DUSTBATHING AND FEATHER LIPID IN BOBWHITE (*COLINUS VIRGINIANUS*)

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The general sequence of dustbathing components in Bobwhite (*Colinus virginianus*) has been described and the frequency of some of the components found to increase with dust deprivation (Borchelt et al. 1973). Upon replication, a sex X deprivation interaction for the frequency of some components was discovered, with male Bobwhite exhibiting greater increases than females (Borchelt 1972).

I observed in both these experiments that birds deprived of dust for 5 days had a more "oily" appearance than birds which had just dustbathed. Furthermore, casual observations indicated the frequency of "oiling" behavior remained about the same when birds were deprived of dust. These observations suggest that dustbathing functions as part of a regulatory system serving to maintain an optimum amount of oil, or lipid, on the surface of the feathers. In such a system, a relatively constant frequency of "oiling" behavior deposits lipid from the uropygial gland onto the surface of the feathers. This lipid substance insures adequate waterproofing of the feathers, maintenance of insulation, and reduction of wear and chances of breakage (Simmons 1964). Presumably, when the amount of lipid increases above some critical level, the bird dustbathes. Dustbathing thus removes lipid from the plumage when it is absorbed by the dust and shaken out of the plumage.

This explanation for avian dustbathing suggests that there is lipid accumulation on the plumage when a bird is prevented from dustbathing. The purpose of this study is to confirm the previously observed increase in lipid on the plumage of Bobwhite which had been deprived of dust.

METHODS

Sixteen male and 26 female Bobwhite, approximately 6 months old, were divided into four groups. Group 1 (4 males, 5 females) was deprived of access to dust for 1 day, group 2 (5 males, and 6 females) for 5 days, group 3 (2 males, 7 females) for 15 days, and group 4 (5 males, 8 females) for 180 days. Prior to the appropriate level of deprivation, groups 1, 2, and 3 were given 7 days continuous access to dust. The dust, which consisted of dry earth sifted through a 0.6-mm wire mesh screen, was presented to the birds in a wooden tray (45 × 25 × 30 cm) inserted into each cage.

Groups 1, 2, and 3 were each housed in cages 137 × 50 × 30 cm on a 14 to 10 hr light/dark cycle. Members of group 4 were maintained by the Department of Poultry Science, Michigan State University, under continuous light in a 100 × 75 × 24 cm cage with approximately 50 other birds until 5 months of age, when they were transferred to a cage and maintenance condition identical to the other groups. This group was included to assess the effects of prolonged deprivation of dust on the amount of feather lipid. Food (King Milling Co., Lowell, Michigan) and water were available ad libitum for all groups.

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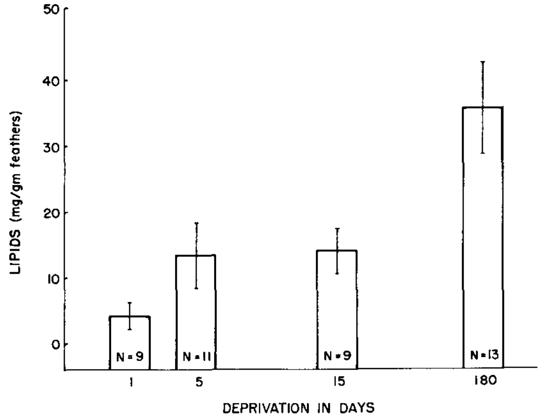

FIGURE 1. Mean amount (± standard deviation) of lipid on the feathers with deprivation of dust.

After the appropriate period of dust deprivation, all birds in each group were sacrificed by ether overdose. The feathers of each bird were then cleaned with compressed air to remove any remaining dust from the plumage. The distal portion of most of the feathers (except the primaries) of each bird were clipped off, leaving the calamus intact. A 2–3 g sample of feathers from each bird was dried, weighed, and subjected to a standard ether extraction procedure on a Goldfisch apparatus for 2 hr. The collected lipid and ether were poured into tared containers, the ether evaporated, and the remaining lipid weighed to an accuracy of 1 mg. Replicate samples of feathers were prepared from birds in groups 1, 2, and 4.

RESULTS

No differences were found between replicates and the data were combined for each group. The results are shown in figure 1 which depicts the mean amount (± standard deviation) of lipid for each of the groups. A one-way analysis of variance revealed the change in amount of feather lipid with deprivation of dust to be highly significant ($F = 79.4$, df = 3/38, $P < 0.001$). Comparisons between individual groups, using the Newman-Keuls procedure (Winer 1962), indicated that all of the differences were highly significant ($P < 0.001$), except for the difference between groups 2 and 3, which was not significant. No difference was found in amount of feather lipid between male and female birds.

No differences were found among the body weights of the birds in groups 1, 2, and 4, but the weight of the birds in group 3 averaged about 20% less than the other groups (160 vs. 200 g). This may explain the lack of an expected difference in amount of feather lipid between groups 2 and 3 since it has been reported that dietary fat is converted to lipid secretion from the uropygial gland (Apandi and Edwards 1964; Elder 1954).

DISCUSSION

The results show a significant increase in feather lipid with deprivation of dust, confirming earlier observations (Borchelt et al. 1973; Borchelt 1972) which suggest that Bobwhite bathe in dust to remove excess lipids. Endogenous feather lipids, probably formed as a by-product of keratinization (Bolliger and Gross 1958; Bolliger and Varga 1960), are supplemented, through "oiling" behavior, by lipids from the uropygial gland to insure that the feathers are properly lubricated. Dustbathing removes excess lipids and prevents the feathers from becoming matted.

This explanation for dustbathing requires a reassessment of the generally accepted thesis (Goodwin 1956; Simmons 1964; Stoddard 1931) that it serves primarily to remove ectoparasites. In both this and a previous study, the feathers of birds were observed microscopically and no ectoparasites were found. However, since the principal food of avian ectoparasites is lipid substances from the feathers (Dubinen, cited in Kelso and Nice 1963), dustbathing may secondarily remove ectoparasites by reducing their food supply, or perhaps by desiccating them or interfering with their respiration.

If dustbathing serves to remove excess lipids, then several predictions should be true. Removal of the uropygial gland should lead to a decrease in the frequency of dustbathing components, although the changes in dustbathing might be influenced by the bird's previous dustbathing experience. Application of artificial lipids to the plumage should increase the amount of dustbathing. Factors which might affect "oiling" behavior, such as rainy weather or indirect manipulation of the output of the uropygial gland (for instance by increasing or decreasing the fat content of the diet), should also influence dustbathing.

Another area for further research concerns the sex differences found for the frequencies of the head and side rub components of dustbathing (Borchelt 1972). Although no sex differences in the amount of feather lipid were found in the present study, this may have been due to the pooling of the greater amount of large feathers from the breast and back of each bird with the lesser amount of small feathers from the head and flanks. A difference in the chemical composition of feather lipid between small and large feathers from an unspecified species of duck has been reported (Bolliger and Varga 1961). It is clear that additional research involving both quantitative and qualitative analysis of the lipid from both the feathers and uropygial gland of one species of bird will be necessary to determine the relations between sex, uropygial and feather lipid, and dustbathing. Such analyses may also shed some light on the mechanisms underlying other behaviors associated with care of the body surface, such as waterbathing and "anting."

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NOTES ON THE FEEDING BEHAVIOR OF THE COMMON MERGANSER (*MERGUS MERGANSER*)

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The biology of the Common Merganser (*Mergus merganser*) has, until recently, been neglected. This species breeds in forested regions and uses large bodies of water during migration and in winter thus making it relatively inaccessible for study. Further, because of its low esteem as a game bird, it has not attracted the attention of game biologists other than with respect to its impact on game fish.

Erskine (1971, 1972) has studied the annual cycle in weights, reproductive organs, and molt, as well as nesting dispersion and postbreeding dispersal. Age and sex characteristics have been studied by Anderson and Timken (1971) and Erskine (1971). In the central United States, other studies have been made: food habits (Timken and Anderson 1969); and weights, age, and sex ratios (Anderson and Timken 1972). Our purpose in this report is to consider feeding activities during migration and winter and to report on observed posturing during feeding. This study was conducted along the Missouri River between Vermillion and Pickstown, at the Lake Andes National Wildlife Refuge in South Dakota, at Lake Hendricks and the Rock River in southwestern Min-

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