

## Mercury and Cesium-137 in Urban Gray Squirrels

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Recent emphasis upon the revitalization of major cities has underscored a need for urban wildlife management. Intensive management of the wildlife populations indigenous to metropolitan areas will enhance our quality of life in many ways. One important benefit is that certain species can serve as sensitive indicators of environmental change. The gray squirrel (Sciurus carolinensis) is usually abundant in cities and they are often subject to a variety of destructive environmental factors. In an attempt to evaluate the gray squirrel as an indicator of zoonoses and pollutants, the Health Program Office of the Department of Health and Rehabilitative Services conducted a multifaceted study in Jacksonville, Florida during 1974. This report presents baseline measurements of body burdens of mercury and cesium-137.

### MATERIALS AND METHODS

Squirrels were captured in wire box-type live traps baited with peanut butter and pecans. Animals were collected from 36 sites within the city of Jacksonville. Details of the study design and processing protocol have been presented previously (BIGLER & HOFF 1976, McKINNON et al. 1976). Portions of tails provided hair samples for mercury determinations (flameless atomic absorption) and eviscerated carcasses were analyzed for gamma-emitting radio-isotopes in shielded whole body counters using NaI scintillation detectors and 400 channel pulse height analyzers. The results were standardized against Amersham standards (CUMBIE & JENKINS 1975, JENKINS & FENDLEY 1968).

The squirrels were differentiated by socio-economic stratum of the area where trapped, the land use pattern, and by age of the animals. These data were subjected to a one way analysis of variance on all three groups with the two contaminants. In two cases, means were significantly different at the 90% level and then Duncan's multiple range test at the five % level of significance was applied.

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## RESULTS AND DISCUSSION

Results of the analyses for mercury are presented in Table 1. Concentrations of mercury ranged from 0.07 to 9.2 ppm in hair. There were no significant differences in mean concentrations at the 90% level of mercury when squirrels were grouped by human socio-economic stratum or land use pattern. The values were influenced by age. The one-year-old squirrels and the less than one-year-olds were not significantly different at the 95% level, but the squirrels that were older than two years were significantly higher at the 95% level of confidence than either of the younger age classes. The overall mean value of 1.1 ppm for mercury from these urban animals was significantly greater than the mean of 0.43 ppm obtained from six squirrels trapped in a rural campground in Pasco County, Florida.

Table 1. Mercury residues (ppm) in gray squirrel hair in relation to socio-economic strata and land usage pattern of Jacksonville.

	No.	Mean $\pm$ SE	Range
<u>Socio-economic Stratum</u>			
Low	18	1.0 $\pm$ 0.2	0.35 - 4.3
Middle	18	1.2 $\pm$ 0.5	0.20 - 9.2
High	30	1.1 $\pm$ 0.2	0.07 - 6.7
<u>Land Use Pattern</u>			
Residential	29	1.1 $\pm$ 0.3	0.07 - 6.7
Park	23	1.0 $\pm$ 0.4	0.15 - 9.2
School	10	0.9 $\pm$ 0.4	0.23 - 4.3
Cemetery	4	1.4 $\pm$ 0.3	0.58 - 2.2
<u>Age of Squirrels</u>			
< one year	34	1.1 $\pm$ 0.2	0.07 - 6.7
One year	19	0.9 $\pm$ 0.2	0.12 - 3.3
$\geq$ 2 years	5	2.7 $\pm$ 0.2	0.30 - 9.2
Overall Values	66	1.1 $\pm$ 0.2	0.07 - 9.2

Mean concentrations of cesium-137 ranged from 250 to 29,000 pCi/kg of muscle. Values within socio-economic stratum were not significantly different at the 90% level. On the other hand, the land use pattern showed some differences with low income areas, parks, and cemeteries significantly less (95% level) than school areas. Variations in the availability of selected preferred food items such as mushrooms and acorns may account for the difference in land use area uptake. Age of the squirrels did not seem to be a factor in bioaccumulation. The mean body burdens of these

animals were higher than values recorded for gray squirrels from the upper coastal plain, piedmont, and mountains of Georgia (JENKINS & FENDLEY 1968, WISE 1968). Cesium-137 levels in squirrels compared favorably with the mean concentrations found in raccoons (Procyon lotor) from northeast Florida (BIGLER et al. 1975).

Table 2. Cesium-137 residues in gray squirrels in relation to socio-economic strata and land usage pattern of Jacksonville expressed in picocuries per kilogram of muscle wet weight.

	No.	Mean $\pm$ SE	Range
<u>Socio-economic Stratum</u>			
Low	11	2,200 $\pm$ 400	680 - 4,700
Middle	17	5,000 $\pm$ 1,700	250 - 29,000
High	18	4,800 $\pm$ 1,300	590 - 20,000
<u>Land Use Pattern</u>			
Residential	18	4,200 $\pm$ 1,300	300 - 20,000
Park	18	2,500 $\pm$ 500	250 - 7,400
School	6	11,000 $\pm$ 4,000	4,200 - 29,000
Cemetery	4	2,900 $\pm$ 1,100	1,200 - 5,900
<u>Age of Squirrels</u>			
< one year	20	4,200 $\pm$ 1,200	590 - 20,000
One year	18	4,700 $\pm$ 1,600	250 - 29,000
$\geq$ 2 years	8	3,500 $\pm$ 1,300	780 - 12,000
Overall Values	46	4,300 $\pm$ 800	250 - 29,000

In general, squirrels are better indicators of the presence of mercury in the environment than deer (Odocoileus virginianus), rabbits (Sylvilagus floridanus), or cotton rats (Sigmodon hispidus) (CUMBIE & JENKINS 1975) but not as good as raccoons. Older predaceous fish such as bass (Micropterus salmoides) and otters (Lutra canadensis) pick up relatively large amounts of mercury (CUMBIE & JENKINS 1975). The upper limit on food-stuffs has been set at 0.5 ppm at this time but since hair is usually about ten or more times higher than muscle (CUMBIE & JENKINS 1975) only about two of the squirrels out of the 66 may well have been above the EPA level. Fish are commonly so high in Europe that, perhaps as a convenience, the level there has been recently raised to 1 ppm. Squirrels would appear to be a good indicator of mercury presence in the terrestrial environment whereas raccoons, otters, and predatory fish are good indicators of contamination in the aquatic food chain. Exactly how the squirrels acquire mercury in the urban environment is not known at this time.

The cesium levels are most variable in these urban squirrels. In general, we have found low levels in urban squirrels (JENKINS & FENDLEY 1968, WISE 1968) as opposed to squirrels living nearby under wild conditions in rural areas. From a food standpoint, the squirrels were all considered to be at a safe level. The highest squirrel encountered (29,000 pCi/kg) is approaching the level (40,000 pCi/kg) at which children probably should not be eating them (JENKINS & FENDLEY 1968). Adults can probably eat squirrels up to 100,000 pCi/kg with little measurable effect. Strict limits on eating are still somewhat arbitrary since the problem is seldom encountered. Domestic beef is usually 300 pCi/kg or less (JENKINS & FENDLEY 1968). The highest squirrels may well have been feeding previous to collection on mushrooms, acorns, or palmetto berries all of which are known to sometimes be heavy accumulators of  $^{137}\text{Cs}$  (JOHNSON & NAYFIELD 1970, STOCKBRIDGE & JENKINS 1974). The source of this radioactive isotope is assumed to have been fallout from weapons testing previous to 1964. Squirrels appear to be excellent indicators of the quantities of  $^{137}\text{Cs}$  taken up by plants in the environment.

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