**Cover Sheet for a Hanford
Historical Document
Released for Public Availability**

Released 1994

**Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830**

**Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute**

CLASSIFICATION			DOCUMENT IDENTIFICATION NO.																																
UNCLASSIFIED			BNWL-SA-3047																																
<div>BATTELLE B NORTHWEST</div> <div>BATTELLE MEMORIAL INSTITUTE</div> <div>PACIFIC NORTHWEST LABORATORIES</div> <div>POST OFFICE BOX 999 / RICHLAND, WASHINGTON 99352</div>			COPY AND SERIES NO. 1 -																																
TITLE AND AUTHOR			DATE																																
Autoradiographic Studies Of ⁶⁵ Zn Adsorption By Periphyton			February 2, 1970																																
FL ROSE AND CE CUSHING			CONTRACT ☐ - 1830 ☐ - 1831																																
			PROJECT NO.																																
			RESERVED FOR TECHN. INFO. USE																																
<div>DISTRIBUTION</div> <table border="1"><thead><tr><th>NAME</th><th>COMPANY</th><th>LOCATION</th><th>NAME</th><th>COMPANY</th><th>LOCATION</th></tr></thead><tbody><tr><td colspan="3" rowspan="2"><div>RECORD COPY</div></td><td colspan="3" rowspan="2"><div>RECORD COPY</div></td></tr><tr></tr></tbody></table>						NAME	COMPANY	LOCATION	NAME	COMPANY	LOCATION	<div>RECORD COPY</div>			<div>RECORD COPY</div>																				
NAME	COMPANY	LOCATION	NAME	COMPANY	LOCATION																														
<div>RECORD COPY</div>			<div>RECORD COPY</div>																																
<table border="1"><thead><tr><th>ROUTE TO</th><th>PAYROLL NO.</th><th>COMPANY</th><th>LOCATION</th><th>FILES ROUTE DATE</th><th>SIGNATURE AND DATE</th></tr></thead><tbody><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td>MASTER</td></tr></tbody></table>						ROUTE TO	PAYROLL NO.	COMPANY	LOCATION	FILES ROUTE DATE	SIGNATURE AND DATE																								MASTER
ROUTE TO	PAYROLL NO.	COMPANY	LOCATION	FILES ROUTE DATE	SIGNATURE AND DATE																														
					MASTER																														
UNCLASSIFIED CLASSIFICATION																																			

RECORD COPY

BATTELLE NORTHWEST
FEB 25 1970
REFERENCE COPY
TECHNICAL INFO. SECTION

RECORD COPY

RECORD COPY

MASTER

7P

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, make any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

AUTORADIOGRAPHIC STUDIES OF ⁶⁵ZN ADSORPTION BY PERIPHYTON

ABSTRACT

Autoradiographic studies have shown that the major site of ^{65}Zn adsorption in natural, mat-like periphyton is on the upper surface of the community and that there is a diffusion gradient within the community. Expression of results from short-term spiking experiments should thus be presented on an areal rather than gravimetric basis.

Mineral cycling in periphyton communities is conveniently studied by using radionuclides as tracers. There are, however, questions as to whether to express rates and quantities on an areal or gravimetric basis. Nelson, Kevern, Wilhm, and Griffith (1) present data suggesting that uptake of ^{32}P by periphyton is a community surface phenomenon; and Rose and Cushing (2) found that cycling data were more meaningful when expressed on an areal rather than gravimetric basis.

The present experiment was designed to determine, by autoradiographic techniques, whether the entire periphyton community is uniformly exposed to the ambient water or whether there is a diffusion gradient within the community. This information would be important relative to quantifying data in gravimetric or areal terms. Natural Columbia River periphyton communities were cultured on paraffin blocks until a mature mat-like colony dominated by diatoms was present, as judged by morphological characters. The periphyton community was then placed in a two-liter beaker containing $0.45\ \mu$ filtered river water with a ^{65}Zn concentration of 10 nCi/ml for 24 hrs. Water was circulated by a stream of air from an air stone. After air drying, the paraffin blocks and periphyton were suspended in large paraffin boats and imbedded in Paraplast Plus under vacuum. This essentially resulted in an intact periphyton community suspended in paraffin. Five micron thick sections were cut, taken to a darkroom, transferred to Kodak NTB nuclear track plates which were then stored in light-tight boxes at 5 C for 14 days, developed, and covered for permanent mounts. Sites of ^{65}Zn deposition show up microscopically as small black spots (3).

Comparison of the autoradiographs of a test (a) and control (b) cross section of the natural periphyton community (Fig. 1) shows the site of ^{65}Zn deposition as being on the upper surface and within the upper layers of the community; the control section is clear. The fact that the ^{65}Zn is present

mainly on the surface and in decreasing amounts within the community indicates that radionuclide uptake in these communities is largely a surface phenomenon and that there is a diffusion gradient within the periphyton.

Whitford and Schumacher (4) have discussed the interactions of currents and diffusion gradients in determining mineral uptake by algae. Our results extend this relationship to entire algal communities. Cushing (5) found significant correlations among various limnological factors and ^{32}P and ^{65}Zn accumulation by periphyton when data were expressed on an areal rather than gravimetric basis, even though the periphyton had colonized clean substrates and were exposed to the radionuclides throughout their growth period. Neal, Patten, and DePoe (6) present data showing high activity-densities (dpm/mg) when periphyton biomass was low, and low activity-densities when biomass was high. They suggest that uptake may be linear over a certain range of biomass but as the mass increases, proportional accumulation diminishes; they refer to this as a hyperbolic "weight dilution" effect. Harvey and Patrick (7) and Watts and Harvey (8) give data relating uptake of radionuclides, expressed on a gravimetric basis, in batch and continuous flow systems. In general, uptake was higher in the batch cultures and the authors attributed this to a biological dilution effect due to the increased growth rate in the continuous flow system. Harvey suggests that cell division in the lower layers of a periphyton community would tend to dilute the activity per cell, hence per weight, and that upper layers would have more radioactivity (9). This is similar to the interpretations of Neal et al. (6) and would be consistent with the present findings and those of Cushing (5). Whittaker (10) reported results of ^{32}P uptake by weight of sessile algae communities in "spiked" aquaria; but the combination of varying ambient concentration, as a result of cycling, and new growth during the extended time of the study confuse the interpretation of the periphyton uptake data.

The evidence from the autoradiographs and the literature indicates that data from short-term nutrient cycling experiments, including ^{14}C productivity studies, involving the "spiking" of intact periphyton communities should be expressed on an areal rather than gravimetric basis. Caution is advised in interpretation of data from studies of periphyton exposed to radionuclides during all or part of their growth period, or when significant growth occurs during an experiment.

F. L. Rose*

C. E. Cushing

Ecosystems Department

Pacific Northwest Laboratories

Battelle Memorial Institute

Richland, Washington 99352

REFERENCES AND NOTES

1. D. Nelson, N. Kevern, J. Wilhm, and N. Griffith, Water Res. 3, 367 (1969).
 2. F. Rose and C. Cushing, in preparation.
 3. The nuclear tracks are a result of the Auger electron decay of ^{65}Zn .
N. Dockum, Hanford Biology Research Annual Report for 1961, p. 97,
Hanford Atomic Products Operation, Richland, Washington (1962).
 4. L. Whitford and G. Schumacher, Limnol. Oceanog. 6, 423 (1961).
 5. C. Cushing, Hydrobiologia. 29, 125 (1967).
 6. E. Neal, B. Patten, and C. DePoe, Ecology. 48, 918 (1967).
 7. R. Harvey and R. Patrick, Biotechnol. Bioeng. 9, 449 (1967).
 8. J. Watts and R. Harvey, Limnol. Oceanog. 8, 45 (1963).
 9. R. Harvey, personal communication.
 10. R. Whittaker, Ecol. Monographs. 31, 157 (1961).
 11. Work performed under Contract No. AT(45-1)-1830 between the U.S. Atomic Energy Commission and Battelle Memorial Institute while the senior author was on an AEC Post-doctoral Fellowship. We thank V. Faubert and J. Beamer for their assistance with the autoradiographic work and our colleagues for criticizing the manuscript.
- * Present address: Department of Biology, Idaho State University, Pocatello, 83201.

FIGURE LEGEND

Fig. 1 (a) test and (b) control autoradiographs of periphyton communities. Paraffin substrates were at bottom edge of both communities. Arrows indicate darkened areas of ^{65}Zn deposition.