

Heavy Metal Levels in Feathers of Wild Turkeys from Virginia

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Heavy metal contamination is an ever increasing problem to wildlife populations. Of special concern is the relative scarcity of information on background levels of heavy metals that could be considered normal for non-contaminated environments. Elements in feathers of waterfowl have been shown to reflect the elemental pattern of soils frequented by waterfowl at the time of feather growth (HANSON and JONES 1968). This knowledge has proved useful in determining the breeding and molting grounds of wild geese. It could reasonably be expected that elements in feathers of upland birds might reflect levels in soils though this may be modified by the ability of plants to take up these elements from the soil (JONES et al. 1968). A non-migratory species normally inhabiting remote areas such as the wild turkey (*Meleagris gallopava*) could provide reasonable background data on heavy metal levels. The present paper is concerned with levels of lead, cadmium, nickel and zinc in feathers of wild turkeys from 19 counties in two physiographic regions of Virginia.

MATERIALS AND METHODS

Feathers were collected from 175 wild turkeys killed by hunter during the fall hunting season of 1976. Feathers from turkeys killed in 19 Virginia counties and 2 physiographic regions were included in the sample. Regions and counties together with number of turkeys per county are shown in Table 1. The feathers were used to determine age and sex of the turkeys. A tenth primary feather from each turkey was used for heavy metal determinations. Only feathers which had not been damaged by shot were selected for analysis.

Feathers were oven-dried, weighed, ashed in a muffle furnace and the ash brought into solution in nitric acid/hydrochloric acid. Levels of lead, cadmium, nickel, and zinc were determined for each feather by means of atomic absorption spectrophotometry using an Instrumentation Laboratories Model 351 spectrophotometer. Heavy metal levels were calculated in terms of $\mu\text{g/g}$ dry weight of feathers.

The Statistical Analysis System (SAS) of BARR et al. (1976) was used to analyze data. Data were analyzed by analyses of

TABLE 1

Mean (\pm S.E.) lead, cadmium, nickel, and zinc levels ($\mu\text{g/g}$) in turkey feathers collected from 19 Virginia counties in 2 physiographic regions (Piedmont, P and Mountain, M).

County (Region)	N	Lead ^x	Cadmium	Nickel ^x	Zinc
Cumberland (P)	16	4.1(\pm 0.9)	0.24(\pm 0.08) bc	0.66(\pm 0.20)	94.2(\pm 6.0) bcd
Pittsylvania (P)	7	3.0(\pm 1.3)	0.14(\pm 0.09) c	0.46(\pm 0.11)	93.5(\pm 10.3) bcd
Charlotte (P)	2	0.3(\pm 0.3)	0.04(\pm 0.00) c	3.54(\pm 3.19)	90.8(\pm 8.2) bcd
Nelson (P)	4	258.2(\pm 256.5)	1.43(\pm 1.39) a	0.40(\pm 0.04)	83.1(\pm 11.9) cd
Amherst (P)	2	0.9(\pm 0.3)	0.03(\pm 0.01) c	2.32(\pm 1.64)	96.7(\pm 6.7) abc
Campbell (P)	7	0.3(\pm 0.2)	0.08(\pm 0.02) c	0.54(\pm 0.09)	124.8(\pm 27.1) a
Appomattox (P)	3	1.4(\pm 0.3)	0.60(\pm 0.30) bc	0.48(\pm 0.00)	94.0(\pm 3.9) bcd
Halifax (P)	4	3.2(\pm 1.2)	0.84(\pm 0.35) ab	0.74(\pm 0.26)	76.9(\pm 13.6) d
Pr. Edward (P)	7	1.3(\pm 0.6)	0.12(\pm 0.09) c	0.90(\pm 0.29)	83.3(\pm 4.5) cd
Buckingham (P)	19	1.5(\pm 0.4)	0.06(\pm 0.01) c	0.62(\pm 0.10)	90.7(\pm 5.2) cd
Bedford (P)	6	7.8(\pm 6.7)	0.03(\pm 0.01) c	0.92(\pm 0.23)	108.2(\pm 11.3) abc
Montgomery (M)	11	3.8(\pm 1.6)	0.29(\pm 0.15) bc	3.23(\pm 2.62)	115.2(\pm 11.4) a
Craig (M)	13	2.1(\pm 0.5)	0.46(\pm 0.24) bc	0.48(\pm 0.09)	92.6(\pm 6.6) bcd
Roanoke (M)	3	18.0(\pm 17.0)	0.05(\pm 0.01) c	0.45(\pm 0.03)	87.3(\pm 12.7) cd
Smyth (M)	7	3.4(\pm 1.3)	0.21(\pm 0.19) bc	0.66(\pm 0.17)	113.3(\pm 10.8) ab
Tazewell (M)	8	0.8(\pm 0.3)	0.02(\pm 0.01) c	0.02(\pm 0.21)	78.6(\pm 7.4) d
Russell (M)	3	1.3(\pm 0.8)	0.02(\pm 0.02) c	1.94(\pm 1.34)	86.9(\pm 7.5) cd
Bland (M)	17	3.6(\pm 0.7)	0.11(\pm 0.05) c	18.56(\pm 12.71)	79.8(\pm 5.5) d
Botetourt (M)	36	100.7(\pm 98.8)	0.20(\pm 0.06) c	2.12(\pm 1.18)	81.1(\pm 3.9) d

a, b, c, d: Means with different superscripts in the same column significantly ($P < 0.10$) different from one another. x: No significant differences between counties in lead and nickel levels.

variance and where significant differences were discovered Duncan's multiple range tests were used to locate the differences.

RESULTS

Data are presented in Table 1 on mean levels of lead, cadmium, nickel, and zinc in turkey feathers from different counties. Significant differences ($P < 0.10$) among counties were observed in lead and nickel levels. Differences between regions (Mountain vs. Piedmont) were not observed for any of the 4 elements (Table 2). Lead levels in feathers of individuals were

TABLE 2

Mean (\pm S.E.) levels ($\mu\text{g/g}$ d.w.) of lead, cadmium, nickel, and zinc in feathers of wild turkeys from 2 regions of Virginia.

Region	N	Lead ($\mu\text{g/g}$)	Cadmium ($\mu\text{g/g}$)	Nickel ($\mu\text{g/g}$)	Zinc ($\mu\text{g/g}$)
Piedmont	58	20.61 (± 17.68)	0.30 (± 0.10)	0.81 (± 0.14)	95.87 (± 4.36)
Mountain	117	33.10 (± 30.39)	0.18 (± 0.04)	3.95 (± 1.94)	89.03 (± 2.48)

generally low ($< 10 \mu\text{g/g}$). In only 12 turkeys (6.9%) extremely high levels were noted (range 224 to 3558 $\mu\text{g/g}$).

Significant ($P < 0.01$) differences were noted in the zinc levels due to age (Table 3). There were no significant age differences for the other elements though a significant ($P < 0.03$) interaction occurred for lead between county, age, and sex. There were no significant differences in any element due to sex (Table 4).

DISCUSSION

The eastern wild turkey frequents remote areas and avoids human contact (WRIGHT and SPEAKE 1975). Consequently, its feathers should reflect elemental levels of relatively undisturbed and relatively unpolluted areas. Rather little data are available on elemental contents of feathers of upland birds. ANDERSON and STEWART (1970) published data on levels of lead, nickel, and zinc in feathers of ring-necked pheasants (*Phasianus colchicus*) from Illinois.

Lead levels in feathers of Illinois pheasants ranged from 62 $\mu\text{g/g}$ to 500 $\mu\text{g/g}$ (d.w. ash). This range encompassed 3 pheasant age groups and 3 areas of the state and the birds sampled were from



TABLE 3

Mean (\pm S.E.) levels ($\mu\text{g/g}$ d.w.) of lead, cadmium, nickel, and zinc in immature and adult wild turkey feathers from Virginia.

Groups	N	Lead ($\mu\text{g/g}$)	Cadmium ($\mu\text{g/g}$)	Nickel ($\mu\text{g/g}$)	Zinc ($\mu\text{g/g}$)
Immature	68	55.96 (± 52.27)	0.27 (± 0.06)	1.38 (± 0.45)	79.36 ^a (± 2.91)
Adult	107	11.81 (± 9.60)	0.19 (± 0.06)	3.88 (± 2.10)	98.89 ^b (± 2.87)

^{a,b} Means with different superscripts in the same column significantly different ($P < 0.01$).

TABLE 4

Mean (\pm S.E.) levels ($\mu\text{g/g}$ d.w.) of lead, cadmium, nickel, and zinc in male and female wild turkey feathers from Virginia.

Sex	N	Lead ($\mu\text{g/g}$)	Cadmium ($\mu\text{g/g}$)	Nickel ($\mu\text{g/g}$)	Zinc ($\mu\text{g/g}$)
Male	113	43.15 (± 32.67)	0.19 (± 0.06)	1.92 (± 0.84)	93.44 (± 2.89)
Female	62	3.12 (± 0.89)	0.28 (± 0.07)	4.70 (± 3.33)	87.39 (± 3.29)

agricultural areas. Such levels are considerably higher than those found in turkeys. Lead levels in turkeys were extremely low ($< 10 \mu\text{g/g}$ feather d.w.) in 93.1 percent of turkeys. In the remaining turkeys the possibility of contamination at shooting exists. High levels in feathers may reflect ingestion of lead about the time of feather growth. This may have been in the form of lead shot. If this was the case the frequency of lead ingestion is probably very low. Lead levels of forest soil in western Virginia are low - $7.8 \mu\text{g/g}$ (d.w.) (GOLDSMITH et al. 1976). Based on the data from turkey feathers wild turkeys do not appear to be subjected to lead contamination from particulate lead.

Nickel and zinc levels of turkey feathers appear considerably lower than levels in Illinois pheasant feathers (ANDERSON and

STEWART 1970). Nickel levels in pheasant feathers ranged from 53 $\mu\text{g/g}$ to 86 $\mu\text{g/g}$ (d.w. ash) while in the present report levels approximated 1 $\mu\text{g/g}$ of feather except in 4 birds. These levels approximate those in uncontaminated Virginia soils (SCANLON, unpublished). Zinc levels of turkeys also approximated levels in uncontaminated Virginia soils and were very much less than in Illinois pheasants.

No data on cadmium in feathers of other species were available for comparison. Levels in turkey feathers were compared to levels in Virginia soils (SCANLON, unpublished).

As the levels of mineral elements studied in the great majority of turkey feathers reflected those earlier found in soils it could be concluded that the wild turkey has considerable potential as a source of biological material for providing background levels of mineral elements in uncontaminated environments.

SUMMARY

Levels of lead, cadmium, nickel, and zinc were determined in feathers of 175 wild turkeys (*Meleagris gallopavo*) shot by hunters in 19 Virginia counties in 2 physiographic regions. Lead and nickel levels did not vary by county, region, sex, or age. Zinc and cadmium levels were significantly ($P < 0.01$) higher in adult turkeys.

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