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Heavy Metal Concentrations in Feathers of Ruffed Grouse Shot by Virginia Hunters

Patrick F. Scanlon[1], Richard G. Oderwald[2], Timothy J. Dietrick[1] and Joe L. Coggin[3]

[1]*Department of Fisheries and Wildlife Sciences,* [2]*Department of Forestry, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061;* [3]*Virginia Commission of Game and Inland Fisheries, Eagle Rock, VA 24085*

Heavy metal contamination is a continuing problem for populations of wild animals and in environmental management. One concern is the relative scarcity of information on background concentrations of heavy metals that could be considered normal. Background patterns of elemental concentrations have been found to be reflected in elemental contents of feathers of waterfowl (HANSON & JONES 1968). Those species which inhabit relatively undisturbed environments and are non-migratory probably present the best opportunities to obtain background concentrations of heavy metals under present day conditions. Work on one such species-the wild turkey (Meleagris gallopava)-has been reported earlier (SCANLON et al. 1979). The present report is concerned with concentrations of lead, cadmium, nickel, zinc, silver and copper in ruffed grouse (Bonassa umbellus) shot by hunters in Virginia.

MATERIALS AND METHODS

Wing and tail feathers of ruffed grouse shot by hunters during the hunting seasons of 1977/78 and 1978/79 were returned by hunters for population studies(determination of sex and age). All returns were from southwestern Virginia. Primary feathers were selected for heavy metal analysis and care was taken to avoid any feathers which had been damaged by shot. Feathers of individual birds were dried, ashed, and dissolved in acid. Concentrations of lead, cadmium, nickel, zinc, silver and copper were determined by atomic absorption spectrophotometry using an Instrumentation Laboratories Model 351 spectrophotometer in the flame mode. Procedures used in preparing samples and determining heavy metal concentrations are given in SCANLON et al. (1980). Concentrations were calculated in terms of µg/g dry weight (d.w.) of feathers for all elements.

Data were analyzed using Wilcoxon rank sum tests (CONOVER 1971) to determine differences between sexes (male and female), age groups (adult and immature i.e. <1 year old) and between hunting seasons 1977/78 and 1978/79 for all elements.

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RESULTS AND DISCUSSION

Data on all 6 elements are presented in Table 1. Mean lead concentrations did not vary significantly between sexes, age-groups, and seasons of harvest. Individual values were quite variable as reflected by high standard errors. However the lack of difference between sexes and age groups indicate that lead is probably not being accumulated beyond background concentrations by the species. The mean concentrations of lead in ruffed grouse were considerably lower than those in wild turkeys harvested from the same general area but the data from turkeys contained a few extremely high values and were otherwise comparable (SCANLON et al. 1979a). Lead concentrations were lower than those reported in the feathers of American woodcock (Philohela minor) by SCANLON et al. (1979b).

Table 1. Mean concentrations (µg/g d.w., ±S.E.) of lead, cadmium, nickel, zinc, silver, and copper in feathers of ruffed grouse harvested from southwestern Virginia.

Group	N	Pb	Cd	Ni	Zn	Ag	Cu
All	130	6.4 ±1.9	0.74 ±0.69	0.05 ±0.03	94 ±6	<0.01	4.2 ±0.2
Adults	77	7.5 ±2.7	1.2 ±1.2	0.06 ±0.05	97 ±9	<0.01	4.0 ±0.2
Juveniles	53	4.8 ±2.7	0.04 ±0.01	0.02 ±0.02	90 ±5	<0.01	4.4 ±0.4
Male	88	8.7 ±2.8	1.1 ±1.0	0.06 ±0.05	98 ±8	<0.01	4.4 ±0.3
Female	42	1.5 ±0.5	0.02 ±0.01	0.02 ±0.02	84 ±5	<0.01	3.6 ±0.2
1977-78 Harvest	82	5.2 ±2.3	0.05 ±0.01	0.01 ±0.01	82 ±3	<0.01	3.9 ±0.2
1978-79 Harvest	47	8.3 ±3.5	2.0 ±1.2	0.10 ±0.09	112 [a] ±14	<0.01	4.6 ±0.4

[a] significantly ($P<0.01$) greater than values for birds harvested in 1977-1978 season.

Overall mean cadmium concentrations were less than 1 µg.g d.w. and did not differ between sexes, ages and hunting seasons. They were somewhat higher than those in feathers of wild turkeys from the same general

area (SCANLON et al. 1979a). Nickel concentrations in ruffed grouse feathers which had an overall mean value of 0.05±0.03 µg/g d.w. and which did not vary due to sex, age, and hunting season appeared considerably lower than those in wild turkeys from Virginia (SCANLON et al. 1979a). Data on nickel concentrations in feathers of pheasants (Phasianus colchicus) from Illinois (ANDERSON & STEWART 1970) are difficult to compare as overall means were not presented and the data were based on concentrations in ash. However, the nickel concentrations reported for ruffed grouse feathers herein appear considerably lower.

Mean concentrations of zinc in ruffed grouse feathers varied significantly ($P<0.01$) between hunting seasons. Means were comparable to those in wild turkeys (SCANLON et al. 1979a) but substantially less than in pheasants (ANDERSON & STEWART 1970).

Silver was not detected at sensitivity levels used in any of the ruffed grouse studied. ANDERSON & STEWART (1970) did report silver concentrations in feathers of pheasants though the concentrations were very low. Copper concentrations in ruffed grouse did not vary with age, sex or season of harvest. The mean value (4.2 ±0.2 , overall) was probably higher than values reported for pheasants by ANDERSON & STEWART (1970).

Ruffed grouse in common with wild turkeys probably provide reasonably realistic background values on heavy metal concentration in remote forested areas in Virginia. The values for lead, cadmium and nickel from ruffed grouse were less variable than those for wild turkeys. Data from feathers reflect primarily contamination on birds at the time of feather growth.

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