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Standard Guide for Conducting In-situ Field Bioassays With Caged Bivalves[1]

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1. Scope

1.1 This guide describes procedures for conducting controlled experiments with caged bivalves under field conditions. The purpose of this approach is to facilitate the simultaneous collection of field data to help characterize chemical exposure and associated biological effects in the same organism under environmentally realistic conditions. This approach of characterizing exposure and effects is consistent with the US EPA ecological risk assessment paradigm. Bivalves are useful test organisms for in-situ field bioassays because they (*1*) concentrate and integrate chemicals in their tissues and have a more limited ability to metabolize most chemicals than other species, (*2*) exhibit measurable sublethal effects associated with exposure to those chemicals, (*3*) provide paired tissue chemistry and response data which can be extrapolated to other species and trophic levels, (*4*) provide tissue chemistry data which can be used to estimate chemical exposure from water or sediment, and (*5*) facilitate controlled experimentation in the field with large sample sizes because they are easy to collect, cage, and measure **(1, 2)**[2]. The experimental control afforded by this approach can be used to place a large number of animals of a known size distribution in specific areas of concern to quantify exposure and effects over space and time within a clearly defined exposure period. Chemical exposure can be estimated by measuring the concentration of chemicals in water, sediment, or bivalve tissues, and effects can be estimated with survival, growth, and other sublethal end points **(3)**. Although a number of assessments have been conducted using bivalves to characterize exposure by measuring tissue chemistry or associated biological effects, relatively few assessments have been conducted to characterize both exposure and biological effects simultaneously **(2, 4, 5)**. This guide is specifically designed to help minimize the variability in tissue chemistry and response measurements by using a practical uniform size range and compartmentalized cages for multiple measurements on the same individuals.

1.2 The test is referred to as a field bioassay because it is conducted in the field and because it includes an element of relative chemical potency to satisfy the bioassay definition. Relative potency is established by comparing tissue concentrations with effects levels for various chemicals with toxicity and bioaccumulation end points **(6, 7, 8, 9, 10)** even though there may be more uncertainty associated with effects measurements in field studies. Various pathways of exposure can be evaluated because filter-feeding and deposit-feeding are the primary feeding strategies for bivalves. Filter-feeding bivalves may be best suited to evaluate the bioavailability and associated effects of chemicals in the water column (that is, dissolved and suspended particulates); deposit-feeding bivalves may be best suited to evaluate chemicals associated with sediments **(11, 12)**. It may be difficult to demonstrate pathways of exposure under field conditions, particularly since filter-feeding bivalves can ingest suspended sediment and facultative deposit-feeding bivalves can switch between filter- and deposit feeding over relatively small temporal scales. Filter-feeding bivalves caged within 1 m of bottom sediment have also been used effectively in sediment assessments from depths of 10 to 650 m **(5, 13, 14)**. Caged bivalve studies have also been conducted in the intertidal zone **(15)**. The field testing procedures described here are useful for testing most bivalves although modifications may be necessary for a particular species.

1.3 These field testing procedures with caged bivalves are applicable to the environmental evaluation of water and sediment in marine, estuarine, and freshwater environments with almost any combination of chemicals, and methods are being developed to help interpret the environmental significance of accumulated chemicals **(6, 7, 9, 16, 17)**. These procedures could be regarded as a guide to an exposure system to assess chemical bioavailability and toxicity under natural, site- specific conditions, where any clinical measurements are possible.

1.4 Tissue chemistry results from short- and long-term exposures can be reported in terms of concentrations of chemicals in bivalve tissues (for example, µg/g), amount (that is, weight or mass) of chemical per animal (for example, µg/animal), rate of uptake, or bioaccumulation factor (BAF, the ratio between the concentration of a chemical in bivalve tissues and the concentration in the external environment, including

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[2] The boldface numbers in parentheses refer to references at the end of this standard.

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