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Seed-Eating Birds

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SEED-EATING BIRDS

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ABSTRACT

The objective of this study was to understand the effects of seed availability on the diets of sparrows and their population density. Seed availability was estimated from random soil samples and birds were censused weekly; sparrows captured from sample sites were forced to regurgitate. Between January 19 and March 2 seed abundance decreased from 150 x 10^6 seeds/ha to 121 x 10^6 seeds/ha, while the number of seed species increased from 51 to 57. A decrease in abundance occurred in most species, but *Ipomea* spp. showed a 10^7 seeds/ha increase. The observed diets were not the diets expected if the seed species consumed were eaten in the proportions available. By considering sparrow density as a function of grass seed production, we can assume that the birds eat most of the seeds available only in years when grass seed production is very low.

INTRODUCTION

The study of seed-eating birds at the Silverbell IBP site had two primary goals. These were: 1) to understand how the availability of seeds affects the diets of sparrows, and 2) to ascertain how seed availability might regulate the population density of sparrows. It was hoped that the data would also bear on the question of the overall impact of granivorous birds on the seed reserves in the soil.

The study was funded for only the last year of the IBP program. In my original proposal, I pointed out that a one-year study would not be adequate to answer these questions but that something could be learned by comparison with my similar work at The Research Ranch (TRR). As it turned out, the year of the study had unusually low seed production and sparrow populations were too low at Silverbell to obtain diet samples. I therefore continued as planned to census granivorous birds and measure seed availability at Silverbell but I shifted my diet studies to the grasslands at TRR where wintering sparrows were more abundant. As the original plan had been to study the diet of Brewer's Sparrow (*Spizella breweri*) at Silverbell, I studied instead the closely related Chipping Sparrow, *Spizella passerina*.

The data on sparrow abundances and seed availability from the IBP site is analyzed for the one study year. In order to get an approximate answer to question 2, I compared this data to the several years of similar data from my studies at TRR.

METHODS

As detailed descriptions of the methods and results will appear in published reports, I shall only outline them here.

At the Silverbell site, six study plots were chosen, three each in the two major plant associations. Each plot was 500 x 50 m. Birds were censused weekly using the standard Emlen census technique from a transect along the main axis of each plot. Seed availability in the soil was estimated from soil samples (each 10 x 10 x 0.5 cm) sampled at random (stratified) from one habitat in each plant association. All seeds were separated from the soil, identified and counted in my laboratory. Thus, the primary data consist of seed availability and bird abundance through an annual cycle.

The sparrow diet study plot was a 400 x 70 m area in an oak woodland at TRR. Birds were mist-netted on the same site where soil samples were collected for analysis of seed availability. Each bird was given 0.5 cc of the emetic tincture of digitalis to cause it to regurgitate its crop contents. On each soil sampling date 28 soil samples were collected at random from the entire study plot.

RESULTS

On January 19, there were approximately 150 x 10^6 seeds/ha of 51 species at TRR. Between that date and March 2 many seed species decreased in abundance (Table 1), though *Ipomoea* spp. showed an increase of about 10^7 seeds/ha. On March 2, total seed abundance was approximately 121 x 10^6 seeds/ha, representing 57 species. All species of seeds which had more than an average of one seed per soil sample (100 cm^2) on either sample date are shown in Table 1 along with a few species which were less common but showed up in Chipping Sparrow diets.

Table 1. The common seed species from soil samples taken January 19 and March 2, 1975 plus a few rare seed species which occurred in sparrow diets

Species	January 19		March 2	
	Seeds/100 cm^2	σ^2/mean	Seeds/100 cm^2	σ^2/mean
Amaranthus retroflexus	3.57 ± 2.49	48.4	2.18 ± 1.15	17.1
Aristida divaricata	1.11 ± 0.40	4.0	1.50 ± 0.42	3.3
A. hamulosa	3.89 ± 2.50	45.1	0.54 ± 0.27	3.9
Bidens leptocephala	1.04 ± 0.60	9.8	5.82 ± 3.84	70.9
Bouteloua chondrosioides	0.93 ± 0.61	11.4	0.07 ± 0.05	1.0
B. curtipendula	2.32 ± 0.56	3.8	2.04 ± 0.67	6.1
B. gracilis	0.14 ± 0.07	0.9	0.46 ± 0.36	7.7
Cassia leptadenia	18.00 ± 6.07	57.4	18.61 ± 4.03	24.4
Convolvulus sp.	0.00		1.57 ± 0.57	5.7
Croton sp.	0.2 ± 0.22	4.6	0.86 ± 0.62	12.4
Desmodium batocaulon	3.32 ± 1.32	14.7	0.68 ± 0.34	4.8
Diodia teres	0.36 ± 0.26	5.2	0.43 ± 0.43	12.0
Eragrostis lehmannia	19.32 ± 4.74	32.7	19.57 ± 6.38	58.3
Eriochloa gracilis	0.25 ± 0.22	5.2	0.00	
Euphorbia hyssopifolia	7.75 ± 1.90	13.1	0.79 ± 0.35	4.5
Ipomoea spp.	4.71 ± 1.32	10.3	14.14 ± 2.28	10.3
Leptochloa dubia	0.00		0.82 ± 0.78	21.0
Lycurus phleoides	2.07 ± 1.85	46.4	0.00	
Mollugo verticillata	37.64 ± 15.02	168.0	17.79 ± 6.12	59.9
Panicum obtusum	0.89 ± 0.31	3.0	2.54 ± 0.83	7.7
Paspalum sp.	0.00		1.25 ± 0.46	4.7
Polanisia sp.	0.89 ± 0.30	2.9	2.18 ± 0.81	8.4
Portulaca oleracea	1.46 ± 0.36	2.5	1.07 ± 0.25	1.7
P. retusa	28.61 ± 9.24	83.5	13.36 ± 2.89	17.5
Rumex sp.	1.14 ± 0.39	3.7	0.71 ± 0.21	1.8
Schkuhria wislizeni	1.68 ± 0.72	8.6	1.96 ± 1.11	17.5
Sida procumbens	0.54 ± 0.24	3.1	0.61 ± 0.27	3.3
Trichachne californica	0.04 ± 0.04	1.0	0.00	
Unidentified E#64	1.29 ± 0.59	7.7	1.82 ± 0.75	8.7
Unidentified I#4	0.00		1.54 ± 1.02	19.1
Total	143.25		114.91	
25 other species	6.32		6.03	
Total seeds/100 cm^2	149.57		120.94	

The variance/mean ratios shown in Table 1 indicate that the seeds were very clumped. These ratios do not rule out the possibility that the seeds were randomly distributed over a portion of the study site but absent from the rest of the site. Therefore, I compared the distribution of seed abundances to that expected for a Poisson with added zeros and found a poor fit with means still larger than variances for all common species. Thus, most species exhibited clumped distributions and could be adequately fitted to a negative binomial distribution.

The observed diets of Chipping Sparrows are shown in Table 2. Table 3 compares the observed diets to that expected if the sparrows were eating the seed species observed in their diets but eating them in the proportions available. It is clear that even among these species the diet is not a random subset of what is available.

Figure 1 shows the sparrow densities at TRR and Silverbell as functions of the grass seed production. The circles are data from TRR taken in two habitats over the years 1972-1976. It can be seen that the birds eat most of the seeds available (i.e., food limitation) only in years when grass seed production is very low. I have only a crude estimate of grass seed production at Silverbell; my methods were designed to study seed availability, not seed production. The two data points indicate that the Silverbell sites fall in line with the TRR results. However, this would have to be confirmed by estimating seed production and sparrow abundance over a variety of years, particularly when seed production is high.

Table 2. Observed diets of Chipping Sparrows foraging in an oak woodland habitat and seed weights

Species	Seed wt (mg)	January 10 Average seeds/sample ± S.E.	March 1 Average seeds/sample ± S.E.
Amaranthus retroflexus	0.05	14.44 ± 4.35 (28.3%)	6.50 ± 1.63 (13.8%)
Aristida spp.	1.00	1.07 ± 0.61 (2.1%)	0.44 ± 0.32 (0.9%)
Bouteloua chondrosioides	1.38	0.33 ± 0.27 (0.6%)	0 0
B. curtipendula	0.63	0.63 ± 0.32 (1.2%)	0.88 ± 0.81 (1.9%)
Croton sp.	0.50	0 0	0.06 ± 0.06 (0.1%)
Eragrostis lehmanniana	0.11	22.22 ± 6.49 (43.5%)	12.00 ± 4.49 (25.4%)
Leptochloa dubia	1.18	0 0	4.06 ± 2.83 (8.67)
Lycurus phleoides	0.20	0.15 ± 0.15 (0.3%)	0.06 ± 0.06 (0.1%)
Mollugo verticillata	0.06	0.37 ± 0.23 (0.7%)	1.94 ± 0.88 (4.1%)
Panicum obtusum	1.00	1.22 ± 0.54 (2.4%)	0.13 ± 0.13 (0.3%)
Paspalum sp.	1.18	0 0	1.56 ± 1.03 (3.3%)
Portulaca spp.	0.22	10.00 ± 2.48 (19.6%)	12.56 ± 5.59 (26.6%)
Schkuhria wislizeni	1.20	0 0	0.06 ± 0.06 (0.1%)
Talinum sp.	1.30	0 0	1.81 ± 1.15 (3.8%)
Trichachne californica	0.37	0.15 ± 0.12 (0.3%)	0 0
Unknown E#64	1.33	0 0	4.88 ± 3.02 (10.3%)
3 unidentified species	--	0.48 ± 0.27 (0.9%)	0.25 ± 0.15 (0.5%)
Total seeds/sample		51.06	47.19
Total number samples		27	16

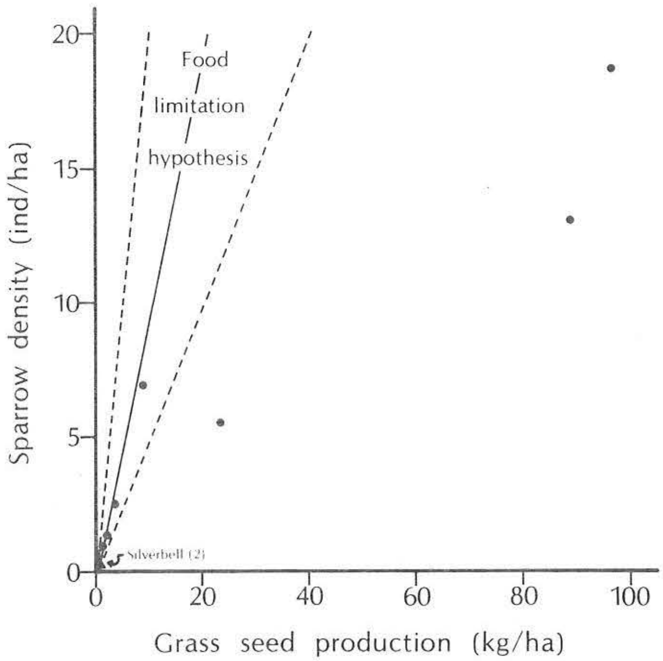

Figure 1. Relation between sparrow density and available food at Silverbell (triangle) and The Research Ranch sites (circles). See text for discussion of food limitation hypothesis.

Table 3. Expected and observed frequencies of seeds included in the diet. Expected values are from the frequencies of the seed species in soil samples

Species	January 19 sample			March 2 sample		
	Percent available	Expected number in diet	Observed number in diet	Percent available	Expected number in diet	Observed number in diet
Amaranthus retroflexus	3.4	46.4	390	3.2	23.4	104
Aristida spp.	4.7	63.8	29	3.0	21.9	7
Bouteloua chondrosioides	0.9	12.1	9	0.1	0.8	0
B. curtipendula	2.2	30.2	17	3.0	21.9	14
Croton sp.	0.3	3.8	0	1.3	9.2	1
Eragrostis lehmanniana	18.4	251.2	600	29.0	209.8	192
Leptochloa dubia	0.0	0.0	0	1.2	8.8	65
Lycurus phleoides	2.0	27.6	4	0.0	0.0	1
Mollugo verticillata	35.8	489.5	10	26.4	190.7	31
Panicum obtusum	0.8	11.6	33	3.8	27.2	2
Paspalum sp.	0.0	0.0	0	1.9	13.4	25
Portulaca spp.	28.6	391.0	270	21.4	154.7	201
Schkuhria wislizeni	1.6	21.8	0	2.9	21.0	1
Trichachne californica	0.0	0.5	4	0.0	0.0	0
Unknown E#64	1.2	16.8	0	2.7	19.5	78