Trace Elements in Small Mammal Hair

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INTRODUCTION

Excesses and deficiencies of environmental trace elements can result in pathological conditions for animals including humans living in a given environment. In some of these cases the environmental level of the trace element has been correlated with hair level of the trace element. Sub-pathological but extra-optimal levels of certain elements may influence animal distribution and occurrence and these levels may be reflected in hair. Some trace elements (Pb, Hg, Cd and others) are important pollutants and their levels in the environment are generally increasing. High environmental Pb levels have been shown to correlate directly with Pb levels in pigeon feathers, and preliminary analyses indicate the same conclusion for Hg in pheasant feathers. It seems reasonable to expect hair might likewise provide a sensitive environmental monitor.

Before the role of hair in trace element management can be determined, it must be shown if there is a species-specific hair trace element complement, or if all species in a given environment show essentially the same hair trace elements.

Many analyses of human hair trace elements have been made, but results are inconsistent due to large differences in diet and the application of cosmetics.

Populations of mice and shrews in the same limited habitat would be less subject to such variables. With species of known home-range size and food habits, it could be asserted that the animals caught in the same traps during the same trapping period represent one small segment of the environment. Differences in their hair trace elements would thus be due to species differences in food habits and metabolism.

METHODS

To test for the existence of a species-specific hair trace element complement, four areas less than two acres in size were sampled for mice and shrews. Two non-mineralized control areas, one a sedge-willow marsh, the other a grassy meadow, were located within 0.25 miles of the Jackson Hole Research Station, Wyoming. Collections were made there in July of 1969. The other two areas were selected for known high concentrations of mercury, gold, and molybdenum. Mercury and gold are found at relatively high levels at the confluence of Cottonwood Creek and the Gros Ventre River in Teton County, Wyoming. A sedge-willow marsh at this location was sampled in August, 1970.

The molybdenum area is about 1.25 miles below the American Smelting and Refining Company's molybdenum development in the White Cloud Peaks near Challis, Idaho. A sedge-willow marsh there was sampled in July, 1970.

Species caught and tested were *Microtus pennsylvanicus*, *M. montanus*, *M. richardsoni*, *M. longicaudus*, *Clethrionomys gapperi*, *Zapus princeps*, *Eutamias* sp., and *Sorex vagrans*.

Neutron activation analyses for trace elements were performed at the National Reactor Testing Station in Idaho. Neutron activation is a highly sensitive and accurate method of elemental analysis. When a neutron is added to a stable nucleus, the nucleus is rendered radioactive. Ordinarily the activity is the emission of beta and gamma rays. The energy of the gamma rays is characteristic for each element ("gamma fingerprints"). Determining the gamma ray energy with a spectrometer will thus name the radioactive elements.

Hair samples averaging about 100 mg were pulled with forceps and washed in 1% non-ionic detergent (7-X O'matic) with agitation on a Burrel wrist-action shaker for 20 minutes. The samples were then rinsed with 2 liters of demineralized water and dried overnight at $100^{o}C$. After drying, they were allowed to stand protected from dust at room conditions for at least four hours until moisture equilibrium was attained. The samples were then weighed, packed and sealed in quartz ampules for irradiation.

Irradiations were performed in the Materials Testing Reactor hydraulic rabbit facility at thermal neutron fluxes ranging between 1 and 2 x 10^{14} n/cm^2/sec. for six hours, or after the MTR was shut down permanently, the Engineering Test Reactor at a thermal neutron flux of about 1.7 x 10^{13} n/cm^2/sec. for twenty days. This length of time was much more than necessary, but the ETR had no rabbit facility and the samples had to be left in-tank (near the core) for the full cycle, until the reactor was shut down for refueling.

The samples were allowed to cool for about 200 hours, or until the Na-24, K-42, and Br-82 activity died away sufficiently. After removal from the quartz ampules, elemental content of the hair was determined by gamma-ray spectrometry, utilizing Ge(Li) detectors of about 25, 30, and 60 cubic centimeter volumes, and multi-channel analyzers of 1024 and 4096 channels.

The gamma-ray spectra were analyzed by the Super Gauss program on an IBM 360/75 computer, by the Gamma Analyses Package on a PDP-9 comupter, or by the PKS and 50DT programs, an on-line analysis with a PDP-8 computer. Each program computes the activity (number of gamma rays detected per unit time) of each gamma ray peak, which is compared with the activity of a standard of known weight for each element analyzed to give quantitative results. It is beyond the scope of this report to discuss the relative advantages of each program.

RESULTS AND DISCUSSION

Tim W. Clarke trapped and identified in 1969, and Franz J. Camenzind identified the species of animals caught in 1970.

At this time, analyses are not complete and conclusions would be premature. Table I summarizes the qualitative results obtained up to the present. This work should be complete by early 1971.

TABLE I

Trace Element Content of Small Mammal Hair, Jackson Hole, Wyoming, July, 1969. ? Denotes Less Than 0.01 mg Present in the Sample

		Elements Detected (T 1/2 > 400 hours)						
Microtus pennsylvanicus	1	Se	Zn	Fe				
	2	Se	Zn					
	3	Se	Zn					
	4	Se	Zn		Sc?			
	5	Se	Zn	Fe	Sc	Sb?		
	6	Se	Zn				Cd	
	7	Se	Zn				Cd	
	8	Se	Zn				Cd	
	9	Se	Zn	Fe				
	10	Se	Zn		Sc?		Cd	
	11	Se	Zn				Cd	
	12	Se	Zn				Cd	
Clethrionomys gapperi	1	Se	Zn	Fe		Sb	Cd	Ag
	2	Se	Zn	Fe			Cd?	Ag?
	3	Se	Zn	Fe				Ag?
	4	Se	Zn	Fe				Ag?
	5	Se	Zn				Cd	Ag?
	6	Se	Zn				Cd	Ag
	7	Se	Zn		Sc		Cd	Ag
	8	Se	Zn		Sc		Cd	Ag
	9	Se	Zn		Sc	Sb	Cd	Ag
	10	Se	Zn		Sc	Sb?	Cd	Ag
Sorex vagrans	1	Se	Zn	Fe		Sb	Cd	Ag
	2	Se	Zn	Fe?		Sb	Cd	Ag
	3	Se	Zn			Sb	Cd	Ag
	4	Se	Zn			Sb	Cd	Ag
	5	Se	Zn			Sb	Cd	Ag
	6	Se	Zn			Sb	Cd	Ag
	7	Se	Zn	Fe?		Sb		Ag?
	8	Se	Zn			Sb		Ag
	9	Se	Zn			Sb		Ag

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