Effects of Seed Weathering on Food Selection by Mourning Doves

Steven E. Hayslette,[1] *School of Forestry and Wildlife Sciences, 108 M. White Smith Hall, Auburn University, AL 36849-5418*

Ralph E. Mirarchi, *School of Forestry and Wildlife Sciences, 108 M. White Smith Hall, Auburn University, AL 36849-5418*

Abstract: Changes in seed nutrient content during field weathering may have important effects on food selection by mourning doves (*Zenaida macroura,* hereafter 'doves') and other granivorous wildlife. We documented changes in food selection by mourning doves with seed weathering, and we compared patterns of seed preference pre- and post-weathering with seed deterioration rates documented in an earlier-published study. Doves selected white proso millet over all other species among fresh seeds, but selected broadleaf signalgrass *(Brachiaria platyphylla)* over most others among weathered seeds. Results generally confirmed shifting food preferences of doves from cultivated to wild foods with seed weathering. These shifts in preference seem to be based on differential deterioration rates among seed types; selection among weathered seeds seems to favor those most resistant to mass loss. Deterioration-resistant wild seeds may be important in sustaining mourning dove populations during non-growing periods, and establishment or encouragement of wild seeds may increase the long-term use and benefits of dove food plantings.

Key words: deterioration, food preference, seed, weathering, *Zenaida macroura*

Proc. Annu. Conf. Southeast. Assoc. Fish. And Wildl. Agencies 57:192–199

Seed weathering and associated deterioration may be an important consideration in the management of food sources for mourning doves and other granivorous wildlife. Our earlier work has indicated that nutrient content is an important determinant of food selection in mourning doves (Hayslette and Mirarchi 2001), and that nutrient levels in important mourning dove foods change with weathering under terrestrial field conditions (Hayslette and Mirarchi 2002). If so, then nutritional changes with seed weathering may cause changes in dove food preferences and, hence, values of various seed types to the species over time. Seed deterioration rate, as indexed by mass loss, has been documented in select game bird foods (Neely 1956, Shearer et al. 1969, Preacher 1978, Nelms and Twedt 1996, Hayslette and Mirarchi 2002), and a positive linear relationship between seed mass loss and loss of important nutrients has been established (Hayslette and Mirarchi 2002). Deterioration studies generally have indicated that seeds of cultivated species deteriorate more rapidly than seeds of

1. Present address: Department of Biology, Tennessee Tech University, Box 5063, Cookeville, TN 38505

wild species, leading us to suggest that the long-term benefits to wildlife of wild seeds may be greater than the benefits of cultivated crops (Hayslette and Mirarchi 2002). Dillon (1961) reported that few weathered seeds of agricultural crops were found in dove crops, while weathered seeds of wild species commonly were found there. However, in the only controlled study examining the effects of seed weathering on wildlife food selection, shifts in food preferences of northern bobwhites *(Colinus virginianus)* with seed weathering did not clearly favor slower-deteriorating wild seeds (Preacher 1978). Because the relationship between seed deterioration and food selection by mourning doves and other granivorous wildlife is poorly studied, the actual benefits of wild versus cultivated seeds for these species are unknown.

Mourning doves are among the most popular and economically important game birds in the United States (Baskett and Sayre 1993). Food plantings are an important component of habitat management for mourning doves in the southeastern United States and elsewhere (Baskett 1993). Effective and cost-efficient management of food sources for doves and other granivorous species, however, requires information regarding factors affecting the use and value of these food sources through time. Our goals were to document changes in dove food selection patterns caused by seed weathering, and to test the hypothesis that these foraging changes were based on differential deterioration rates among different seed types. Mourning doves generally select agricultural grains over wild seeds when fresh (Hayslette and Mirarchi 2001). We predicted that preferences of doves would shift with weathering in favor of slower-deteriorating wild seeds.

Methods

This study was conducted at the North Auburn Research Unit of the Alabama Agricultural Experiment Station (AAES) during September–December 1997 and 1998. We used seeds of species commonly cultivated as mourning dove foods and seeds of wild species commonly eaten by doves in Alabama. Browntop millet, corn, white proso millet, broadleaf signalgrass, common ragweed *(Ambrosia artemisiifolia),* and yellow bristlegrass *(Setaria lutescens)* were used during the first year; sunflower, milo, and common barnyardgrass *(Echinochloa crusgalli)* replaced corn, browntop millet, and common ragweed in the second year.

We subjected three 2,000-cm^3 samples of seeds of each of the six species studied each year to weathering for 66 days beginning 26 September 1997 and 24 September 1998. Each sample was placed in a 1.8- $\times$ 0.9- $\times$ 0.6-m exclosure made of 3.8- $\times$ 1.9-cm wooden strips covered in 1.3-cm hardware cloth (top and sides) and 1-mm fiberglass mesh (bottom). One exclosure of each seed type was placed in each of three randomly selected-locations on bare ground in an open field such that the mesh bottom of each box rested on bare soil. Seeds were spread evenly in a single layer over the mesh bottom of the compartment. We removed samples from exclosures following the weathering period each year and air-dried them 96 h at room temperature. We hand-removed germinated and otherwise physically damaged seeds and combined the three samples of each seed for use in feeding trials.

We documented selection by mourning doves among fresh and weathered seeds in a captive setting at the Auburn University mourning dove research facility during 5–18 December 1997 and 10–24 December 1998. Each year we used immature doves captured during the previous breeding season on the Auburn University campus, and initially housed and maintained following Mirarchi (1993). Doves were housed individually in outdoor pens (2.4 × 1.8 × 1.8 m) throughout this study and maintained on a standard pelleted pigeon ration during all trial and non-trial periods. Water and grit were provided ad libitum in each pen during all trial and non-trial periods.

Three feeding trials were conducted each year. During the first four days of study, 2 independent preliminary trials determined preferences of doves among seeds of wild and cultivated species separately. Each cultivated and wild seed trial used eight different doves in two 2-day trial periods. Four randomly-selected doves received fresh seeds during the first 2-day trial and four received deteriorated foods. Seed type (fresh or deteriorated) was switched for each dove during the second 2-day trial period. At the beginning of each 2-day trial period, we offered 200 cm^3 (known mass) of each food to each dove in a separate, randomly-selected compartment of a 4-compartment feeder. Spilled material was caught in trays made of wooden sides covered by hardware cloth (top) and 1-mm fiberglass mesh screen (bottom) placed under feeders. Control feeders in unoccupied pens were used to estimate seed mass gain or loss due to moisture absorption or evaporation. After two days, we collected remaining seeds of each species and determined their masses, adjusted for changes in moisture by dividing mass of remaining material by the mean ($N = 3$) final mass:original mass ratio from unoccupied pens, and calculated consumption of seeds of each species by subtraction. Following the two preliminary trials and a one- (1997) or two- (1998) day non-trial period, a third combined trial included the two most-preferred cultivated and wild species from preliminary trials. Lack of deteriorated white proso millet prevented its inclusion in the 1998 combined trial. Combined seed trials used 10 different doves and four two-day trial periods. Five randomly-selected doves received fresh seeds during the first two-day period, and five received weathered seeds; seed type (fresh or deteriorated) alternated for each dove in successive trial periods.

We analyzed data separately by year and trial (cultivated seed, wild seed, and combined). We compared seed consumption among species and state (fresh or deteriorated) using split-plot ANOVA, with state as whole plot and species as subplot factors, and Tukey's procedure. The crossover whole-plot design was analyzed without carryover effects (Kuehl 1994). Seed consumption was pooled by species and state across two-day periods for each dove in combined trials, and the resulting four-day consumption totals were analyzed. We used the Statistical Analysis System (SAS 1989) and $\alpha = 0.05$ for all analyses.

Results

Differences in seed consumption among species varied markedly between seeds in fresh and deteriorated states (species × state interaction) during cultivated seed

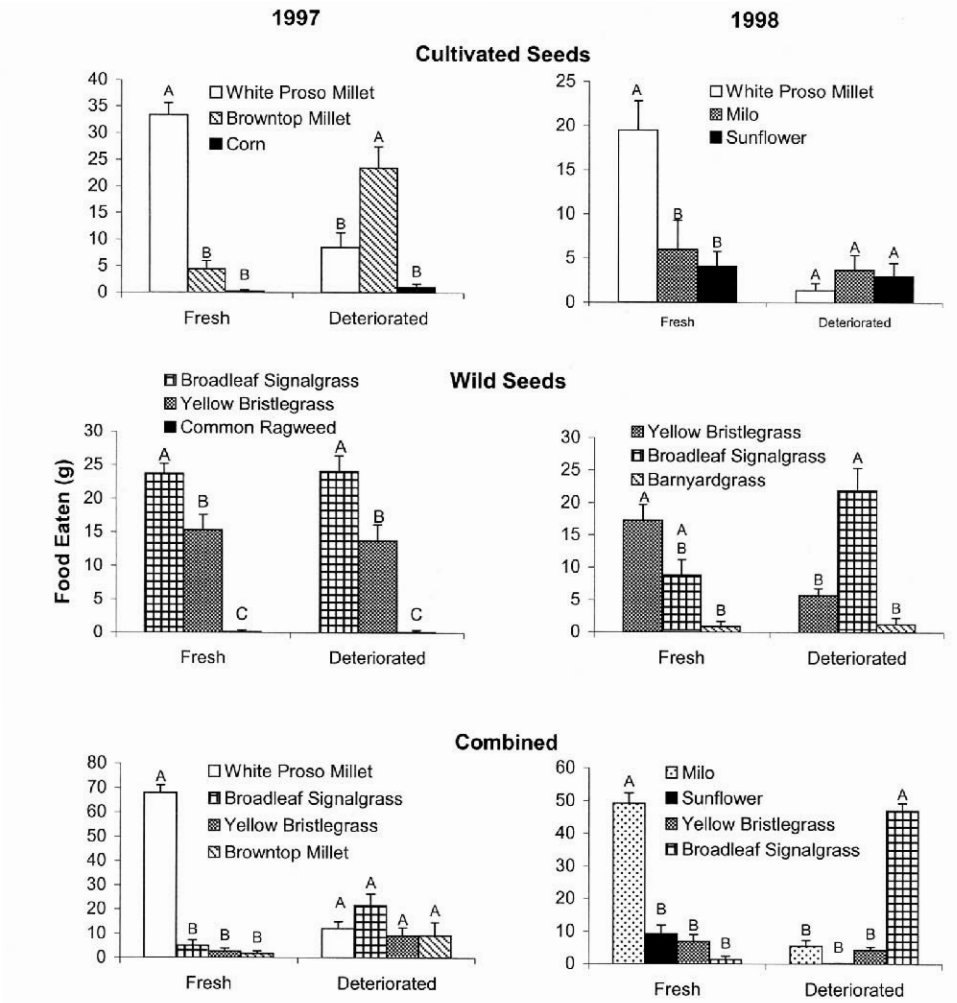

Figure 1. Masses of fresh and deteriorated (weathered) seeds eaten by captive mourning doves during two-day (cultivated and wild) or four-day (combined) periods, east-central Alabama, December 1997 and 1998. Error bars are ± 1 SE. Bars within year/state groups with the same letters represent values that do not differ ($P > 0.05$) using Tukey's procedure.

($F_{2,28} = 31.9$, $P < 0.001$) and combined ($F_{3,54} = 39.3$, $P < 0.001$) trials in 1997, and during cultivated seed ($F_{2,28} = 6.3$, $P = 0.006$), wild seed ($F_{2,28} = 13.2$, $P < 0.001$), and combined ($F_{3,54} = 137.2$, $P < 0.001$) trials in 1998 (Fig. 1). Consumption of wild seeds varied among species in 1997 (species main effect: $F_{2,28} = 71.6$, $P < 0.001$; Fig. 1). In 1997, fresh white proso millet was selected over fresh browntop millet, corn, broadleaf signalgrass, and yellow bristlegrass. After deterioration, browntop

millet was selected over white proso millet and corn in the cultivated seed trial, but no preference was indicated among white proso millet, browntop millet, broadleaf signalgrass, and yellow bristlegrass in the combined trial. Broadleaf signalgrass was selected over yellow bristlegrass and common ragweed, and yellow bristlegrass was selected over common ragweed in both fresh and deteriorated states. In 1998, among fresh foods, white proso millet was preferred to milo and sunflower; milo was preferred to sunflower, yellow bristlegrass and broadleaf signalgrass; and yellow bristlegrass was preferred to common barnyardgrass. However, among deteriorated foods, doves indicated no preference among white proso millet, milo, and sunflower; broadleaf signalgrass was preferred to milo, sunflower, yellow bristlegrass, and barnyardgrass; and doves showed no preference between yellow bristlegrass and barnyard grass.

Discussion

Our results confirmed that under captive conditions, strong preferences of mourning doves for seeds of agricultural crops such as white proso millet change with seed weathering, and may shift to selection for more durable wild seeds. Doves selected white proso millet over all other species whenever it was offered in fresh seed trials, but never selected it over other species in deteriorated seed trials. Broadleaf signalgrass, on the other hand, was selected over others in only one of four fresh seed trials in which it was offered, but was selected in three of four deteriorated seed trials. In only one instance (1997 wild seed trial) was seed selection similar among fresh and deteriorated seeds; doves selected broadleaf signalgrass over all other species among both fresh and weathered seeds in this case. Strong selection by doves for white proso millet among fresh seeds has been reported earlier (Hayslette and Mirarchi 2001). Our results also support the earlier observation by Dillon (1961) that doves consume weathered wild seeds but few seeds of weathered agricultural crops. The food selection shifts that we documented appear more dramatic than those observed by Preacher (1978), however. In the earlier study, although weathering clearly reduced preferences of northern bobwhites for four species, three of which were cultivated, sorghum was most preferred among both fresh and weathered (60 days) seeds of 35 species. Additionally, eight of the 10 most-preferred species among fresh seeds remained among the 10 most-preferred species after 60 days of deterioration; six of these eight were cultivated species. Stronger shifts in selection patterns following weathering in our study may have been due to differences in the extent of seed deterioration (Hayslette and Mirarchi 2002). Mass loss (deterioration) rates of the seed types used here during weathering were established during a second study conducted concurrently at the same location using the same methods (Hayslette and Mirarchi 2002). This second study documented more rapid deterioration of some seeds, notably white proso millet, than Preacher (1978) experienced.

When considered in conjunction with results of our concurrent seed deterioration rate study (Hayslette and Mirarchi 2002), shifts in dove food preferences with weathering to favor broadleaf signalgrass support the hypothesis that preference

changes were related to differential deterioration rates of seeds. Of the six seed types used in feeding trials, broadleaf signalgrass deteriorated least in both 1997 and 1998. White proso millet, in contrast, was among the two most rapidly-deteriorating seed types in 1998, although deterioration of white proso millet in 1997 could not be estimated due to extensive germination during weathering (Hayslette and Mirarchi 2002).

If seed weathering causes a shift in food preferences toward seeds that deteriorate least rapidly, selection among weathered seeds in some trials remains to be explained. Doves selected weathered browntop millet over in the 1997 cultivated seed trial, although corn deteriorated lass rapidly than browntop millet (Hayslette and Mirarchi 2002). Doves showed no preference among weathered seeds in the 1997 combined trial, although broadleaf signalgrass deteriorated less rapidly than the other foods offered (Hayslette and Mirarchi 2002). Likewise, doves showed no preference among weathered seeds in the 1998 cultivated seed trial, despite the fact that milo deteriorated less rapidly than did sunflower or white proso millet (Hayslette and Mirarchi 2002). One possible explanation is that, in addition to deterioration resistance, seed physical characteristics such as size, shape, or hardness may have affected food preference patterns. In the first case, large seed size of corn may have created handling problems and limited consumption relative to browntop millet, despite the slower deterioration rate of corn. Effects of seed handling characteristics may have affected forging efficiency, and thus preference results, in the second and third cases, as well. Earlier authors have indicated a need to consider seed physical characteristics affecting handling in studies of food selection among avian granivores (Greig-Smith and Wilson 1985, Ramos 1996); seed characteristics such as size, shape, and hardness are thought to be important determinants of food preferences among some species, including mourning doves (Wilson and Harmeson 1973, Schluter 1982, Goldstein and Baker 1984, Diaz 1990, Hayslette and Mirarchi 2001).

Limits on physiological demands imposed by captivity is a second possible explanation for lack of preference toward slowest-deteriorating foods in the three trials mentioned above. Relatively low energetic demands associated with captivity may have reduced the importance of selecting the highest-quality seeds. Our previous work, however, has documented greater dove diet selectivity in captive than in free-flying situations, perhaps a function of differences in energetic and/or predation costs between the two situations (Hayslette and Mirarchi 2001).

Management Implications

Although plantings of highly-preferred agricultural crops such as white proso millet may provide excellent short-term benefits for mourning doves and other granivorous species, rapid deterioration is likely to limit use of these foods in the first two–three months of availability. Thus, the value of wild foods in sustaining populations of mourning doves and other species during non-growing periods may be greater than previously appreciated, even in predominantly agricultural landscapes. Establishment or encouragement of stands of wild seed producing plants such as

broadleaf signalgrass should greatly increase the long-term benefits of dove food plantings to the species. Resistance to mass loss may be a useful criterion for predicting mourning dove use of, and preferences for, seeds following weathering.

Acknowledgments

We thank S. L. Bales, J. P. Blume, J. S. Borgo, C. A. Christakos, M. P. Cook, S. L. Cotney, D. J. Lee, A. L. Grilliot, K. M. Pannier, and J. N. Reynolds for field and laboratory assistance. We also thank C. E. Braun, F. S. Dobson, K. D. Guyse, G. R. Hepp, G. E. Hill, and several anonymous reviewers for reviewing the manuscript. Funding was provided by the Alabama Department of Conservation and Natural Resources (Division of Wildlife and Freshwater Fisheries) and the Alabama Agricultural Experiment Station.

Literature Cited

Baskett, R. K. 1993. Shooting field management. Pages 495–506 *in* T. S. Baskett, M. W. Sayre, R. E. Tomlinson, and R. E. Mirarchi, editors. Ecology and management of the mourning dove. Stackpole Books, Harrisburg, Pennsylvania.

Baskett, T. S. and M. W. Sayre. 1993. Characteristics and importance. Pages 1–6 *in* T. S. Baskett, M. W. Sayre, R. E. Tomlinson, and R. E. Mirarchi, editors. Ecology and management of the mourning dove. Stackpole Books, Harrisburg, Pennsylvania.

Diaz, M. 1990. Interspecific patterns of seed selection among granivorous passerines: effects of seed size, seed nutritive value and bird morphology. Ibis 132:467–476.

Dillon, O. W. 1961. Mourning dove foods in Texas during September and October. Journal of Wildlife Management 25:334–336.

Goldstein, G. B. and M. C. Baker. 1984. Seed selection by juncos. Wilson Bulletin 96:458–463.

Greig-Smith, P. W. and M. F. Wilson. 1985. Influence of seed size, nutrient composition and phenolic content on the preferences of bullfinches feeding in ash trees. Oikos 44:47–54.

Hayslette, S. E. and R. E. Mirarchi. 2001. Patterns of food preferences in mourning doves. Journal of Wildlife Management 65:816–827.

_____ and _____. 2002. Is mass loss a useful index of seed deterioration in a terrestrial environment? Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 56:290–300.

Kuehl, R. O. 1994. Statistical principles of research design and analysis. Duxbury Press, Belmont, California.

Mirarchi, R. E. 1993. Care and propagation of captive mourning doves. Pages 409–428 *in* T. S. Baskett, M. W. Sayre, R. E. Tomlinson, and R. E. Mirarchi, editors. Ecology and management of the mourning dove. Stackpole Books, Harrisburg, Pennsylvania.

Neely, W. W. 1956. How long do duck foods last underwater. Transactions of the North American Wildlife Conference 21:191–198.

Nelms, C. O. and D. J. Twedt. 1996. Seed deterioration in flooded agricultural fields during winter. Wildlife Society Bulletin 24:85–88.

Preacher, J. W. 1978. Deterioration rates of 35 bobwhite quail foods and their preferential use. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 23:356–363.

Ramos, J. A. 1996. The influence of size, shape, and phenolic content on the selection of winter foods by the Azores bullfinch *Pyrrhula murina)*. Journal of Zoology 238:415–433.

SAS. 1989. SAS/STAT user's guide, version 6, 4th edition. SAS Institute Inc., Cary, North Carolina.

Shearer, L. A., B. J. Jahn, and L. Lenz. 1969. Deterioration of duck foods when flooded. Journal of Wildlife Management 33:1012–1015.

Schluter, D. 1982. Seed and patch selection by Galapagos ground finches: Relation to foraging efficiency and food supply. Ecology 63:1106–1120.

Wilson, M. F. and J. C. Harmeson. 1973. Seed preferences and digestive efficiency of cardinals and song sparrows. Condor 75:225–234.