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Orchard substrates, in general, provide excellent conditions for pine vole (<u>Pitymys pinetorum</u>) growth and reproduction as indicated by the distribution and abundance of pine voles within orchard situations in the eastern United States (Gourley and Richmond, 1972). However, the specific characteristics which are attractive to pine voles and facilitate their proliferation are poorly understood. The basis for selection of any particular habitat component by the pine vole is in large part a function of the vole's physiological requirements, because the physiological needs of the animals must be met by appropriate habitat resources. Thus, information on specific habitat parameters critical to pine vole survival can be obtained from an understanding of pine vole physiology. In this investigation, we present evidence that pine voles have very high water requirements and suggest that one habitat component of some importance to their survival is a high level of water availability.

Water metabolism of laboratory reared pine voles was assessed during 5 days exposure to 15° or 30°C. Ten adult voles assigned to each treatment group were weighed and then housed singly in plastic cages equipped with hardward cloth bottoms. Water, in inverted graduated cylinders, and food (Big Red rabbit food) were provided <u>ad libitum</u>. After the voles were exposed to 15° or 30° for 24 hr, the cage was placed over a pan of mineral oil and a urine sample collected for measurement of concentration. A second concentration determination was made on day 5 of temperature exposure for some voles, but because the early and late samples did not differ in concentration a single sample was collected for most voles. The voles were then transferred to clear, plexiglas metabolism chambers through which air was pumped for measurement of evaporative water loss. Hardware cloth partitions in the bottom of the chambers suspended the animals over a layer of mineral oil; this prevented evaporation of water from urine and feces. After the voles equilibrated for 1 hr, a preweighed tube of silica gel was placed in the air outlet of the chamber for 1 hr. If an animal became particularly active, as assessed by visual observation, the tube was disconnected and then reinserted into the airline after activity ceased. Subsequently, the voles were removed from the chambers, weighed and injected intraperitoneally with 50 ul^3H_2O (15 uCi). Urine samples were collected once or twice daily for 4 days and analyzed for ^3H_2O concentration. Using standard regression techniques, an expression for loss of tritiated water with increasing time was developed for each vole; biological half-life of ^3H_2O was calculated as ln 2/k where k is the slope of the associated regression line (Richmond et al., 1960).

Food and water consumption were measured during the last 3 days of temperature exposure. Daily preformed water intake was determined by calculating the amount of food consumed and the moisture content of the food. Similarly, oxidative water intake was calculated from daily food consumption which was corrected for fecal loss, and the manufacturer's suggested food composition.

Fecal water loss was determined from the weight of daily dried fecal material and the moisture content of 2 fresh fecal samples. Lastly, daily urinary water loss was calculated as the numerical difference between total daily water inputs and outputs. Data were analyzed by means of Student's t test.

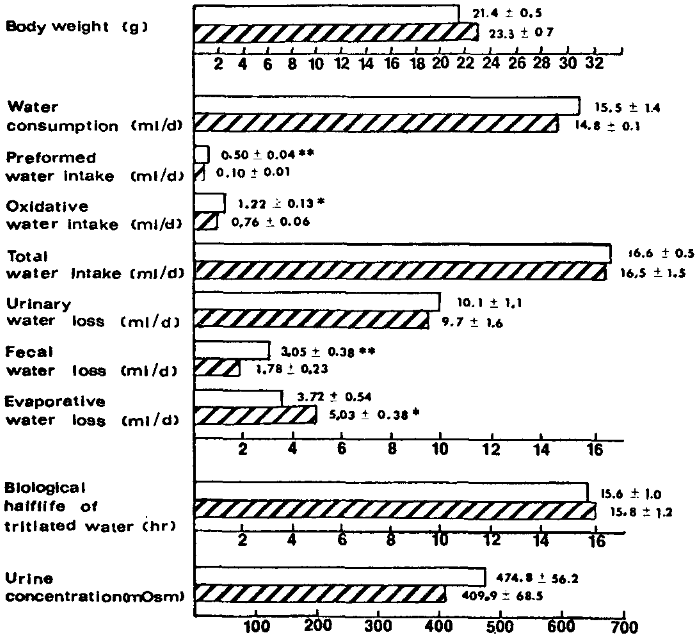

Figure 1. Summary of water metabolism in the pine vole, *Pitymys pinetorum*. Clear bars represent 15° treatment and striped bars represent 30° treatment. Values represent means ± one standard error of the mean. (*P <0.05; **P <0.01)

High rates of water use by voles were observed in both temperature treatments (Fig. 1); total daily water inputs represented 77% and 71% of the average body weight at 15° and 30°, respectively. Cold exposed mice exhibited increases in food consumption relative to voles maintained at 30° and, as a result, obtained significantly more water from food moisture and from oxidation of food components than did mice kept at 30°. Fecal loss of water was significantly elevated in cold exposed mice, whereas evaporative water loss was significantly greater in voles maintained at 30°. Daily water consumption and urinary output were high relative to other similar sized microtine and non-microtine rodents (Church, 1966; Deavers and Hudson, 1977). Urine concentrating ability was also similar between temperature treatments, but indicated a poor ability to conserve water. Similarly, the biological halflife of tritiated water did not differ between temperature treatments but indicated a very rapid turnover of body water in pine voles.

The results from this investigation indicate that pine voles have very poor mechanisms for water conservation and that high levels of water availability are critical to their survival. Furthermore, these results suggest that pine voles may require very moist habitat conditions as has been suggested for other voles (Odum, 1944; Chew, 1951). This requirement may be particularly pronounced in pine voles not only because of their physiological need for large amounts of water, but also because moist soil adds to the integrity of the vole's tunnel system. Thus, two potential methods for pine vole control are suggested by this study: 1) management of pine vole physiology with substances such as diuretics which could elevate water losses to the point of exceeding water inputs, and 2) management of orchard substrate first to reduce moisture content thereby achieving a decrease in free water availability and second to render the soil drier and less amenable to tunnel formation. Future studies will be concerned with the investigation of each of these possibilities.

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