

stratification and favorable higher temperatures. However, it is known that gibberellins are naturally occurring growth regulators that are synthesized in various plant parts, including seeds, in response to particular levels of environmental factors (Paleg, 1965); these levels presumably forecast conditions favorable for growth.

If the species examined constitute a fair representation of the range of variability among all species of mountain rangeland with respect to germination requirements, then the treatments and combinations used in this study may have wider applicability for inducing rapid and nearly complete germination. In particular, if a species fails to respond to photoperiodic and alternating temperature treatments, and if scarification, leaching, or removal of certain accessory parts is not indicated, then a successful treatment may include stratification of seeds in water or GA₃ for three to four months before a return to higher temperature. A modification of this treatment, whereby the imbibed seeds are transferred from a higher temperature to 2°C, also may be considered.

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Radionuclide Deposition and Elimination in a Darkling Beetle¹

The introduction of man-made radioactive materials into the biosphere has prompted the study of food chains to identify the kinds of organisms that accumulate radionuclides. Selected radionuclides are useful in ecological studies to aid in the identification of animal food sources and to determine rates of food consumption (Wiegert, Odum and Schnell, 1967).

This paper reports on the elimination rate (biological half-time) and gross pattern of body distribution of ¹³⁴Cs, ⁸⁵Sr, ⁶⁵Zn, and ²²Na in a darkling beetle, *Eleodes hispilabris*, one of the conspicuous ground dwelling insects of desert steppe ecosystems.

Materials and Methods Employed

Field trapped beetles were brought indoors and accommodated to a diet of dry oatmeal flakes and water supplied ad libitum. Each beetle, maintained separately in a pasteboard carton, was fed oatmeal flakes containing about 2 microcuries of radionuclide. After ingesting the treated flakes, the beetles were supplied a radionuclide-free diet. The rate of elimination of radionuclide was determined by periodically counting each beetle for radioactivity over a four- to five-week period. For counting purposes each beetle was placed inside a test tube which in turn was inserted into a 3 x 3 inch well-type NaI(Tl) gamma ray detector crystal. The influence of environmental temperature upon radionuclide retention was studied by maintaining beetles in incubators held at temperature regimes of 23° C and 32° C. Relative humidity was held at 80 per cent. Experiments with ²²Na and ⁶⁵Zn were conducted under room conditions.

Samples of voluntary muscle, exoskeleton and internal organs were taken four weeks after radioisotope administration to obtain information concerning the body distribution of ⁸⁵Sr and ¹³⁴Cs.

In this investigation, biological half-time ($T_{1/2}$) is regarded as the amount of time required for a particular loss component to decrease by a factor of two.

The elimination component half times were obtained by fitting lines to the retention curves by the least squares method (Snedecor, 1956). The line fitting technique was begun on the slowest phase component to allow for a correction of its contribution to radioisotope loss during the initial rapid loss phase (or phases).

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Results and Discussion

Cesium-134

The initial loss of ^{134}Cs from the beetles was characterized by rapid elimination. During the first week more than 95 per cent of the ingested radionuclide had been eliminated (Figure 1). Cesium was still being eliminated after the first week but much more slowly. Beetles maintained under the 32°C temperature regime lost cesium more rapidly than beetles maintained at 23°C . The $T_{1/2}$ of the rapid loss component was calculated at 1.0 day for the 32°C beetles as compared to 1.5 days for the 23°C beetles. The difference in rates was statistically significant ($\alpha = 0.05$). The faster loss of ^{134}Cs by the beetles maintained at 32°C is partially attributed to increased daily food consumption, since they consumed about 40 per cent more food each day than 23°C beetles.

After four weeks, less than 1 per cent of the ingested cesium remained in the beetle regardless of temperature regime. The remaining cesium was mostly associated with exoskeleton and muscle rather than internal organs (Table 1). According to

TABLE 1. Percentage of initial body burden of ^{134}Cs and ^{85}Sr per milligram tissue in *E. hispilabris* 28 days post-labeling.*

	^{134}Cs	^{85}Sr
Abdominal Organs	0.17 ± 0.04	1.69 ± 0.24
Muscle	0.61 ± 0.08	0.33 ± 0.09
Exoskeleton	0.67 ± 0.08	0.06 ± 0.01

* Labeled beetles were held in incubators at 23°C and 80% R. H.
 \pm Standard error, $n = 9$ for ^{134}Cs and $n = 6$ for ^{85}Sr .

Crossley and Pryor (1960), cesium is rapidly assimilated in the insect body so that the rapid loss component seen here probably does not represent fecal passage of non-assimilated radionuclide but turnover of cesium incorporated into tissues.

Strontium-85

A two component curve represented the loss of ^{85}Sr at 23°C and 32°C temperature regimes (Figure 2). The biological half times of the rapid elimination components were not significantly different ($\alpha = 0.05$) regardless of temperature regime. The biological half time of ^{85}Sr from beetles of the 32°C and 23°C temperature regime was 1.8 days and 1.5 days respectively. The $T_{1/2}$ of the slow loss components was also similar, i.e., 11 and 12 days. The time zero intercept of the slow phase component of 23°C was about 78 per cent, whereas the corresponding value at 32°C was only 27 per cent. Under the higher temperature regime the rapid loss phase was predominant over a 12 day period as compared to only a six day period under the lower temperature. The concentration of ^{85}Sr at the end of 28 days was higher in internal organs than in either muscle or exoskeleton (Table 1). It is reasonable to expect that strontium would accumulate in beetle tissues in a fashion similar to its chemical analog, calcium. Mineral analyses of beetles (*Chrysomelidae*) have indicated that haemolymph is a site of calcium accumulation (Florkin and Jeuniaux, 1964). It is likely that accumulations of calcium occur in the eggs of gravid females. The late summer beetles used in these investigations did not have well developed eggs because oviposition occurs in the spring (Wakeland, 1926).

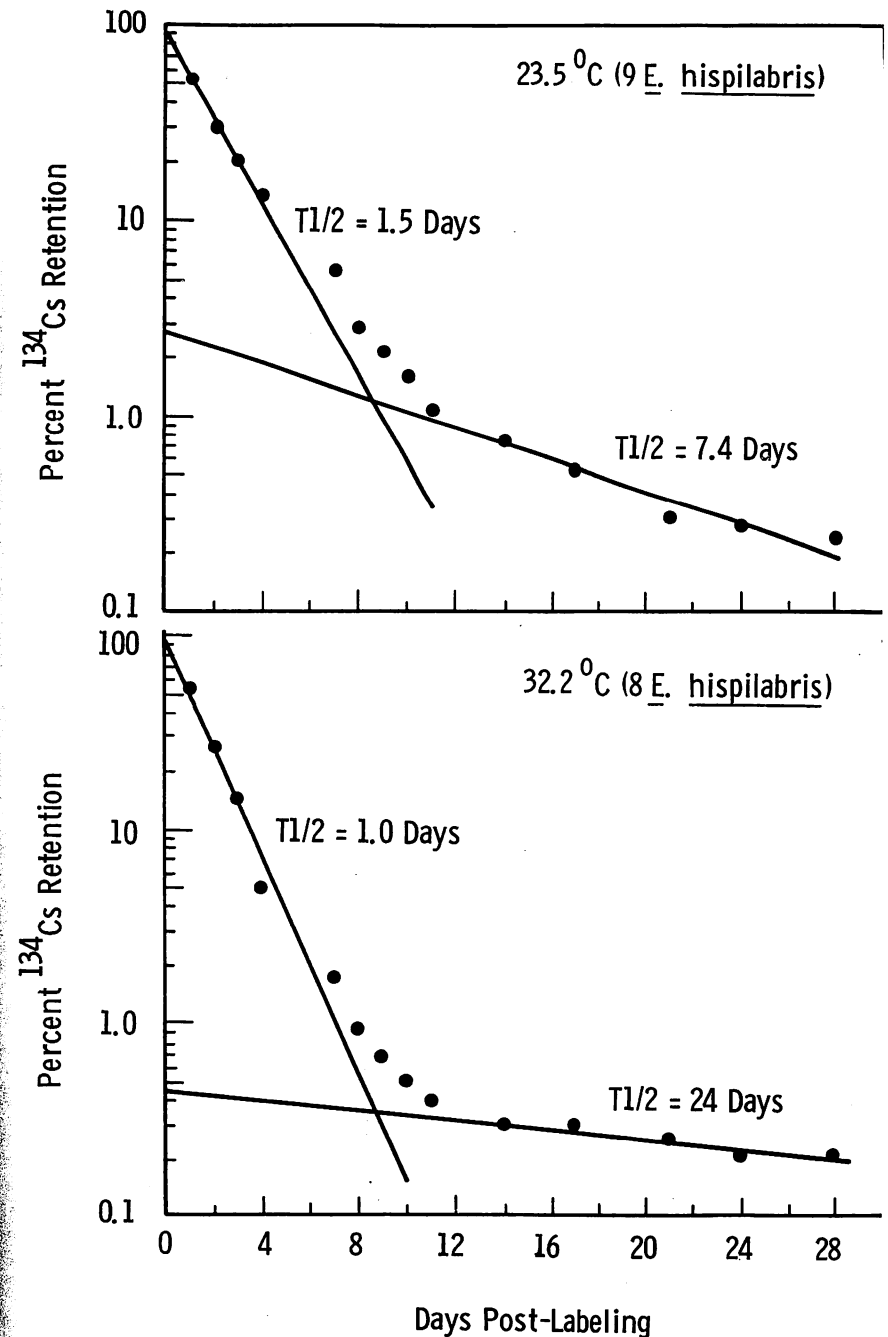


Figure 1. Comparison of elimination curves and biological half-time ($T_{1/2}$) of ^{134}Cs in *Eleode hispilabris* held at 23.5°C and 32.2°C for 28 days post-labeling.

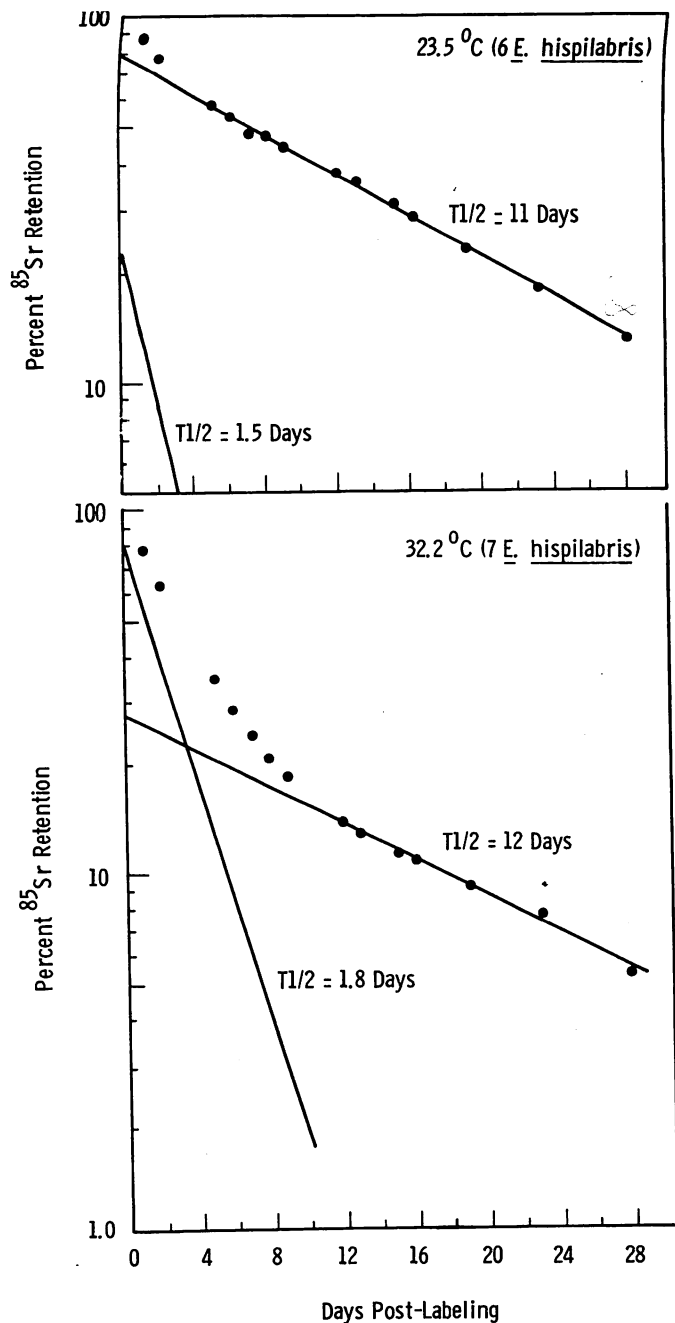


Figure 2. Comparison of elimination curves and biological half-time ($T_{1/2}$) of ^{85}Sr in *Eleodes hispilabris* held at 23.5° and 32.2° C for 28 days post-labeling.

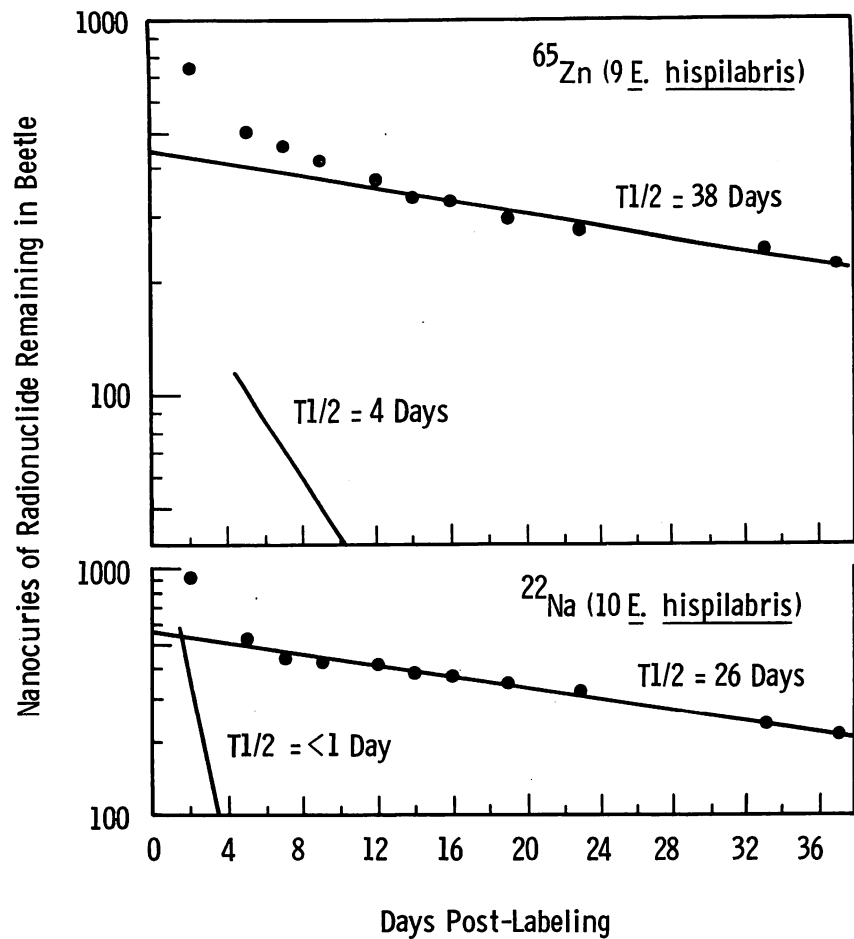


Figure 3. Comparison of elimination curves and biological half-time ($T_{1/2}$) of ^{65}Zn and ^{22}Na in *Eleodes hispilabris* at room temperatures for 36 days post-labeling.

Zinc-65 and Sodium-22

The retention of ^{22}Na is illustrated by the curves in Figure 3. A two component curve was apparent for ^{22}Na as it was for cesium and strontium. About 80 per cent of the sodium was lost during the first week. Only 5 per cent remained after 37 days.

Zinc-65 loss differed from the other experimental radionuclides in that three different elimination rates were discernible (Figure 3). About 50 per cent of the ingested zinc was lost during the rapid and intermediate elimination phases. At the end of 37 days about 20 per cent of the ^{65}Zn remained in the beetles. In vertebrate animals ^{65}Zn was observed to be associated with melanistic pigments (Buhler, 1967). The long retention of ^{65}Zn in *Eleodes* also suggests a possible association with the black pigments of the exoskeleton.

Ecological Considerations

The accumulation of radionuclides by insects has received little attention from the viewpoint of a potential human health hazard because insects are usually not directly in a food chain that leads to man (Crossley and Pryor, 1960). However, insects play an important role in the breakdown of plant litter and are an important part of the biological cycling of essential mineral elements in deciduous forest ecosystems. In desert steppe regions, annual production of plant material is low and litter does not accumulate on the soil surface in appreciable amounts. *Eleodes hispilabris* feeds upon a variety of living and dead plant material above ground as adults but the larvae are mostly subterranean. Tagging plants with radionuclides would appear to be one way to contribute to the knowledge of consumer organisms of semi-arid regions. Radionuclides would also be useful in determining the roles of mineral elements under different temperature and moisture regimes and in the discrete life cycle stages of darkling beetles.

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Association News

Biology of Alder Symposium Proceedings Published

Proceedings of the symposium, sponsored by the Botany-Zoology and Forestry Section at the 1967 NWSA meeting at Pullman, have been published by courtesy of the Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture. The proceedings, entitled "Biology of Alder" and edited by J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, include 28 papers and a total of 297 pages. Topics include aspects of *Alnus* taxonomy, distribution, ecology, soil and micro biological relationships, physiology, and growth and yield. Individual copies may be obtained without charge by addressing a request to the Director, Pacific Northwest Forest and Range Experiment Station, Box 3141, Portland, Oregon, 97208.

Constitution Changes Proposed

Some proposed changes in the constitution of the Northwest Scientific Association will be voted on at the annual meeting (Eastern Washington State College, Cheney March 21-22, 1969). They are outlined below.

Present Constitution—Article III

Article III. Membership

Membership in this Association shall be divided into the following classes:

- (1) Member: Anyone interested in the purpose of the Association may become a member on the annual payment of four dollars.
- (2) Student Member: Any college student, graduate or undergraduate, may become a member of the Association upon the payment of annual dues of two dollars: Student members shall receive *Northwest Science* and will have all privilege except voting and holding office.
- (3) Institutional Member:
 - a. State universities, colleges, and similar educational institutions with enrollments of 2,500 or more—Annual dues, \$25.
 - b. Teachers colleges, junior colleges, or other educational institutions with enrollments less than 2,500 and professional organizations—Annual dues, \$10
- (4) Honorary Life Member: An individual who has given unusual service to the Association or who has attained outstanding recognition in his field may be elected to Honorary Life Membership at an annual meeting by a vote of three fourths of the members present.
- (5) Sustaining Member: An individual may become a sustaining member by paying annual dues of \$10 or more a year. A business organization, state or Federal agency may become a sustaining member through payment of annual dues of \$25 or more a year.
- (6) Honorary Trustees: Chosen as provided in Article V, Section 2.