a larger volume of animal than plant food. Arthropods, gastropods, and a single vertebrate accounted for 80% of the yearly diet by volume, and plant remains accounted for the remaining 20%. Grackles ate a proportionately greater volume of animal matter during the summer than at any other time of the year. Between January and March, the volume of animal food represented 15–35% of the diet, but this increased suddenly in April to about 80% and remained at this level through October. During November, the animal fraction of the diet was 55% by volume, and during December it was 80%.

Beal (1900) reported that 40% of the diet of the grackles he collected in Texas was derived from animals and 60%, from plants. Beal did not explain how these figures were calculated, but he mentioned specific numbers of items

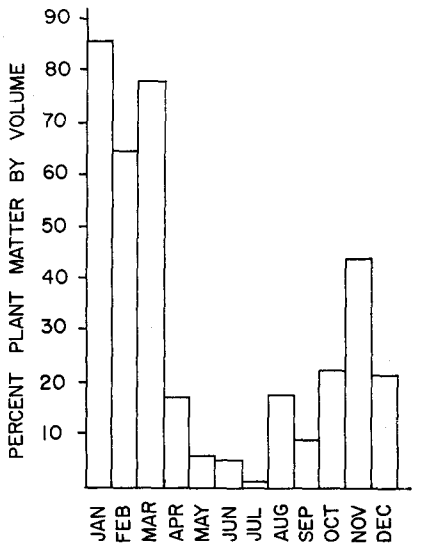

FIGURE 2. Seasonal changes in the relative volume of plant matter in the reconstructed diet of a sample of 129 Great-tailed Grackles collected in Brazos County, Texas, from June 1968 through July 1969.

several times and never spoke of volumes. It appears that he expressed relative abundance in terms of absolute numbers of items. Recalculating the samples of this study using absolute numbers of food items revealed that 30% of the food items were animal and 70% plant.

In Brazos County, orthopterans made up 51% of the diet by volume; grass seeds, 15%; coleopterans, 14%; araneids, 8%; and hemipterans, 5%. Items in these five categories accounted for 90% of the total volume in the yearly diet.

The average volume of food present in an individual was lowest in March and highest in July. Volumes were less than 0.70 cc from January through March, between 1.20 and 4.20 cc from June through September, and between 1.40 and 2.10 cc from October through December. If the contents of gizzard and proventriculus indicate even roughly the amounts of food consumed by individual birds, Great-tailed Grackles tend to consume considerably larger volumes of food in summer and early fall than during winter and early spring.

The varying availability of specific food items must account for some of the changes in diet observed. Availability was not measured directly during this study, but its effects are reflected in some of the results obtained. During the hibernal season (November–March), the mean monthly volumes of both

TABLE 1. Systematic list of food items and their relative volume in the reconstructed diet of a sample of 129 Great-tailed Grackles collected in Brazos County, Texas, from June 1968 through July 1969.

Items	% Vol.	Items	% Vol.	Items	% Vol.	Items	% Vol.
Araneida		Homoptera		Lepidoptera		Hymenoptera	
Ctenizidae	1.51	Cicadellidae	0.14	Nymphalidae	0.04	Tenthredinidae	0.03
Salticidae	0.75	Aphididae	0.01	Hesperiidae	0.04	Ichneumonidae	0.02
Lycosidae	4.98	?	0.00	Sphingidae		Cynipidae	0.01
Oxyopidae	0.30			(Larva)	0.11	Formicidae	0.15
Araneidae	0.04	Coleoptera		Noctuidae	0.04	Vespidae	0.08
?	0.21	Carabidae	1.77	Noctuidae		? (Adult)	0.18
		Carabidae		(Larva)	0.26		
Orthoptera		(Larva)	0.23	Geometridae		Insecta (other)	0.24
Acrididae	2.94	Dytiscidae	0.04	(Larva)	0.04		
Tettigoniidae	3.39	Noteridae	0.01	? (Adult)	0.11	Gastropoda	1.36
Gryllidae	23.97	Hydrophilidae	0.01	? (Larva)	0.53		
?	21.03	Staphylinidae	0.02	Chrysalis	0.08	Squamata	
		Elateridae	0.04			Colubridae	0.13
Dermaptera		Erotylidae	0.04	Diptera			
Labiduridae	0.19	Tenebrionidae	0.11	Tipulidae	0.03	Graminales	
		Scarabaeidae	5.76	Sepsidae	0.01	*Avena/Triticum*	5.19
Hemiptera		Scarabaeidae		Ephydridae	0.02	*Paspalum* sp.	0.35
Belostomatidae	0.23	(Larva)	3.92	Tachinidae	0.02	*Sorghum vulgare*	8.32
Reduviidae	0.04	Chrysomelidae	0.02	Schizophora		*Zea Mays*	1.13
Lygaeidae	0.49	Curculionidae	1.63	(Larva)	0.02		
Coreidae	0.15	Curculionidae		Cyclorapha		Urticales	
Cydnidae	0.02	(Larva)	0.01	(Larva)	0.01	*Celtis laevigata*	0.08
Scutelleridae	0.60	? (Adult)	0.32	Puparium	0.07		
Pentatomidae	2.79	? (Larva)	0.01	? (Adult)	0.11	Unknown	2.91
?							

TABLE 2. Reconstructed aestival (April–October) and hibernal (November–March) diets of a sample of 129 Great-tailed Grackles collected in Brazos County, Texas, from June 1968 through July 1969.

	Adult male		Adult female		Immature male		Immature female		Nestling
$N =$	2	16	28	18	11	2	15	15	12
Order	Aestv.	Hibr.	Aestv.	Hibr.	Aestv.	Hibr.	Aestv.	Hibr.	Aestv.
Animal									
Araneida	8.73	3.16	7.46	3.13	2.09	0	0.74	10.72	15.6
Orthoptera	29.94	4.75	63.34	11.75	63.27	0	68.53	0	50.6
Dermaptera	0	0	0	0	0	11.36	0	4.02	0
Hemiptera	13.60	11.39	5.05	6.34	2.27	5.68	4.42	0	2.6
Homoptera	0	0.16	0.32	0.12	0.06	0	0.15	0.27	0
Coleoptera	15.97	7.91	11.40	47.72	12.81	30.68	11.75	8.04	18.2
Lepidoptera	3.74	0	1.59	0.59	1.69	0	0.74	1.34	1.9
Diptera	0.19	0	0.49	0.55	0	0	0.11	2.82	0
Hymenoptera	0.37	0.24	0.49	1.41	0.24	1.14	0.77	1.34	0
Gastropoda	0	1.58	0.24	0	0	0	0.74	0	3.9
Squamata	0	2.77	0	0	0	0	0	0	0
Unknown	0	1.26	0	0	0.49	0	0	0	1.9
Plant									
Graminales	24.77	47.94	9.51	19.38	17.08	51.14	12.01	67.15	5.2
Urticales	0	1.58	0	0	0	0	0	0	0
Unknown	2.68	17.25	0.11	8.89	0	0	0.04	4.29	0
Animal	72.55	33.22	90.38	71.61	82.92	48.86	87.95	28.55	94.7
Plant	27.45	66.77	9.62	28.27	17.08	51.14	12.05	71.44	5.2
Total	99.99	99.99	100.00	99.88	100.00	100.00	100.00	99.99	99.9
Diversity Index (H')	1.737	1.685	1.235	1.549	1.141	1.167	1.073	1.203	1.468

plant and animal matter were similar (4.93 cc plant, 5.10 cc animal). During the aestival season (April–October), the monthly mean plant volume (3.02 cc) approximates the hibernal means but the mean animal volume (28.10 cc) is considerably increased. This suggests that the apparent shift in emphasis from animal to plant food in the winter is really a shift in availability. Grackles eat roughly equivalent volumes of plant food throughout the year but supplement this with large volumes of animal matter when it is available.

The standard deviation of monthly total volumes of plant matter from the annual mean is 2.20 and the same statistic for animal matter is 28.16, indicating again that plant material is the more consistent component of the diet.

EFFECT OF WEATHER ON THE COMPOSITE DIET

Weather data were taken from the records of the university weather station on the Texas A&M University campus in the center of the study area. Correlation of changes in food habits with changes in weather was difficult because retention of some fragments of food items masked short-term changes, and because the sample of birds associated with a given weather change was usually small. However, long-term changes were detected and drastic changes, such as the passage of cold fronts in the winter, did cause noticeable changes in food habits. On 31 December, for example, a severe cold front climaxed a week of mild weather and caused a decrease in the consumption of insect food in spite of the masking effect just mentioned.

On the basis of temperature, the year can be divided into two seasons in Brazos County, an aestival season from April through October and a hibernal season from November through March. The monthly mean temperature during the aestival period varied from 20–30°C, but means of consecutive months never differed more than 5°C. The monthly

means between November and March were from 10–13°C. However, the April mean was 10°C warmer than that for March, and the November mean was 10°C colder than that for October (Lightfoot, pers. comm.). These abrupt changes were reflected in the food habits of Great-tailed Grackles. Consumption of insects increased by 60% during March and April and remained at a high level until the following autumn when, during October and November, insect consumption decreased by 35%. This autumnal response was reversible, however, and insect consumption increased in December 1968, probably in response to favorable weather. During the first week in January, severe conditions caused insect consumption to decrease to 15%, a change that was not reversed until March and the change in season.

ADULT MALES

Adult male grackles consumed a volume of animal matter representing 52% of the year's diet. This source accounted for 33% of the hibernal diet and contributed 72% of the aestival diet. Grass seeds were the most important single type of food annually, representing 35% of the diet for the year. Grass seeds were of primary importance during the hibernal season, accounting for 48% of the diet, and orthopterans were most significant in the aestival season, constituting 30% of the diet.

ADULT FEMALES

Although adults of both sexes were omnivorous, females tended to be more insectivorous than males. Animal matter composed 81% of the annual diet, 72% of the hibernal diet, and 90% of the aestival diet. Orthopterans were the most important constituents of the annual diet, representing 50% of the volume. Coleopterans were the primary hibernal food source, providing 48% of the diet, and orthopterans provided 63% of the aestival diet. During April, May, and June, seven adult females with brood patches were examined and six of these had recently consumed grain. None of the 12 nestlings examined showed any trace of grain.

IMMATURE MALES

Immature male grackles consumed a volume of animal matter representing 66% of the year's diet, 49% of the hibernal diet, and 83% of the diet during the aestival months. Orthopterans were the most important constituents annually, representing 60% of the diet for the year. Grass seeds were of primary importance during the cool season, accounting for 51% of the diet, and orthopterans were most significant in the warm season, constituting 63% of the diet.

IMMATURE FEMALES

Immature female grackles consumed a volume of animal matter representing 58% of the year's diet, 29% of the cool season diet, and 88% of the diet during the warm months. Orthopterans were the most important constituents annually, representing 53% of the diet for the year. Grass seeds were of primary importance during the cool season, accounting for 67% of the diet, and orthopterans were most significant in the warm season, constituting 68% of the diet.

NESTLINGS

The diet of nestling grackles was composed of 99% animal matter. Orthopterans were the most important constituents, accounting for 76% of the diet, and araneids represented 17%. Grit was found in the stomachs of 9 of 12 nestlings collected. A single grass stem, 38.7 mm long, was discovered in the esophagus of one bird, and compact balls of plant fibers, possibly representing other grass stems, were found in the stomachs of five nestlings.

DISCUSSION

DIFFERENTIAL FEEDING HABITS

Observations recorded as field notes during collecting operations for this study (which should not be considered to represent an organized study of movements and feeding behavior) suggested that adult and immature females feed together in a large flock during much of the winter. It also seemed that males of all ages were more solitary in their feeding habits than females, and the two sexes fed in different areas. There were also indications that females feed their male offspring longer than their female young.

Selander (1966) stated: "In some species the advantage of large size in the males may be so great that they are in a sense 'pushed' by sexual selection into 'inferior' subniches, with the result that mortality rates are higher in males than in females." It seems logical that characters such as large size or longer tail may also affect the feeding behavior of males. Impaired maneuverability might make it difficult for adult males to capture rapidly moving insects such as crickets and grasshoppers.

Accepting these observations and speculations, a model of the feeding behavior of Great-tailed Grackles can be suggested to ex-

plain variations in the diets of different age and sex classes.

Grackles prefer insects to grain; and highly maneuverable, experienced adult females are best equipped to exploit this resource. Adult males are larger, less agile, and unable to capture insects as easily as females, and they are forced to supplement their diet with relatively larger volumes of grain. Immature females are equally maneuverable but less experienced than adult females. The two feed together in compact flocks in which older females are more successful in capturing available insects, forcing younger birds to supplement their diet with grain. Immature males are more maneuverable than adult males due to their smaller size and less fully developed tails, and they encounter less intraspecific competition than do immature females, thereby enabling them to consume larger relative volumes of insects than either mature males or immature females.

The diversity of foods taken by adult females might be greater than the other categories. Orians (1966) utilized the standard diversity index from information theory ($H' = -\Sigma p_i \log p_i$) to measure diversity of foods in nestling Yellow-headed Blackbirds (*Xanthocephala xanthocephala*). Application of the formula to the data in table 2, however, does not produce the expected results: adult males have a greater diversity index than adult females, followed by immature males and immature females. However, the grouping of food organisms in table 2 masked some of the diversity in that each category (order) may represent one to several subcategories (families).

Examination of the foods habits for each age-sex class at the family level for food items reveals that adult females take a number of insects requiring extensive searching, whereas adult males feed on insects that "stand out" in their environment (J. C. Schaffner, pers. comm.). Further, examination of table 2 makes it readily apparent that adult males take significantly less insect food and significantly more plant material.

Selander (1966) has explored the significance of differential feeding habits in reducing intraspecific competition and he observes that the phenomenon is especially noticeable in species with promiscuous breeding systems. The evidence presented here supports such a point of view.

RELATIONSHIP WITH LOCAL LIVESTOCK AND CROPS

Approximately 4900 acres of grain sorghum (*Sorghum vulgare*) were harvested in Brazos County during 1968 (Texas Crop and Livestock Reporting Service 1969), providing an important potential source of food for grackles. The crops were planted during March, April, and May and were harvested in August and September. Grackles were observed picking seed grain out of the ground (R. Sifford, pers. comm.) and feeding on ripe sorghum heads in the summer. Grackles consumed twice as much sorghum in April (during planting) as in any other month between January and June, and the level of consumption between August and December (during harvesting) was twice as high as the level for the first half of the year. However, grackles consumed the largest volume of grain sorghum during the 2 months following harvest.

Livestock were fed throughout the year in the area from which the grackle sample was taken, and grain sorghum was a major constituent of all the prepared feeds used (R. Sifford, pers. comm.). Sorghum was stored and handled locally in large quantities prior to the milling of these feeds and spillage was common. This spillage provided grackles with an excellent source of food, and field observations indicated that they frequently feed in storage areas during the winter and early spring.

The volume of wheat and oats consumed represented 35% of the grain fraction of the diet, and the largest volumes were taken in January, February, and March. Neither of these grains was grown in Brazos County, but rolled oats and wheat bran were common ingredients in prepared livestock feed (R. Sifford, pers. comm.). Barns in the vicinity of the A&M University campus were cleaned regularly throughout the year, and the hay, dung, and loose grain from them were spread over nearby pastures in which large flocks of grackles fed regularly during the winter and early spring.

The data suggest that grain is consumed most readily when it is on the ground as seed, as spillage during transport, or as feed for livestock or waste from barns and pens. Since grackles are primarily ground feeders, such behavior might be expected.

SOURCES OF ERROR AND BIAS

Two probable sources for bias should be mentioned. Differential digestion caused some fragments of food items to remain in the gizzard longer than others, creating a bias in favor of organisms having hard, heavily sclerotized parts. The extent of this bias was unknown. A nestling male taken in July contained 106 mandibles representing at least 53 orthopterans with a minimal volume of 21 cc.

The capacity of a filled gizzard was approximately 5 cc, indicating that more than one meal, and probably more than a single day's ration, was represented in this large sample of crickets. Arthropods probably overemphasized in this regard were orthopterans, hemipterans, and coleopterans; those probably underestimated were araneids, dermapterans, dipterans, and hymenopterans. Some soft-bodied forms such as larval lepidopterans and coleopterans possess tough skins that persist after the contents have been digested, and these were usually wadded into a compact mass difficult to expel from the gizzard.

Grains of oats in the proventriculus and esophagus of one bird had split open and the endosperm had begun breaking down, whereas sorghum grains in the same location in the same bird had not broken open and the endosperm was still firm. This indicated the probability that remains of wheat and oats were broken down and left the gizzard faster than remains of grains of sorghum, causing a bias in favor of the latter.

The retention of hard fragments were also significant in regard to changes in diet caused by rapid changes in weather conditions. A cold front passed through Brazos County on the night of 30–31 December, and the maximum temperature the following day was 0.5°C. Stomachs of the eight birds collected on 31 December contained coleopterans, gastropods, dipteran larvae, hemipterans, homopterans, and hymenopterans in addition to various seeds. The previous day's temperature range (6–20°C) would have been more conducive to insect consumption, and remains of items taken then might have remained in the gizzard until the following day. This kind of retention might have masked some day-to-day changes in diet due to short-term weather fluctuations.

The second possible source of bias was the small sample size for some classes of individuals during certain months. In June, July, and August, immature and nestling males and females of all ages consumed larger volumes of insects than at any other time of the year. During this time, only one adult male was collected, introducing the possibility that data indicating that adult male grackles consume smaller volumes of insects than adult females may reflect a faulty sample rather than different feeding behavior. Elimination of aestival data for all classes of individuals revealed a tendency for adult males to place less emphasis on insect food than did adult females, even in nonsummer months. Sampling bias probably affected the data, but not sufficiently to change the basic conclusion in this case.

SUMMARY

The esophagus, proventriculus, and gizzard from each of 129 Great-tailed Grackles taken in Brazos County during 1968 and 1969 were opened and the included food items were identified and counted. Volumes of preserved whole specimens of the items encountered were measured and used to estimate the original volume of the food items. The number of stomachs in which a given item occurred, the number of items of that kind observed, and the estimated original volume of the items in question were recorded and used to calculate indices of relative abundance. These indices were utilized in constructing a model of the annual diet and the diets of five age and sex classes of grackles.

The annual diet is composed of 80% animal material and 20% plant seeds. Orthopterans represent 51% of this diet by volume; grass seeds, 15%; coleopterans, 14%; araneids, 8%; and hemipterans, 5%. Weather conditions and associated dietary changes suggest recognition of a hibernal season from November through the following March and aestival season from April through October. Animal material represents 46% of the cool season diet and 87% of the diet during the warm season. The most drastic change in the diet occurs between March and April when the animal portion of the diet increases from 20–80% by volume.

The absolute volume of plant food consumed remains almost constant throughout the year, while the volume of animal food fluctuates widely. Great-tailed Grackles tend to consume larger absolute volumes of food in summer and early fall than in winter and early spring.

Females feed nestlings of both sexes an insectivorous diet and also supply grit for their gizzards. While they are feeding the young, females continue to consume small volumes of grain but offer none to their nestlings. Immature males consume equal amounts of plant and animal food, whereas young females concentrate on grain. Adult males are more nearly granivorous and adult females are mostly insectivorous.

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LITERATURE CITED

BEAL, F. E. L. 1900. Food of the Bobolink, blackbirds, and grackles. U.S. Dept. Agr. Biol. Surv. Bull. 13.

BENT, A. C. 1958. Life histories of North American blackbirds, orioles, tanagers, and allies. Bull. U.S. Nat. Mus. 211.

BLANKINSHIP, D. R. 1966. The relationship of White-winged Dove production to control of Great-tailed Grackles in the lower Rio Grande valley of Texas. Trans. N. Amer. Wildl. Nat. Resources Conf. 31:45–58.

CARRIKER, M. A. 1910. List of the birds of Costa Rica. Ann. Carnegie Mus. 832.

COTTAM, C., AND J. B. TREFETHEN. 1968. Whitewings. Van Nostrand Co., Inc., Princeton, p. 200–202.

GRISCOM, L. 1932. The distribution of bird-life in Guatemala. Bull. Amer. Mus. Nat. Hist. 64:1–439.

LAMB, C. C. 1944. Grackle kills warbler. Condor 45:245.

ORIANS, G. H. 1966. Food of nestling Yellow-headed Blackbirds, Cariboo Parklands, British Columbia. Condor 68:321–337.

SELANDER, R. K. 1966. Sexual dimorphism and differential niche utilization in birds. Condor 68: 113–151.

SELANDER, R. K., AND D. R. GILLER. 1961. Analysis of sympatry of Great-tailed and Boat-tailed Grackles. Condor 63:29–86.

TEXAS CROP AND LIVESTOCK REPORTING SERVICE. 1969. Texas Field Crop Statistics. Bull. 52: 1–68.

TUTOR, B. M. 1962. Nesting studies of the Boat-tailed Grackle. Auk 79:77–84.

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