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BODY LIPIDS AND PESTICIDE BURDENS OF MIGRANT BLUE-WINGED TEAL

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The widespread use of DDT, dieldrin, and other persistent pesticides continues in Latin America, although use of some of these chemicals has been suspended in the United States. Little information exists concerning the levels of environmental pollutants that migratory birds acquire on the wintering grounds south of the U.S. Johnston (1975) reported higher levels of pesticides in some passerine species in spring than in fall; the birds had wintered in South America and were collected dead at television towers in Florida. White (1976) found high levels of DDT in a small sample of Blue-winged Teal (*Anas discors*) collected in Louisiana in April during their northward migration.

Most of the North American Blue-winged Teal population winters in parts of Latin America (Bennett 1938, Bellrose 1976). These are the first waterfowl to leave the breeding grounds in fall and the last to return in spring, thus the length of time spent in wintering areas or in transit is prolonged. Breeding ground surveys have shown a 20% decline in Blue-winged Teal numbers between 1955 and 1974; also, Blue-wings are known to have a higher annual mortality rate than other dabbling ducks, despite low hunting pressure (Bellrose 1976). Our study was conducted primarily to determine if Blue-winged Teal were accumulating potentially harmful levels (Stickel 1973) of organochlorine pesticides on their wintering grounds and to determine if pesticide burdens were significantly related to overall body condition, i.e., weight and percent lipid. Although some data on Blue-wing body weights are published, we found no reports of lipid levels in this species. Therefore, we compared body weights and carcass lipid levels in our spring and fall migrants to determine if birds were heavier or fatter at one time or the other.

METHODS

Organochlorine residues may accumulate in avian tissues over a long period; accumulation may be rapid or gradual, but loss of residues is usually slow (Stickel 1973). Thus, we mainly collected juvenile (first-year) birds for analysis because they would be making their first migration to suspected areas of high pesticide use, and body burdens of northward migrants would reflect recent exposure. A smaller sample of adults was taken for comparison. Fall collections were made in September and October 1977 at Swan Lake National Wildlife Refuge (NWR), Missouri (10 juveniles), and at Powderhorn Lake near Indianola, Texas (19 juveniles, 12 adults). Spring collections were made in April 1978 at Powderhorn Lake (3 adults) and at San Bernard NWR, Texas (19 juveniles, 8 adults). Birds were aged and sexed following Carney (1964) and Dane (1968).

Chemical analysis of carcasses was conducted at the Patuxent Wildlife Research Center, Laurel, Maryland. Before analysis, birds were weighed to the nearest gram, skinned, and the feet, beaks, and gastrointestinal (GI) tracts were removed. Adipose tissue adhering to the skin and GI tract was scraped off and retained with the carcass. Carcasses were homogenized and a portion of each homogenate was analyzed for lipid content and organochlorine residues (DDT, DDE, DDD, dieldrin, heptachlor epoxide, chlordane isomers, endrin, toxaphene, hexachlorobenzene, polychlorinated biphenyls (PCBs), and mirex). The analytical procedures we used are described in detail by Cromartie et al. (1975) and Kaiser et al. (1980). Limits of quantification were 0.1 ppm for organochlorine pesticides and 0.5 ppm for PCBs on a wet weight basis.

We used one-way analysis of variance and Tukey's HSD procedure to detect differences in body weights and lipid levels among groups (Sokal and Rohlf 1969). Linear regression analysis was used to determine the relationships between pesticide levels, body weights, and lipid levels.

RESULTS

Migrant Blue-winged Teal were relatively pesticide-free. Only 4 of 41 birds in the fall collection had measurable amounts of organochlorine residues in the carcass; of these 4, 3 were adults. DDE (the major metabolite of DDT) in the 4 carcasses averaged 0.48 ppm, ranging from 0.11 to 1.20 ppm. Dieldrin occurred in one bird (0.45 ppm) but no other organochlorine residues were detected. Teal collected in spring during their northward migration also were low in pesticides; only 8 (5 juveniles and 3 adults) of 30 birds contained detectable residues. DDE averaged 0.38 ppm and ranged from 0.10 to 0.88 ppm. Dieldrin occurred in 1 bird (0.11 ppm) but nothing else was found in the samples. Because pesticide residues were so low and infrequent in carcasses, there was no significant ($P > 0.05$) correlation between residues and either body weight or lipid content.

Mean whole body weights of Blue-wings separated by collection time, age, and sex are shown in Table 1; fall weights from Missouri and Texas were combined because there was no difference in weights between sites. Weights among individuals were highly variable as evidenced by the extreme values in each group (Table 1). There was no significant difference ($P > 0.05$) in body weights among most age and sex classes in either fall or spring, except that combined males (juvenile and adult) were heavier ($P < 0.025$) in fall than in spring. There was no difference in weights among combined females between collections but the sample sizes were relatively small for adult females and this probably biased the statistical analysis. Our spring body weights for both sexes appeared to be considerably higher than those reported by Bennett (1938), but the fall weights were similar. Bellrose (1976) reported weights of combined males to be about 60 g heavier, on the average, than those of our males, but there was no mention of collection dates in Bellrose's data.

Mean lipid levels of skinned carcasses are shown in Table 1. Lipid

TABLE 1. Mean body weights and carcass lipid content of migrant Blue-winged Teal, 1977–78.

Season	Year	No.	Age	Sex	Weight (g)	Lipid (%)
Fall	1977	15	Juv	F	388 (273–444)[a]	9.6 (4.0–16.2)
		2	Ad	F	401 (398–404)	7.5 (3.0–11.9)
		14	Juv	M	409 (315–504)	10.1 (2.2–25.8)
		10	Ad	M	427 (342–547)	12.6 (3.3–34.1)
Spring	1978	6	Juv[b]	F	382 (325–440)	9.7 (6.3–15.4)
		2	Ad	F	352 (322–382)	6.3 (4.5–8.0)
		13	Juv	M	388 (329–446)	8.6 (4.3–13.3)
		9	Ad	M	376 (305–422)	6.2 (2.0–8.9)

[a] Extreme values.
[b] Yearlings.

content was highly variable among individuals, ranging from 2 to 34%, consequently there was no significant difference ($P > 0.05$) in lipid levels among age and sex classes in either fall or spring. However, there was a significant positive correlation ($P < 0.01$, $r = 0.61$, d.f. = 69) between body weight and lipid level for all birds combined (Fig. 1); as body weight increased so did percent lipid. We recognize that skinned carcasses do not reflect *total* body lipid. Bailey (1979) found that subcutaneous fat was the largest source of stored energy in Redheads (*Aythya americana*) and that skin weight was a good predictor of total fat. Wishart (1979) reported that weights of abdominal fat plus skin fat in American Wigeons (*Anas americana*) were the best predictors of lipid reserves. Therefore, our estimates of body lipid in Blue-wings probably are low in most instances because the skins were discarded. Skinned carcasses of wintering Canvasbacks (*Aythya valisineria*) averaged about 7% lipid, similar to that which we report for skinned Blue-wings; however, plucked Canvasbacks averaged about 17% lipid, but there was much variability among the samples (White et al. 1979).

DISCUSSION

The Blue-winged Teal we sampled in 1977–78 did not accumulate elevated levels of organochlorine pesticides on their wintering grounds. Only DDE and dieldrin were detected and then at very low levels in a

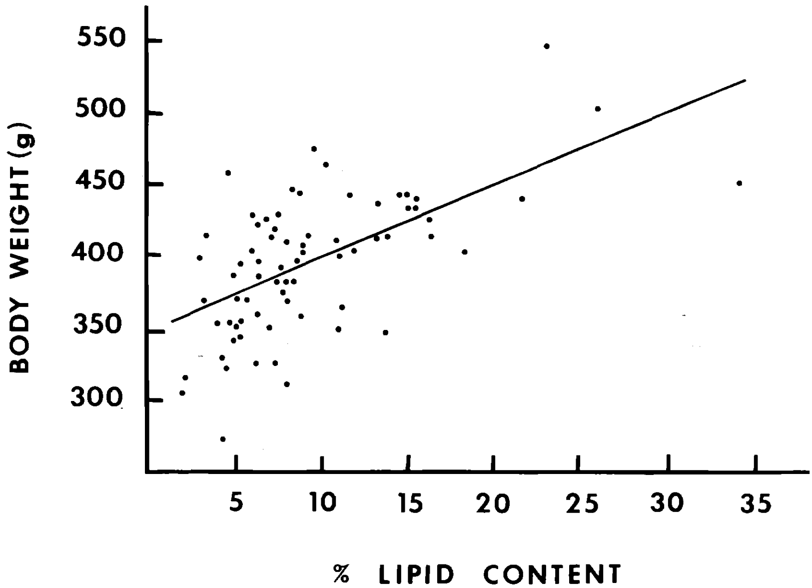

FIGURE 1. Relationship of body weight to lipid content in migrant Blue-winged Teal. Linear regression analysis, $\bar{Y} = 346.57 + 5.16X$, $N = 71$.

small proportion of the samples; these levels are far below those known to have adverse effects in other avian species (Stickel 1973). It is gratifying that these birds were so lightly contaminated, not only for the teal population itself, but also for the Peregrine Falcons (*Falco peregrinus*) and other raptors that occasionally prey on them (Sherrod 1978).

Apparently the spring-collected teal did not winter near agricultural lands where persistent pesticides are used, although their exact wintering areas are unknown. Some Blue-wings do remain in Texas throughout the winter, but numbers vary considerably among years (Bellrose 1976). We saw fewer than 10 individuals during frequent surveys from early November 1977 through late March 1978 along the south Texas coast and none was seen at the actual collection sites in Texas after the peak fall migration ended in October. Therefore, we are confident that most of our spring-collected migrants had wintered outside the U.S. Bellrose (1976) suggested that the major wintering areas for Blue-wings migrating through Texas are probably the coastal regions of southwestern Mexico and western Central America.

Body weights of fall- and spring-migrant Blue-wings did not differ statistically for most of the various age and sex classes, except that combined males weighed more in fall than in spring. Body weight was significantly correlated with percent lipid, thus we attribute the extreme variability in individual body weight, in part, to the amount of fat present and *not* to overall body size, age, or sex. Bellrose (1976) reported little difference in body or wing lengths among adult and juvenile Blue-wings of both sexes. Body weight in American Wigeons varied greatly over the year and was a poor indicator of structural size (Wishart 1979). Our data are for migrant teal only, therefore we do not suggest that body weights among age and sex classes are similar throughout the entire year; Bennett (1938) reported that female Blue-wings were heaviest just before the nesting season.

SUMMARY

Blue-winged Teal were collected before and after their migration to wintering grounds in Latin America. Pesticide burdens, body weights, and lipid levels of carcasses were determined. Only DDE and dieldrin were detected in a small proportion of the samples and then at concentrations far below known-effect levels. Residue loads, because of their infrequency, were not significantly correlated with overall body weight and percent lipid. Body weights among most age and sex classes did not differ in either fall or spring, nor did percent lipid in any instance. However, body weights and lipid levels were significantly correlated; as body weight increased so did percent lipid. Thus, the extreme variability in body weight appears to be a function of the amount of fat present and not overall body size, age, or sex.

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