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SELECTION OF FORAGING HABITAT BY MOURNING DOVES: A STRUCTURAL APPROACH

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Abstract.—We sought to characterize the foraging habitat of the Mourning Dove (*Zenaida macroura*) by conducting an experiment to determine preferred habitat structure in grassland communities independent of species composition or forage availability. Our manipulations altered grass height, density of grass cover, and coverage of litter. To attract doves, food was added in equal amounts to all plots. We found that doves foraged in manipulated sites significantly more often than in Conservation Reserve Program control sites with an unaltered habitat structure. We concluded that on our study sites doves selected foraging habitat based on grass height and density. Our results suggest that the conversion of wheat fields to grass that has occurred extensively in our study area has resulted in a structural change in habitat that renders it less preferable for foraging by doves.

SELECCIÓN DEL HABITAT DE FORRAGEO POR PARTE DE *ZENAIDA MACROURA:* ENFOQUE ESTRUCTURAL

Sinopsis.—Se trató de caracterizar el habitat de forrajeo de la tórtola *Zenaida macroura* para determinar si estaban limitadas sus áreas de forrageo. Se condujo un experimento para determinar la estructura del habitat preferido en una comunidad de gramíneas, independiente de la composición de especies o disponibilidad de forraje. Mediante manipulación se altero la altura de las yerbas, densidad de estas, cobertura y cobertura de hojarasca. Para atraer a las tórtolas se colocó alimento en iguales cantidades en cada uno de los diferentes tratamientos. Se encontró que las tórtolas forrajearon, significativamente más amenudo, en lugares manipulados que en las áreas controles, en donde la estructura del habitat se mantuvo inalterada. Se concluyó que las tórtolas basaron la selección del habitat de forrajeo, en la altura de las yerbas y en su densidad. Los resultados del trabajo sugieren que la conversión de campos de trigo a yerbasales, lo que ha ocurrido extensamente en el área de estudio, ha resultado en un cambio estructural del habitat que es de menor preferencia para forrajear.

Mourning Doves (*Zenaida macroura*) are distributed from southern

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Canada to Central America (Aldrich 1993). During the 1989 North American Breeding Bird Survey, Mourning Doves occurred on 1254 of 1344 routes, ranking second in frequency of occurrence (Droege and Sauer 1990). As suggested by the survey, Mourning Doves use a wide variety of habitats (Martin and Sauer 1993, Reeves et al. 1993, Tomlinson and Dunks 1993). Lewis (1993) summarized the results of several diet studies and showed Mourning Doves consumed a wide variety of seeds. His results suggested plant species composition of foraging patches varied greatly. Lewis (1993:181) stated that doves foraged where food was "visible or readily accessible in light ground cover." The large number and wide distribution of habitats used by Mourning Doves suggested to us that doves may select habitat based on structure, the arrangement of objects in the environment (McCoy and Bell 1991), rather than plant species composition. Unfortunately, this hypothesis has not been tested. In fact, we were unable to locate studies that specifically described foraging habitat.

Our objective was to determine if Mourning Doves discriminated between habitats with different structural characteristics when food was equally available. If differences in habitat use were observed, we intended to look for differences in the structural variables that distinguished selected from non-selected patches. In grassland habitats similar to our study site, Cody (1968, 1981) found that vegetation height and density were the structural variables segregating the habitats of most grassland birds. Mourning Doves are primarily granivorous ground feeders (Lewis 1993), and litter may interfere with their foraging. To evaluate the importance of ground cover, we included it as a variable.

STUDY AREA AND METHODS

This study was conducted in eastern Millard County, Utah near the community of Fillmore. Average monthly temperatures for July and August were 25.1 C and 24.1 C, respectively (U.S.D.A. Soil Conservation Service [SCS], Fillmore Office, unpubl. data). Major agriculture crops were alfalfa on irrigated fields and wheat on nonirrigated land. Wheat production has decreased greatly over the last 40 years and has been replaced by fallow grasslands due to land enrolled in the U.S.D.A.'s Soil Bank Program, and since 1985, land enrolled in the Conservation Reserve Program (CRP) (U.S.D.A. SCS, Fillmore Office, unpubl. data). CRP fields, planted approximately five years previous, were used as the study sites. Vegetation cover at the CRP and experimental sites was dominated by exotic grasses, common rye (*Secale cereale*) (range 52–98%) followed by tall wheat grass (*Thinopyrum elongatum*) (range 2–48%) (Ostrand 1994). Rye is an annual that is not planted as part of the CRP Program, but rather volunteers into the fields. Together, rye and wheat grass made up nearly 100% of the vegetative cover. Because we were testing structure, composition of fields, although quite similar, was not quantified.

We used a randomized block experimental design (Zar 1984). We located 5 experimental blocks within 80–200 m of features that we knew

TABLE 1. Mean structural characteristics (± SE) for the four treatments located within each experimental block (n = 3). Means within a column sharing a common letter are not significantly different ($P > 0.05$).

Treatment	Grass height (cm)	% bare ground	% standing grass	% litter
Cut	12.4b (2.23)	8c (0.03)	32b (0.08)	60a (0.06)
Cut and Raked	10.4b (2.05)	33b (0.07)	23b (0.09)	44ab (0.01)
Control	32.9a (3.61)	5c (0.02)	55a (0.06)	40b (0.07)
Bare Ground	7.1c (0.51)	62a (0.06)	5c (0.002)	33b (0.06)

attracted Mourning Doves: water, feedpens, or wheat fields. All blocks were ≥1.5 km apart and located on land that was part of the CRP.

Within each block, we established 4 treatment plots. Plots were 10 × 20 m and arranged in an arc to facilitate viewing. All plots within a block were ≥10 m apart. Four treatments (Table 1) were used: all possible organic matter removed (bare ground), mowed grass (12.4 cm in height) with litter not removed (cut), mowed grass with litter removed (cut and raked), and a control in which the vegetation structure was unaltered (control). It was our objective to have significant difference in grass height between the control and all other treatments, less litter and grass cover in the bare-ground treatments, and differences in litter coverage between the cut and the cut and raked treatments. Grass was mowed with a power mower, litter was removed with a hand rake, and the vegetation was removed by scraping the soil. Cut and raked versus cut comparisons were established to determine the influence of the presence of litter on forage site selection. Cut treatments most closely resembled harvested wheat fields and comparison with the control allowed an assessment of whether the replacement of wheat fields with grass had influenced the selection of foraging habitat. Treatments were assigned to experimental plots randomly.

Prior to the experiment, there was little seed available for doves on the ground because the current year seed drop had not occurred. Therefore, at the start of the study we spread 11 kg of millet and 11 kg of wheat over each plot with a hand-crank seed/fertilizer spreader. Grain availability in the plots was then determined (and periodically thereafter) by counting seeds in three randomly placed 10-cm^2 subplots within each plot. When seed density was reduced by 50% across the plots, we spread an additional 11 kg of wheat on each plot. We tried to maintain sufficient seed availability so that the response we observed would be due to structure and not food availability.

We determined mean grass height by randomly selecting 75 points within each plot and measuring the height of the nearest blade of grass. We quantified proportions of ground cover for each plot by randomly selecting 105 points within each plot and recording whether the sites were bare ground, or were covered with litter or standing vegetation. Single factor randomized block analysis of variance (ANOVA) and a Ryan-Einot-Gabriel-Welsch multiple range post-hoc test were performed on data for each structural variable (SAS Inst. Inc. 1988).

We selected a fixed viewing point for each site, 60–80 m from the nearest plot, where the entire block could be observed. Observations were made independently by two individuals from inside the same vehicle to reduce disturbance of birds. We conducted two experimental trials per day beginning at 0730 h. Experimental trials were conducted by observing a block for 30 min and recording the number of birds foraging in each plot. Experimental trials were conducted 5 d/wk for 5 weeks, 7 Jul.–11 Aug. 1993. One week of data collection was lost due to rebaiting. Data were averaged for each of the five observation weeks and analyzed using a randomized block ANOVA with repeated measures, and the Ryan-Einot-Gabriel-Welsch post-hoc test (SAS Inst. Inc. 1988).

RESULTS

One block attracted no doves during the first 3 wk of observation and only a few doves during the last 2 wk; therefore, this block was not included in the analyses. Another block was significantly different ($P <$ 0.10) from the others in grass height, proportion of bare ground, and proportion of litter, and it also was dropped from further analyses. Data on structural variables for the remaining three blocks are given in Table 1. After deletions, 25 trials and 528 dove observations remained in the data set.

Structural variables differed significantly between the control and treatments. Grass height and density was highest in the control followed by the two cut treatments, and least in the bare-ground treatment as intended. The higher percent litter in the cut versus the control showed cutting added litter to the plots. Therefore, our structural manipulations met our objectives.

We found that the number of birds foraging varied among treatments and over time (Fig. 1). The general statistical model for the ANOVA was highly significant ($P = 0.002$). The independent variables, treatment and time were significant ($P = 0.005$ and 0.0002, respectively); the interaction term was not ($P = 0.45$). Mean number of birds per 30 min observation period for cut and raked, bare ground, cut, and the control were 7.68a, 6.64a, 6.64a, and 1.04b birds, respectively (means sharing a common letter were not significantly different at $P < 0.10$).

DISCUSSION

We found a significant relationship between habitat structure and foraging-site selection. Doves discriminated between the control plots versus treatment plots, with less clear differences exhibited among treatments. Our results are consistent with Cody's (1968) observation that vegetation height and density were the structural variables evaluated by grassland birds in resource partitioning. Avoidance of the control plots may be related to the taller and denser grass structure. The probable mechanisms include a higher predation risk resulting from an impaired ability to take

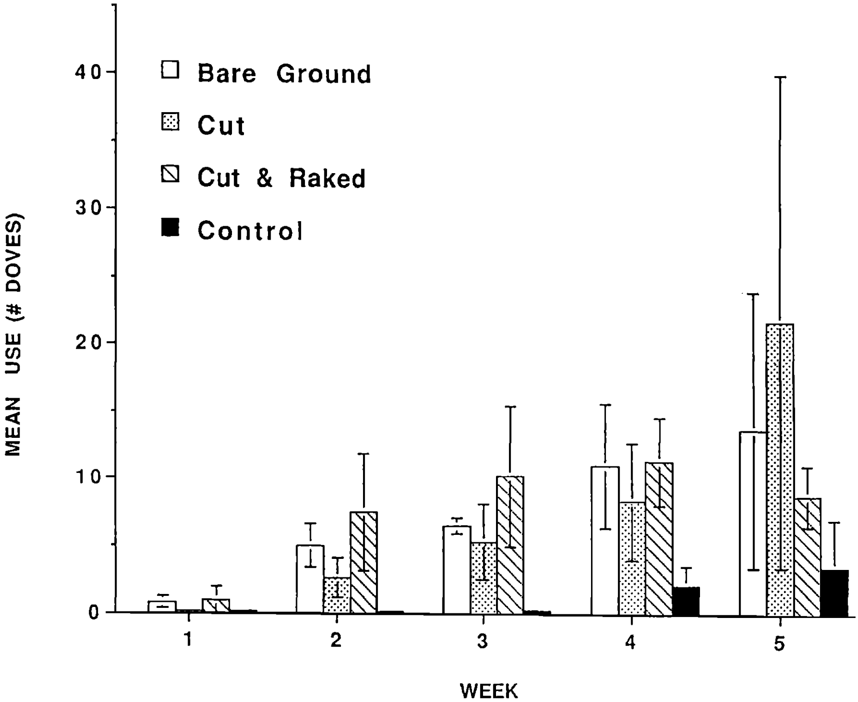

FIGURE 1. Differential use of treatments by doves over 5 weeks. Bars indicate the weekly mean number of doves visiting each treatment. The error bars represent one standard error.

wing due to the grass canopy, and interference with food detection and collection.

Our data suggest doves were selecting cut and raked treatment plots over the other treatment plots. Preference for the cut and raked plots may indicate a trade-off between perceived predation risk associated with structure and the enhancement or constraint of foraging due to structure. When we observed foraging in these plots, we noted doves were harder to detect in the cut and raked plots than in the other plots. Coloration, black spots on a slate grey background, was cryptic when contrasted with bare soil and scattered vegetation of the cut and raked plots. This suggests that doves may select plots based, in part, by their need to reduce risk from avian predators.

In our study area, most wheat fields have been replaced with fallow grasslands which we used as the control in our experiment. Our treatments, particularly the cut plots, structurally resembled harvested wheat fields while our cut and raked plots resembled harvested wheat fields after the wheat straw had been baled, a common practice in the western United States. Our manipulation showed that doves selected habitats with shorter and less dense vegetation. These results suggest that conversion of wheat fields to grass and the resulting change in habitat structures renders it less suitable for foraging by doves. CRP fields were not mowed, sprayed, burned, or grazed. Typically the land remains fallow for an extended period of years. Mowing after seedfall could improve the fields for doves. Meyers (1995) found that Rocky Mountain bee weed (*Cleome serrulata*) contained protein levels two times higher than wheat; however, bee weed had declined significantly in distribution on our site between 1952 to 1994. Re-establishment of bee weed on CRP lands that are mowed periodically could improve the habitat for doves. This conclusion is supported by observational data on very low incidence of foraging (Ostrand 1994) and nesting (Meyers 1995) on CRP land. Hence doves appear to be an avian species negatively impacted by the conversion of cultivated wheat fields into grasslands. Overall, we believe a structural approach will enable biologists to model more accurately Mourning Dove foraging habitat and facilitate dove management.

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