View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by UNT Digital Library

LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

UCRL-PROC-222294

A novel method to develop an otolith microchemistry model to determine striped bass habitat use in the San Francisco Estuary

C. C. Phillis, D. J. Ostrach, M. Gras, Q. Yin, B. L. Ingram, J. G. Zinkl, P. K. Weber

June 21, 2006

4th Biennial CalFed Science Conference
Sacramento, CA, United States
October 23, 2006 through October 25, 2006

This document was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor the University of California nor any of their employees, makes 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 the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or the University of California, and shall not be used for advertising or product endorsement purposes.

Updated October 14, 2003

A novel method to develop an otolith microchemistry model to determine striped bass habitat use in the San Francisco Estuary

C.C. Phillis(1); D.J. Ostrach (2); Michelle Gras (3); Quing-Zhu Yin (4); B.L. Ingram (1); J.G. Zinkl (2); P.K. Weber(5)

(1) Department of Earth and Planetary Science, University of California, Berkeley, 307 McCone Hall, Berkeley, CA 94720-4767
(2) Department of Pathology, Microbiology & Immunology, School of Veterinary Medicine, University of California at Davis, Davis, CA 95616
(3) Department of Agronomy and Range Science, University of California at Davis, Davis, CA 95616
(4) Department of Geology, University of California at Davis, Davis, CA 95616
(5) Chemical Biology and Nuclear Science, Lawrence Livermore Laboratory, L-231, P.O. Box 808, Livermore, CA 94551-0808

Otolith Sr/Ca has become a popular tool for hind casting habitat utilization and migration histories of euryhaline fish. It can readily identify habitat shifts of diadromous fish in most systems. Inferring movements of fish within estuarine habitat, however, requires a model of that accounts of the local water chemistry and the response of individual species to that water chemistry, which is poorly understood. Modeling is further complicated by the fact that high marine Sr and Ca concentrations results in a rapid, nonlinear increase in water Sr/Ca and $^{87}Sr/^{86}Sr$ between fresh and marine waters. Here we demonstrate a novel method for developing a salinity-otolith Sr/Ca model for the purpose of reconstructing striped bass (*Morone saxatilis*) habitat use in the San Francisco Bay estuary. We used correlated Sr/Ca and $^{87}Sr/^{86}Sr$ ratios measurements from adult otoliths from striped bass that experienced a range of salinities to infer striped bass otolith Sr/Ca response to changes in salinity and water Sr/Ca ratio. Otolith $^{87}Sr/^{86}Sr$ can be assumed to accurately record water $^{87}Sr/^{86}Sr$ because there is no biological fractionation of Sr isotopes. Water $^{87}Sr/^{86}Sr$ can in turn be used to estimate water salinity based on the mixing of fresh and marine water with known $^{87}Sr/^{86}Sr$ ratios. The relationship between adjacent analyses on

otoliths of Sr/Ca and $^{87}Sr/^{86}Sr$ by LA-ICP-MS and MC-ICP-MS ($r^2 = 0.65$, n = 66) is used to predict water salinity from a measured Sr/Ca ratio. The nature of this non-linear model lends itself well to identifying residence in the Delta and to a lesser extent Suisun Bay, but does not do well locating residence within the more saline bays west of Carquinez Strait. An increase in the number of analyses would improve model confidence, but ultimately the precision of the model is limited by the variability in the response of individual fish to water Sr/Ca.

Portions of this work were performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.