SUMMERTIME ACTIVITY BUDGETS OF HATCHING-YEAR MOURNING DOVES

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ABSTRACT.—We studied activity budgets of hatching-year Mourning Doves (*Zenaida macroura*) in northern Alabama in August and September 1986, and from July to mid-September 1987. We divided observations among four time blocks (three diurnal, one nocturnal) and six habitats during nonhunting and hunting seasons. Hatching-year Mourning Doves spent an average of 24% of the time alert, 23% preening, 21% resting, 20% feeding, 13% traveling, and <1% in agonistic activities. Feeding, resting, and agonistic activities did not change ($P > 0.05$) between years or seasons, but varied ($P < 0.05$) among diurnal time blocks. Locomotor and alert activities differed ($P < 0.05$) between years and seasons (in 1987), but did not differ ($P > 0.05$) among diurnal time blocks. Preening activity varied ($P < 0.05$) between years, between seasons, and among time blocks (in 1987). Resting was the major (87%) nocturnal activity. Feeding activities were concentrated in upland agricultural fields. The daily activity patterns of hatching-year Mourning Doves centered around feeding, roosting, and loafing areas that minimized energy expenditures and predation risks. *Received 22 February 1989, accepted 26 June 1989.*

MOURNING Doves (*Zenaida macroura*) are among the most abundant migratory land birds in the United States with a postbreeding population of ca. 500 million (Keeler 1977). Although ecological and behavioral information on Mourning Doves is extensive (see Westmoreland et al. 1986), activity budget data are lacking. Previous studies of Mourning Dove activities were based on roadside surveys (Duever and Fatora 1968), on limited observations of color-marked birds (Webb 1949, Jackson and Baskett 1964, Lewis et al. 1982), or on general observations of radio-tagged birds (Sayre et al. 1980). Because those studies were not designed specifically to measure daily activity budgets, subtle differences in activities may have been overlooked.

An understanding of the behavioral ecology of hatching-year (HY) Mourning Doves is important because they comprise up to 86% of the total dove population each year (Tomlinson et al. 1988), and they experience much higher natural and hunting mortality rates than after-hatching-year Mourning Doves (Hayne 1975, Hayne and Geissler 1977, Dunks et al. 1982, Tomlinson et al. 1988). We studied the effects of year, time of day, habitat use, and hunting season on activity budgets of HY Mourning Doves in northern Alabama during the late summer.

MATERIALS AND METHODS

Study area.—We conducted the study on the 2,545-ha Swan Creek Wildlife Management Area (SCWMA), the 13,970-ha Wheeler National Wildlife Refuge (WNWR), and surrounding areas in Limestone and Morgan counties, Alabama. Major terrestrial cover types on the study area included bottomland hardwood stands of oak (*Quercus* spp.) and hickory (*Carya* spp.), upland pine (*Pinus* spp.) plantations, and crop and pasture lands (Thompson 1986). Most cropland was planted in cotton, with the remainder in corn, soybeans, wheat, or milo. We chose these sites because they support abundant Mourning Dove populations.

Radiotelemetry.—We captured Mourning Doves from July through mid-September (1986–1987) using modified Kniffen funnel traps (Reeves et al. 1968) baited with milo, corn, or wheat. Each bird was sexed and aged (Reeves et al. 1968), marked with a USFWS aluminum leg band or radio transmitter, and released. We attached radio transmitters (2.4 g) to 129 hatching-year doves (37 in 1986, 92 in 1987) according to Sayre et al. (1980). We located flocks from the ground using hand-held Yagi antennae, and from light aircraft (Cessna 151 or 172) with 4-element Yagis attached to

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each wing strut (Gilmer et al. 1981). We used radio-instrumented individuals to lead us to dove flocks (>2 birds), but not to collect data.

Sampling diurnal activities.—We sampled flocks 4–7 days/week during August and September 1986, and from July through mid-September 1987. Diurnal observations were divided among three time blocks (0–3.5 h after sunrise [morning], 3.5 h after sunrise to 3.5 h before sunset [midday], 3.5–0 h before sunset [evening]); between nonhunting (July–August) and hunting (September) seasons; and among six habitats (forest, hedgerow, lone tree/tree clump, upland field, wetland, and residential). We observed doves from a truck cab with a 15–60× spotting scope, and sampled 111 flocks (66 h) in 1986 and 198 flocks (157 h) in 1987.

Following a modification of Hailman (1985), we categorized and defined activities as the following: (1) *feeding*—foraging acts directly associated with food, grit, and water intake; (2) *resting*—static postures associated with loafing and sleeping; (3) *preening*—preening of feathers and general comfort movements; (4) *locomotor*—spatial movements indirectly associated with other activities; (5) *alert*—nervous, jerky head movements and pauses that interrupt other activities, alert postures, preflight crouch; and (6) *agonistic*—physical interactions associated with threatening, fighting, and fleeing. We classified activities as 48 mutually exclusive subbehaviors in the field (Table 1).

We selected for the first sample the most readily visible flock member closest to, and using the same habitat as, the radioed bird (Altmann 1974). We used a tape recorder as a metronome (Paulus 1984) and sampled activities instantaneously every 20 s (Altmann 1974) for 5 min per focal bird. If the focal bird disappeared from view before 5 min, we switched to a new focal bird (nearest neighbor) from the same habitat as the out-of-view individual (Losito et al. 1989).

To account for behavioral variation among flock members using different habitats, we used a habitat-use weighting factor (Losito et al. 1989) to dictate the number of focal birds sampled from different habitats. In the analysis of habitat effects, we used only samples where all flock members used a single habitat type.

We attempted to sample flocks for 1 h during each time block. We consistently allowed 10 min to search for new focal birds after all visible members of a sample flock were sampled, or if they departed before the sampling period ended (standard wait period; Losito et al. 1989).

Sampling nocturnal activities.—We sampled nocturnal activities from 2 h after sunset to 2 h before sunrise during August and September 1987. We located roosting individuals by spotlight (Hitchcock and Mirarchi 1986) or flashlight. Immediately after the birds were located, we sampled them using a tripod-mounted 2× night-vision scope aided by infrared light.

TABLE 1. Activity categories and subbehaviors of hatching-year Mourning Doves in northern Alabama (August–September 1986 and July–September 1987).

Activity	Subbehavior
Feeding	Search
	Procure/handle food, grit
	Drink
	Peck bark
Resting[a]	Loaf, sleep
Preening	Preen[b]
	Scratch
	Stretch
	Flap wings
	Shake feathers, head
	Shift body
	Bathe
	Whet bill
	Yawn
Locomotor	Fly
	Walk on perch, ground
	Run, jump
Alert	Alert posture
	Neck extension, twitch
	Head bob, pump, tilt
	Pause
	Pre-flight crouch
Agonistic	Attack-charge, attack-flight
	Physical contact
	Threat display

[a] On perch (canopy, no canopy) and on ground (canopy, no canopy).
[b] Wing, breast, back, tail, rump, neck, crissum, flank, and foot.

Sampling procedures followed those of diurnal sampling except that individual samples were reduced to 20 min, and samples were not restricted to flock members of radio-marked individuals because of difficulty in observing birds. We sampled only 24 doves (8 h), so seasonal and habitat comparisons were not feasible; all nocturnal data were pooled.

Statistics.—We analyzed the data using the Statistical Analysis System (SAS Institute Inc. 1985). We calculated activity percentages for each sample flock by dividing the number of instantaneous recordings of each behavior by the total number of instantaneous recordings (Quinlan and Baldassarre 1984). We angular-transformed the percentage data (Steel and Torrie 1980: 236) and weighted by time of observation for analysis (Baldassarre et al. 1987). Data presented in tables and figures are actual percentages.

We compared each activity between years, and between nonhunting and hunting seasons within years, using *t*-tests. We used one-way analysis of variance (ANOVA) to compare each activity among time blocks within yearly seasons (hunting vs. nonhunting), and among habitats (years, seasons, and time blocks pooled). We used Tukey's studentized range tests to separate means where appropriate. We also used *t*-tests to compare diurnal time spent resting on perch vs.

TABLE 2. Mean percentage of diurnal time spent in activities by hatching-year Mourning Doves in northern Alabama (August–September 1986 and July–September 1987). Number of flocks sampled is in parentheses.

	1986 season			1987 season		
Activity	Nonhunting (70)	Hunting (41)	Both (111)	Nonhunting (146)	Hunting (52)	Both (198)
Feeding	19.7	18.0	19.1	21.9	14.8	20.0
Resting	24.9	24.1	24.6	20.1	17.4	19.4
Preening	19.0	15.4	17.6*	22.2**	30.1**	24.3*
Locomotor	19.4	23.0	20.6*	11.1**	5.4**	9.6*
Alert	16.7	19.4	17.6*	24.4**	32.3**	26.5*
Agonistic	0.3	0.2	0.3	0.3	0.1	0.3

* Differ ($P < 0.05$) between years.
** Differ ($P < 0.05$) between seasons.

ground sites and canopy vs. noncanopy sites, diurnal time spent traveling on perch vs. ground sites, and nocturnal time spent awake vs. asleep. We tested all comparisons at $P < 0.05$.

We transformed (square root) flock size estimates (Steel and Torrie 1980: 234), and used Pearson's correlation coefficients (r) to examine the relationship of flock size to each activity.

RESULTS

Feeding.—Hatching-year Mourning Doves spent an average of 20% of their diurnal time feeding, which did not vary ($P > 0.05$) between years or between nonhunting and hunting seasons within years (Table 2). Feeding activity varied ($P < 0.05$) among daylight hours, and was higher in the morning (11–27%) and evening (17–35%) than at midday (5–9%, Fig. 1). Birds did not feed at night. Each year, feeding was correlated positively ($r = 0.25, 0.49$; $n = 139, 217$; $P < 0.01, P < 0.001$, respectively) with flock size.

Most feeding time (1986, 1987) was spent searching (37%, 47%), and handling/procuring food (53%, 38%) or grit (9%, 6%); drinking was observed rarely (1%, <1%). We usually observed hatching-year doves drinking from temporary pools on dirt roads, where visibility was not restricted by ground vegetation. Consequently, we may have underestimated drinking frequency.

Hatching-year (HY) doves fed most often ($P < 0.05$) in upland fields (Table 3). When feeding there, they foraged on the ground and up to 30 cm above the ground, by climbing stems of plants to reach seed heads or by felling (i.e. walking over or knocking down with one foot) herbaceous plants. We observed foraging in the trees only twice. All feeding activity in forests occurred on the floor of a small (<2 ha) loblolly pine (*P. taeda*)–southern red oak (*Q. falcata*) stand that was prescribe-burned the previous winter. In wetlands, HYs fed on freshwater mudflats, where they often consumed pigweed seeds (*Amaranthus hybridus*; D. White pers. comm.). In residential areas, HYs fed on lawns around homes where they probably ate grass and forb seeds.

Resting.—Hatching-year Mourning Doves spent an average of 21% of their diurnal time resting, which did not vary ($P > 0.05$) between years or between nonhunting and hunting seasons within years (Table 2). Resting activity varied ($P < 0.05$) among times of day, and it always peaked (20–38%) at midday (Fig. 1). Loafing (1986, 1987) was the major diurnal resting activity (97%, 97%), but we rarely (3%, 3%) observed HYs sleeping. Flock size was not correlated ($P > 0.01$) with resting activity. After feeding, HY flocks often flew to perching habitats (e.g. hedgerows) and rested in small groups.

At night, HY Mourning Doves spent most of their time resting (87%). Nocturnal resting activity was distributed more equally among loafing (61%) and sleeping (39%) than diurnal resting activity. At night, birds spent similar ($P > 0.05$) amounts of time awake as asleep.

Diurnal resting activity usually was greatest ($P < 0.05$) in hedgerows and lone trees/tree clumps (Table 3). Birds rested more ($P < 0.05$) on perch (76%) than on ground sites (24%), and more in noncanopy (60%) than in canopy sites (40%). HYs rested more ($P < 0.05$) in noncanopy than in canopy sites in morning (64%, 36%, respectively) and evening (70%, 30%, respectively), and more in canopy (56%) than noncanopy (44%) sites at midday.

Preening.—Overall, HY Mourning Doves spent

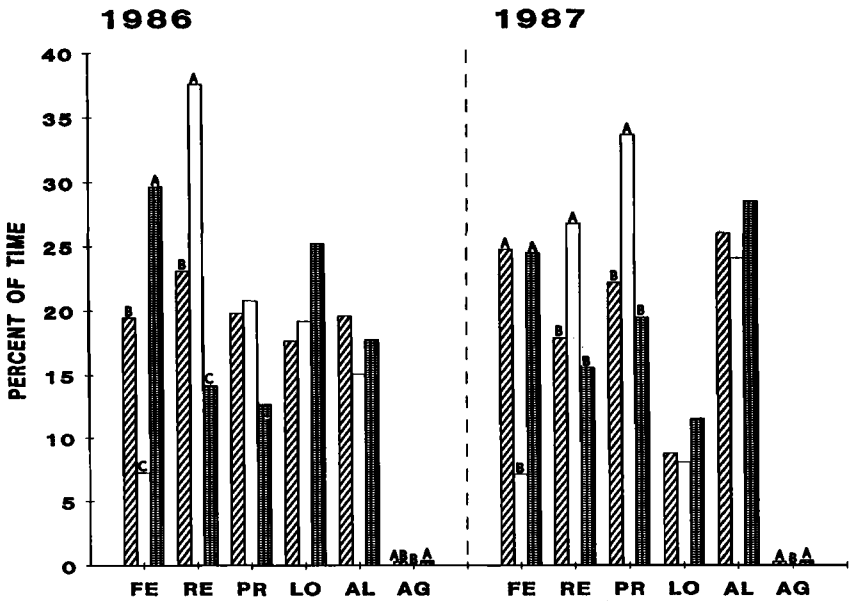

Fig. 1. Diurnal activities of hatching-year Mourning Doves in northern Alabama (August–September 1986 and July–September 1987). For each activity, comparisons among time blocks within years are different ($P < 0.05$) when letters above histobars differ. Histobars with diagonal lines = time block 1 (morning); open = 2 (midday); checkered = 3 (evening). FE = feeding, RE = resting, PR = preening, LO = locomotor, AL = alert, and AG = agonistic. Number of flocks sampled (1986, 1987) for time block 1 = 41, 74; time block 2 = 36, 57; time block 3 = 34, 67.

23% of their diurnal time preening, which varied ($P < 0.05$) between years (18% in 1986 and 24% in 1987). Preening made up only 6% of the nocturnal activity budget.

In 1986, preening activity was similar ($P > 0.05$) between seasons, but HYs spent more time ($P < 0.05$) preening during the hunting than nonhunting season in 1987 (Table 2). In 1986, preening was similar ($P > 0.05$) among the daylight hours. In 1987, HYs allocated more ($P < 0.05$) time for preening at midday than other times (Fig. 1). Time spent preening was generally high ($P < 0.05$) in all habitats, except upland fields (Table 3).

During both years (1986, 1987), the wings (40%, 31%), breast (25%, 26%), and back (10%, 13%) were body parts most often preened, followed by the tail (8%, 4%), neck (5%, 7%), flanks (5%, 5%), rump (6%, 3%), and feet (<1% each year). The most frequent comfort movements were body shifting (3%, 5%), scratching (3%, 6%), stretching (3%, 3%), feather shaking (2%, 2%), and wing-flapping (<1%, 2%).

Locomotor.—Hatching-year Mourning Doves

TABLE 3. Mean percentage of diurnal time[a] spent in various activities by hatching-year Mourning Doves in different habitats in northern Alabama (August–September 1986 and July–September 1987). The number of flocks is in parentheses.

Habitat type	Activity					
	Feeding	Resting	Preening	Locomotor	Alert	Agonistic
Forest (29)	3.0C	26.9B	37.8A	5.6B	23.8A	0.3B
Hedgerow (22)	0.4C	33.4AB	26.4B	8.1B	26.8A	0.2B
Lone tree/tree clump (9)	0.8C	36.9A	40.5A	4.8B	17.1A	0.1B
Upland field (35)	40.6A	13.8C	11.1C	14.1A	19.5A	0.9A
Wetland (26)	1.7C	20.1C	27.0B	5.6B	22.2A	0.1B
Residential (48)	25.7B	14.5C	22.6B	9.5AB	27.6A	0.3B

[a] Means followed by different letters within columns differ ($P < 0.05$).

spent 13% of their diurnal time in locomotor activities. These activities were lower ($P < 0.05$) in 1987 than in 1986. In 1986, time allocated to these activities did not change ($P > 0.05$) between seasons. In 1987, however, HYs spent less time ($P < 0.05$) traveling during the hunting than nonhunting season (Table 2). Locomotion did not occur during nocturnal hours unless the birds were disturbed.

Locomotion (1986, 1987) consisted mostly of flying (61%, 62%) and walking (35%, 31%); jumping (3%, 5%) and running (3%, 2%) were infrequent. Locomotor activity was highest ($P < 0.05$) in upland fields and residential areas (Table 3). Birds spent more time ($P < 0.05$) walking on the ground (77%) than on perch sites. Traveling times by HY Mourning Doves were similar ($P > 0.05$) among times of day (Fig. 1), and were not correlated ($P > 0.01$) with flock size.

Alert.—Hatching-year Mourning Doves averaged 24% of diurnal time in alert activities. These activities were higher ($P < 0.05$) in 1987 than in 1986. In 1986, time allocated to these activities did not change ($P > 0.05$) between seasons; in 1987, however, HYs spent more ($P < 0.05$) time alert during the hunting than nonhunting season (Table 2). Alert activity made up 7% of the nocturnal time budget.

Hatching-year Mourning Doves were equally alert ($P > 0.05$) at all times of day (Fig. 1), and in all habitats (Table 3). Each year, alert activity was correlated positively ($r = 0.25, 0.27$; $n = 139, 217$; $P < 0.01, 0.001$, respectively) with flock size. Hatching-year Mourning Doves appeared to be influenced by activities of conspecifics. For example, regardless of activity, when one individual became alert, neighboring individuals also became alert. After resuming their previous activity, this process usually was repeated when another individual became alert.

Diurnal alert (1986, 1987) activity was mostly neck-twitching (38%, 27%), alert posture (23%, 24%), pausing (14%, 25%), and neck-stretching (16%, 11%) followed by head-tilting (3%, 7%), head pumping (3%, 3%), head bobbing (1%, 2%), and pre-flight crouch (3%, 1%). Hatching-year Mourning Doves spent similar ($P > 0.05$) amounts of time alert at all times of day (Fig. 1), and in all habitats.

Agonistic.—Agonistic activity made up <1% of the time budget and remained similar ($P > 0.05$) between years, and between nonhunting and hunting seasons each year (Table 2). Agonistic activity generally was highest ($P < 0.05$) in the morning and evening (Fig. 1), and was not observed during nocturnal hours. Flock size was not correlated ($P > 0.01$) with time spent in agonistic activity. Agonistic interactions occurred mostly in upland fields (Table 3). Most agonistic interactions (1986, 1987) were intraspecific (92%, 86%) and usually consisted of threat displays (63%, 33%) or charging (24%, 47%). Hatching-year Mourning Doves infrequently made physical contact (8%, 9%).

Overview.—Hatching-year Mourning Doves alternated periods of sedentary activities (resting, preening, alert) and mobile activities (feeding, locomotor, agonistic) within the 24-h period. After resting most of the night, HY Mourning Doves fed during the morning, rested and preened at midday, and fed again in the evening before going to roost around sunset.

Each year (1986, 1987), combined diurnal time spent by HY Mourning Doves resting, preening, and alert (60%, 70%) was greater than combined time allocated to feeding, locomotor, and agonistic activities (40%, 30%). Because they were sedentary at night 100% of time (from the 1987 data), HY Mourning Doves were basically immobile for most (84%) of the diel period.

DISCUSSION

Upland agricultural fields, where HY Mourning Doves fed, are scattered, dynamic habitats that are unpredictable in terms of food abundance and availability. Hence, the birds rely primarily upon flight to locate new food sources when local areas become unprofitable. This is reflected in their large daily movements (Sayre et al. 1980, Howe and Flake 1988, Losito 1988), and in the dominant sedentary aspects (60–84%) of their activity budget. The birds rest for long periods, presumably to conserve energy needed for the high energetic costs of flight. They preen extensively to maintain a clean, functional plumage that maximizes flight efficiency, and they remain alert to reduce predation risks.

Alert activity never fluctuated more than 11% between time periods and habitats; and it was one of the few activities observed at night, which suggests that losses to predators are heavy. In east-central Alabama, 36–86% of Mourning Dove mortality is due to predation; avian predation predominates (Carrington and Mirarchi 1989). Avian predators (American Kestrel, *Falco sparverius*; Cooper's Hawk, *Accipiter cooperii*; Sharp-shinned Hawk, *A. striatus*) of Mourning Doves

were abundant on the study area, although we witnessed only one predation attempt.

Of all habitats used, HY Mourning Doves probably are most susceptible to avian predation in upland fields because of the conspicuousness of feeding flocks in habitats with minimal overhead cover. Therefore, selection should favor individuals that can fulfill their dietary requirements in the least amount of time (i.e. minimize exposure to predators). We found that Mourning Doves spent less time feeding than in most other activities because they generally consumed high-energy, readily metabolized foods (Schmid 1965, Shuman et al. 1988) that were abundant and readily available on the study area.

Only preening, locomotor, and alert activities varied annually, and they appeared to be interrelated. The major decrease in locomotion in 1987 (i.e. 50%) could have reflected differences in habitat use between years. For example, more of the flocks sampled used the areas managed to attract doves in 1987 than 1986. Because all five nonresidential habitats classified in this study were in close proximity on the managed areas, travel between habitats may have been lower in 1987 than 1986, which allowed more time for preening and alert activities.

The direct positive correlations of feeding activity with flock size were consistent with flocking theory, where foraging rates of solitary individuals generally are lower than those of flocking individuals (Murton 1971, Pulliam and Caraco 1984). In contrast, the positive correlation of alert activity with flock size contradicted flocking theory. In large flocks, the prediction is that each individual should reduce time spent in alert activity while feeding, increase feeding activity, and still receive adequate predator forewarning (Pulliam and Caraco 1984). However, individuals on the periphery of Rock Dove (*Columba livia*) flocks spend more time in alert activity than central individuals (Phelan 1987). Because we did not consider flock structure dynamics in our study, we may have biased our selection of focal birds by choosing individuals on the periphery of the flock compared with the less observable central individuals. This could have overestimated alert activity during feeding times.

Overall, differences in preening, alert, and locomotor activities between hunting and nonhunting seasons were inconsistent from year to year. Hatching-year doves always maintained nonhunting season feeding and resting levels during the hunting season. We believe that September hunting of HY Mourning Doves in northern Alabama has minimal effects on their behavioral ecology.

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