

environmental toxicology *and* risk assessment

third volume

**Jane Staveley Hughes
Gregory R. Biddinger
Eugene Mones**
editors



STP 1218

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Environmental Toxicology and Risk Assessment: Third Volume

*Jane Staveley Hughes, Gregory R. Biddinger,
and Eugene Mones, Editors*

ASTM Publication Code Number (PCN)
04-012180-16



ASTM
1916 Race Street
Philadelphia, PA 19103
Printed in the U.S.A.

Library of Congress Cataloging-in-Publication Data

ISBN 0-8031-1895-3

ISSN 1071-720x

ASTM Publication Code Number (PCN) 04-01280-16

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Peer Review Policy

Each paper published in this volume was evaluated by three peer reviewers. The authors addressed all of the reviewers' comments to the satisfaction of both the technical editor(s) and the ASTM Committee on Publications.

To make technical information available as quickly as possible, the peer-reviewed papers in this publication were printed "camera-ready" as submitted by the authors.

The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of these peer reviewers. The ASTM Committee on Publications acknowledges with appreciation their dedication and contribution to time and effort on behalf of ASTM.

Foreword

This publication, *Environmental Toxicology and Risk Assessment: Third Volume* contains papers presented at the symposium of the same name held in Atlanta, GA on 26–29 April 1993. The symposium was sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate. Jane S Hughes of Caroline Ecotox, Inc. in Durham, NC, Gregory R. Biddinger of Exxon Company USA in Benecia, CA, and Eugene Mones of Unilever Research U.S. in Edgewater, NJ presided as chairs, and are the editors of the resulting publications.

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Overview

The Third Symposium on Environmental Toxicology and Risk Assessment: Aquatic, Plant and Terrestrial was held in Atlanta, GA, during 26–29 April 1993. This symposium was actually the 17th consecutive annual ASTM symposium to address environmental toxicology and related issues. The symposium was sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, and the platform and poster presentations were integrated over the four days with meetings of the various subcommittees that are actively engaged in developing the consensus standards for which ASTM is so well known.

A featured highlight of the symposium was a series of sessions on “The Exxon Valdez: Environmental Response and Assessment,” in which the Exxon Valdez oil spill was examined as a “case study” in ecological risk assessment. The presentations from this portion of the symposium are published in a separate volume entitled *The Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters*, edited by Peter Wells, James Butler, and Jane Hughes (ASTM STP 1219).

The theme of the symposium was a review of “Critical Issues in Environmental Toxicology and Risk Assessment.” It is a testament to the development of the field that we have come to the stage of refining those issues that are most critical to taking the next steps in advancing the science of estimating the fate and effects of chemicals in the environment. Across various matrices, over different levels of organization, from molecular to ecosystem, in the lab, in the field, and through models, we seek essentially the same types of information in order to improve the predictive value of our risk assessments.

The plenary session began with a presentation entitled “Critical Issues in Ecological Risk Assessment.” This paper, by Bartell and Biddinger, reviews the current technical status of ecological risk assessment and offers suggestions for advancing the discipline. The prospects for standardization of procedures and methods for ecological risk analysis are discussed, and an argument is presented for adoption of environmental planning to minimize the future need to assess ecological risks.

The remaining 22 papers in this STP have been organized into 5 groups. However, it is indicative of the maturation of the field of environmental toxicology that most of the papers could be placed in a number of categories. Boundaries between traditional categories have become blurred, as we read about plants used to assess the toxicity of sediments, laboratory tests used to assess multiple environmental matrices, and field techniques integrating exposure and effects.

The papers in the first section, “Ecotoxicology: Prediction and Assessment,” are concerned with the estimation and measurement of ecological effects. A protocol for rapid bioassessment, based upon the characterization of the macroinvertebrate community, was used to assess the biological condition of a stream by Vigna et al. DeSesso describes a three-phased approach to ecological risk assessment at hazardous waste sites including the determination of ecological quotients, assessment of biological diversity, and population studies. Linder et al. compare and contrast field and laboratory methods used for evaluating contaminant-impacted wetlands at two different sites. Matthews et al. present a tool for the analysis of multispecies data based upon an artificial intelligence technique known as nonmetric clustering, which characterizes a complex, multivariate system.

For the first time in this ASTM series, a significant number of papers are presented that address "Models in Ecological Risk Assessment." Ferson and Long compare the merits of dependency bounds analysis with Monte Carlo methods for yielding conservative risk estimates with realistic uncertainty. The use of a screening-level model is compared to the use of a more refined food web model for assessing bioaccumulation of Polychlorobenzene (PCBs) in Lake Ontario by Scott and Trowbridge. Based upon multivariate analysis of data from aquatic microcosms (a.k.a. "Wayne's Worms"), Landis et al. challenge the assumption that, after the initial stress, ecosystems recover to resemble the "unchaotic" control state. Physiologically structured models focusing on the individual were used to study the effects of nonpolar narcotic chemicals on two predator-prey systems by Jaworska et al. On the molecular scale, Schultz et al. describe the use of volume fraction analyses to distinguish different mechanisms of toxic action.

Continued interest in the topic, "Sediment Toxicology," is reflected in the next four papers. Weber et al. present procedures used to identify the effects of contaminated sediments on rooted aquatic plants through the use of laboratory toxicity tests involving natural and artificial sediments. Methods for conducting a 28-day sediment bioassay with a marine polychaete for use in the evaluation of dredged material are presented by Dillon et al. Salazar and Salazar measured bioaccumulation and growth to estimate chemical exposure and bioeffects for caged mussels. Transplanted mussels were also used by Salazar et al. to assess the extent and magnitude of contamination in water overlying the sediment at a Superfund site in Puget Sound.

Five papers examine the "Fate and Effects of Chemicals." Wilson et al. used grass shrimp embryos to determine the effects of estuarine sediment on the toxicity and persistence of diflufenzuron in two laboratory microcosm systems. Hovatter and Ross performed a comparative analysis of the toxicity of boron compounds to freshwater and saltwater fish and invertebrates. Fleming et al. examined net photosynthesis and respiration rates for sago pondweed exposed to various concentrations of 11 herbicides. An approach to develop a broad Quantitative Structure-Activity Relationships (QSAR), applicable to surfactants, to predict octanol-water partition coefficients based upon general molecular structural parameters is discussed by Moschner and Cece. This chapter concludes with a review of recent developments and critical issues in the growing field of Lifecycle Assessment by Postlethwaite.

Last, but certainly not least in the hearts and minds of die-hard ASTM members, are the papers addressing "Methods Development." The development and refinement of new methods to assess exposure and toxicity are crucial to progress in the field of risk assessment. Black et al. discuss the development and use of a special chamber to isolate the various xenobiotic elimination routes in fish. The design and use of an automated biomonitoring system using fish ventilatory response and activity as the detector of toxicity is the subject of the paper by Gruber and Frago. Gorsuch et al. discuss the use of vertically mounted seed pouches to assess the effects of heavy metals on the growth of terrestrial plants. Three different modifications to the ASTM Test Method for Biodegradability of Alkylbenzene Sulfonates (D 2667) for biodegradability were investigated by Nielsen et al.

We would like to thank the session chairs for their efforts in organizing the sessions and assistance in selecting manuscript reviewers: Ecological Risk Assessment: Models, Steve Bartell (SENES Oak Ridge, Inc., Oak Ridge, TN); Plants in Toxicity Assessments, Mike Lewis (U.S. EPA, Gulf Breeze, FL) and Nancy Lane (Westinghouse Hanford Co., Richland, WA); Sediment Toxicology, Chris Ingersoll (National Biological Survey, Columbia, MO); Ecological Risk Assessment at Contaminated Sites, Steve Friant (Battelle Pacific Northwest Laboratories, Richland, WA) and Suellen Pirages (Karch and Associates, Washington, DC); Environmental Neurotoxicology, Behrus Jahan-Parwar (NY State Department of Health, Albany, NY); Product Life-Cycle Assessment, Jim Fava (Roy F. Weston, Inc., West Chester,

PA); Research Trends in Ecological Risk Assessment, Greg Linder and Jerry Barker (Mantech Environmental Technology, Inc., Corvallis, OR); Aquatic Toxicology, Jerry Diamond (Tetra Tech, Inc., Owings Mills, MD) and Ian Hartwell (MD Department of Natural Resources, Annapolis, MD); and Poster Session, John Walker (U.S. EPA, Washington, DC). Our gratitude is also extended towards the ASTM staff members that assisted with planning the symposium and with the publication of this volume: Dorothy Savini (Symposium Planning); Kathy Dernoga, Therese Pravitz, and Shannon Wainwright (Acquisitions and Review); Susan Canning (Committee E-47 Staff Manager); and also Ken St. John (representative of Committee on Publications, University of Mississippi).

We would also like to express our appreciation to all of the people who volunteered to review the papers in this volume for their insights and constructive comments. Thanks are also due to the authors of the manuscripts for their patience and cooperation with the publication process.

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ISBN 0-8031-1878-3