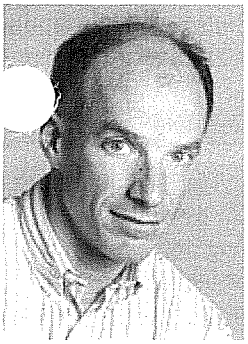

DAVID L. SEDLAK

- Professor of Civil & Environmental Engineering

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Civil and Environmental Engineering
657 Davis Hall
University of California
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Teaching and Research

Professor Sedlak teaches graduate courses in environmental chemistry, water quality engineering and ecological engineering. He also teaches a freshman class in engineering design and analysis. He is group leader for the environme engineering program and an undergraduate advisor for undeclared students inthe College of Engineering.

Professor Sedlak anticipates teaching the classes listed below in the next two academic years. Full descriptions of these classes can be seen in the on-line course catalog.

Semester	Course No.	Course Title	Meeting Times
Fall 2006, 2007	CE 115	Water Chemistry	Tu/Th 11-12:30
Fall 2007	E 10	Engineering Design and Analysis	MWF 11-12
Spring 2007, 2008	CE 217	Environmental Chemical Kinetics	MWF 10-11

Professor Sedlak's research interests are related to the fate and transport of pollutants in the aquatic environment. Rece developments, descriptions of representative projects and publications are listed below.

Ongoing research projects

- The Fate of Hormones in the Aquatic Environment
- The Fate of Wastewater-Derived Contaminants in Effluent-Dominated Waters
- Formation and Fate of NDMA in Water Recycling Systems
- Oxidation of Contaminants by Iron Nanoparticles in the Presence of Oxygen
- News Story About Recent Publication

A Few Recent Publications

[The underlined text will lead you to the abstract for the paper. The DOI will lead you to the full paper if you a viewing this page from a site that has a license for the journal where the paper was published.]

- Pehlivanoglu-Mantas E., Hawley E.L., Deeb R.A. and Sedlak D.L. (2006) Formation of nitrosodimethylamine (NDMA) during chlorine disinfection of wastewater effluents prior to use in irrigation systems. *Water Researc* 341-347.
- Fono L.J. and Sedlak D.L. (2005) Use of the chiral pharmaceutical propranolol to identify sewage discharg surface waters. *Environ. Sci. Technol.*, 39, 9244-9252. DOI: 10.1021/es047965t
- Hsu-Kim H. and Sedlak D.L. (2005) Similarities between inorganic sulfide and the strong Hg(II)-complexing li in municipal wastewater effluent. *Environ. Sci. Technol* 39(11):4035-4041. DOI : 10.1021/es050013i
- Mehrotra A.S. and Sedlak D.L. (2005) Decrease in net mercury methylation rates following iron amendment to anoxic wetland sediment slurries. *Environ. Sci. Technol.* 39, 2564-2570. DOI: 10.1021/es049096d
- Gray J.L. and Sedlak D.L. (2005) The fate of estrogenic hormones in an engineered treatment wetland with den macrophytes. *Water Environ. Res.*,77, 24-31.
- Sedlak D.L., Deeb R.A., Hawley E.L., Mitch W.A., Durbin T.D., Mowbray S., Carr S. (2005) Sources and fate nitrosodimethylamine and its precursors in municipal wastewater treatment plants. *Water Environ. Res.*, 77, 32
- Joo S.H., Feitz A.J., Sedlak D.L. and Waite T.D. (2005) Quantification of the oxidizing capacity of nanoparticu zero-valent iron. *Environ. Sci. Technol.*, 39, 1263-1268. DOI: 10.1021/es048983d
- Kolodziej E.P., Harter T. and Sedlak D.L. (2004) Dairy wastewater, aquaculture and spawning fish as sources o steroid hormones in the aquatic environment. *Environ. Sci. Technol.*, 38, 6377-6384. DOI: 10.1021/es049585d 10.1021/es049585d
- Pehlivanoglu E., and Sedlak D.L. (2004) Bioavailability of wastewater-derived organic nitrogen to the alga Selenastrum Capricornutum. *Water Research,* 38(14-15): 3189-3196. DOI:10.1016/j.watres.2004.04.027
- Mitch W.A. and Sedlak D.L. (2004) Characterization and fate of NDMA precursors in municipal wastewater treatment plants. *Environ. Sci. Technol.*, 38, 1445-1454.
- Pinkston, K.E. and Sedlak D.L. (2004) Transformation of aromatic ether- and amine-containing pharmaceutical during chlorine disinfection. *Environ. Sci. Technol.*, 38, 4019-4025. DOI: 10.1021/es03536811

Links

- Complete Curriculum Vitae
- Environmental Engineering Group
- Department of Civil and Environmental Engineering
- UC Berkeley

Recent Graduates

- Bill Bedsworth (Bridgespan Group, San Francisco)
- James Gray (Postdoc, USGS Boulder, CO)
- Helen Hsu (Assistant Professor, Duke University)
- Ed Kolodziej (Assistant Professor University of Nevada-Reno starting January 2007)
- Anna Mehrotra (Consultant, CDM Pittsburgh, PA)
- William Mitch (Assistant Professor, Yale University)-
- Elif Pehlivanoglu-Mantas (Lecturer, Istanbul Teknik Universitesi, Turkey)
- Karen Pinkston (US Nuclear Regulatory Commission)
- Alavanja Ridge (US Nuclear Regulatory Commission)
- Laurel Schaider (Postdoc/Harvard University)

CURRICULUM VITAE

JOHN P. KNEZOVICH, Ph.D.

John Knezovich is the director of the Center for Accelerator Mass Spectrometry (CAMS) at the Lawrence Livermore National Laboratory (LLNL) and serves as the director of the UC Toxic Substances Research and Teaching Program (UC TSR&TP). He also is an adjunct Professor of Environmental Chemistry at UC Davis. Knezovich has extensive experience in the design and application of experimental approaches for determining the fate, transport and toxicity of contaminants in the environment. In particular, he has assessed the bioavailability of heavy metals that are discharged from nuclear power stations; assisted the EPA's Office of Toxic Substances in the development of risk assessment strategies for the registration of new chemical products; evaluated the potential impacts of mutagenic contaminants and radiation on aquatic organisms; and assessed the risks posed by sediment-sorbed contaminants. As director of CAMS, he oversees a team of scientists who are applying ion-beam analytical techniques to environmental, biomedical, and national security research. As director of the UC TSR&TP, he is focused on establishing interdisciplinary research and education programs that meet existing and emerging needs within California.

EDUCATION

B.A. (Biological Science), University of the Pacific, Stockton, California (1977)
M.S. (Chemical Ecology), University of California, Davis (1980)
Ph.D. (Chemical Ecology), University of California, Davis (1983)

PROFESSIONAL EXPERIENCE

Director, Center for Accelerator Mass Spectrometry, Energy & Environment Directorate, Lawrence Livermore National Laboratory, Livermore, California (1998-Present)
Director, University of California Toxic Substances Research & Teaching Program (2004-Present)
Adjunct Professor of Environmental Chemistry, Department of Environmental Toxicology, University of California, Davis, California (2002-Present)
Instructor, Hazardous Materials Management Program, University of California, Santa Cruz, (1992-Present)
Associate Director, University of California Toxic Substances Research & Teaching Program (2002-2004)
Group Leader, Environmental Chemistry and Toxicology, Health & Ecological Assessment Division, Lawrence Livermore National Laboratory, University of California, Livermore, California (1993-1998)
Staff Scientist, Environmental Sciences Division, Lawrence Livermore National Laboratory, University of California, Livermore, California (1986-1993)
Postdoctoral Research Scientist, Environmental Sciences Division, Lawrence Livermore National Laboratory, Livermore, California (1983-1986)

COMMITTEE MEMBERSHIPS AND PROFESSIONAL SERVICE RELEVANT TO AQUATIC TOXICOLOGY AND RISK ASSESSMENT

Peer Reviewer, "*Methodology for Derivation of pesticide Water Quality Criteria for the Protection of Aquatic Life in the Sacramento River Watershed,*" Central Valley Regional Water Quality Control Board (2006)
Chair, Science Advisory Board, University of California, Pacific Estuarine Ecosystem Indicator Research Program (2001-2006)
Peer Review Panels for Toxicology, Aquatic Toxicology, Environmental Chemistry, Water Disinfection Byproducts, and Graduate Research Fellowships, Office of Research and Development, U.S. Environmental Protection Agency (1996-present)
Scientific Planning and Review Committee, Bay Protection and Toxic Cleanup Program, California State Water Quality Control Board (1996-2001)
Chair, Mercury Program Scientific Review Committee, Water Environment Research Foundation (1998-2001)
World Health Organization Exposure Assessment Working Group, International Commission for Protection Against Environmental Mutagens and Carcinogens (1991-1993)

Board of Directors, Northern California Chapter, Society of Environmental Toxicology and Chemistry (1998-2000)

Session Chair, "Biotransformation and Biodegradation," Society of Environmental Toxicology and Chemistry Annual Mtg., Nashville, Tennessee (November 12-17, 2000)

Program Chair, 18th Annual National Meeting of the Society of Environmental Toxicology and Chemistry, San Francisco, California (1997)

Session Chair, 14th Annual ASTM Symposium on Aquatic Toxicology, San Francisco, California (April 22-24, 1990)

JOURNAL REVIEWER

Aquatic Toxicology, Chemosphere, Ecotoxicology & Environmental Safety, Environmental Science & Technology, Environmental Toxicology & Chemistry, Journal of Agricultural Chemistry, Marine Environmental Research, Nuclear Instruments and Methods in Physics Research

AWARDS

C.M. Boye Full Academic Scholarship (1973-1983)
Jastro-Shields Graduate Research Scholarship (1982)
Donald G. Crosby Outstanding Alumni Award, University of California, Davis (2001)

PUBLICATIONS RELEVANT TO AQUATIC TOXICOLOGY AND RISK ASSESSMENT

F.L. Harrison and J.P. Knezovich, "Effects of Radiation on Aquatic and Terrestrial Organisms," in *Radioecology: Radioactivity & Ecosystems*, E. Van der Stricht and R. Kirchmann Eds. (International Union of Radioecology, Liege, Belgium) Chapter V, pp. 317-375 (2001).

P.A. O'Day, S. A. Carroll, S. Randall, R.E. Martinelli, J.A. Jelinski, S.L. Anderson and J.P. Knezovich, "Metal Speciation and Toxicity in Contaminated Estuary Sediments, Alameda Naval Air Station, California," *Environmental Science and Technology* **34**, 3665-3673 (2000).

J.P. Knezovich, S.L. Anderson, J. Jelinski and R.E. Martinelli, "Pore-Water and Sediment Ecotoxicity Studies of Seaplane Lagoon and West Beach Landfill Wetlands, Alameda Naval Air Station," Berkeley Environmental Restoration Center, University of California, Berkeley (Final Report, 1999).

D. Layton, B. Napier, L. Gomez, J. Knezovich and M. Varela, "Introduction," in *Radionuclides in the Arctic Seas from the Former Soviet Union: Potential Health and Ecological Effects*, D. Layton, R. Edson, M. Varela and B. Napier Eds., Arctic Nuclear Waste Assessment Program, Office of Naval Research, Chapter 1 (November, 1997).

W. Templeton, F. Harrison, J. Knezovich, N. Fischer and D. Layton, "Bioconcentration of Radionuclides in Marine Food-Web Organisms," in *Radionuclides in the Arctic Seas from the Former Soviet Union: Potential Health and Ecological Effects*, D. Layton, R. Edson, M. Varela and B. Napier Eds., Arctic Nuclear Waste Assessment Program, Office of Naval Research, Chapter 4 (November, 1997).

F. Harrison, J. Knezovich and D. Layton, "Assessment of Risks to Marine Aquatic Populations Resulting From Exposures to Radionuclides in Arctic Seas," in *Radionuclides in the Arctic Seas from the Former Soviet Union: Potential Health and Ecological Effects*, D. Layton, R. Edson, M. Varela and B. Napier Eds., Arctic Nuclear Waste Assessment Program, Office of Naval Research, Chapter 5, (November, 1997).

J.P. Knezovich, D.J. Steichen, J. Jelinski and S.L. Anderson, "Sulfide Tolerance of Four Marine Species Used to Evaluate Sediment and Pore-Water Toxicity," *Bull. Environm. Contam. Toxicol.* **57**, 450-457 (1996).

F.L. Harrison and J.P. Knezovich, "Radiobiological Endpoints Relevant to Ecological Risk Assessment," in Proceedings of Radiological Impacts from Nuclear Facilities on Non-human Species, (Canadian Nuclear Society and Canadian Radiation Protection, Ottowa, Canada, 1996).

J.P. Knezovich and R.E. Martinelli, "A Methodology for Assessing the Impact of Mutagens on Aquatic Ecosystems," Lawrence Livermore National Laboratory, Livermore, CA, UCRL-JC-120466 (1995).

S.L. Anderson, J.P. Knezovich, J. Jelinski and D.J. Steichen, "The Utility of Using Pore-Water Toxicity Testing to Develop Site-Specific Marine Sediment Quality Objectives for Metals," Final Report to the U.S. Army Corps of Engineers, LBL-37615/UC-000 (1995), pp. 44.

J.P. Knezovich, "Chemical and Biological Factors Affecting Bioavailability of Contaminants in Seawater," in *Bioavailability: Physical, Chemical, and Biological Mechanisms*, J. Hamelink, P. Landrum, H. Bergman, and W. Benson, Eds. (CRC Press, Inc., Boca Raton, FL, 1994) Chapter 2, pp. 23-30.

R. J. Erickson, T.D. Bills, J.R. Clark, D.J. Hansen, J.P. Knezovich, F.L. Mayer, and A.E. McElroy, "Synopsis of Discussion Session on Physicochemical Factors Affecting Toxicity," in *Bioavailability: Physical, Chemical, and Biological Mechanisms*, J. Hamelink, P. Landrum, H. Bergman, and W. Benson, Eds. (CRC Press, Inc., Boca Raton, FL, 1994) Chapter 3, pp. 31-38.

S.L. Anderson, J.E. Hose, and J.P. Knezovich, "Genotoxic and Developmental Effects in Sea Urchins are Sensitive Indicators of Effects of Genotoxic Chemicals," *Environ. Toxicol. Chem.* **13**, 1033-1042 (1994).

E.R. Hoffman, S.L. Anderson, and J.P. Knezovich, "Determinants of Sediment Toxicity in San Francisco Bay," Final Report to the U.S. Army Corps of Engineers, LBL-36592/UC-000 (1994), pp. 125.

D.W. Layton, T.E. McKone, J.P. Knezovich, and J.J. Wong, "Assessment of Exposures to Genotoxic Substances," in *Methods for Genetic Risk Assessment,* D. Brusick, Ed. (CRC Press, Inc., Boca Raton, FL, 1994), Chapter 13, pp. 29–63.

J.P. Knezovich and L.S. Inouye, "The Influence of Sediment and Colloidal Material on the Bioavailability of a Quaternary Ammonium Surfactant," *Ecotox. Environ. Safety* **26**, 253-264 (1993).

J.P. Knezovich, "Ecological Risk Assessment?," *SETAC News* **14(1)**, 12 (1994).

S.R. Hansen and J.P. Knezovich, "Development of a Site-Specific Criterion for Copper for San Francisco Bay," Final Report, California Regional Water Quality Control Board, San Francisco Bay Region, Oakland, CA, (1992), pp. 124.

F.L. Harrison, J.P. Knezovich, and R.E. Martinelli, "Representative Benthic Bioindicator Organisms for Use in Radiation Effects Research: Culture of *Neanthes arenaceodentata* (Polychaeta)," EPA 520/1-91-018. U.S. Environmental Protection Agency, Washington, DC (1991).

J.P. Knezovich, "The Metabolic Transformation of Aromatic Amines in Marine Bivalves and Implications for Genotoxic Effects," *J. Shellfish Res.* **8**, 437–438 (1989).

S.R. Hansen, J.P. Knezovich, S.L. Anderson and J.I. Daniels, "Risk Assessment: Coagulant Use at the Kuparuk Seawater Treatment Plant," Final Report, ARCO Alaska, Inc, Anchorage, AK, (December, 1989), pp. 79.

R.E. Martinelli, J.P. Knezovich, and F.L. Harrison, "Radiation-Induced DNA Strand Breakage and Repair in the Marine Polychaete *Neanthes arenaceodentata*," *Mar. Env. Res.* **28**, 329–332 (1990).

F.L. Harrison and J.P. Knezovich, "Sublethal Effects of Contaminants on the Metabolism of Metals and Organic Compounds in the Bay Mussel," in *San Francisco Bay: Issues, Resources, Status, and Management. NOAA Estuary-of-the-Month Seminar Series No. 6*, pp. 107–123 (U.S. Department of Commerce, NOAA Estuarine Programs Office, 1987).

J.P. Knezovich, M.P. Lawton, and F.L. Harrison, "*In Vivo* Metabolism of Aromatic Amines by the Bay Mussel, *Mytilus edulis*," *Mar. Env. Res.* **24**, 89–91 (1988).

J.P. Knezovich and F.L. Harrison, "The Bioavailability of Sediment-Sorbed Chlorobenzenes to Larvae of the Midge, *Chironomus decorus*," *Ecotox. Environ. Safety* **15**, 226–241 (1988).

J.P. Knezovich, "Biodegradation of Organic Contaminants," *Energy and Technology Review*, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-52000-88-7, p. 69 (1988).

J.P. Knezovich, J. Hirabayashi, D. Bishop, and F. Harrison, "The Influence of Different Soil Types on the Fate of Phenol and Its Biodegradation Products," *Chemosphere* **17**, 2199–2205 (1988).

J.P. Knezovich, M.P. Lawton, and L.S. Inouye, "Bioaccumulation and Tissue Distribution of a Quaternary Ammonium Surfactant in Three Aquatic Species," *Bull. Environ. Contam. Toxicol.* **42,** 87-93 (1989).

J.P. Knezovich, F.L. Harrison, and R. Wilhelm, "The Bioavailability of Sediment-Sorbed Organic Chemicals: A Review," *Water, Air Soil Pollut.* **32**, 233–245 (1987).

J.P. Knezovich and F.L. Harrison, "A New Method for Determining the Concentrations of Volatile Organic Compounds in Sediment Interstitial Water," *Bull. Env. Contam. Toxicol.* **38**, 937–940 (1987).

F.L. Harrison, J.P. Knezovich, D.W. Rice, Jr., and J.R. Lam, "Distribution, Fate, and Effects of Energy-Related Residuals in Marine Environments," in *Physiological Responses of Marine Organisms to Environmental Stresses*, J.V. Dorigan and F.L. Harrison, Eds, Chapter 13, DOE/ER-0317, pp. 251–292 (U.S. Department of Energy, Washington, DC, 1987).

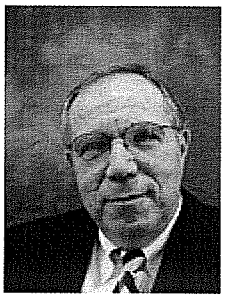
J.P. Knezovich and D.G. Crosby, "The Comparative Metabolism of *o*-Toluidine by the Abalone (*Haliotis rufescens*) and Flatfish (*Platichthys stellatus*)," *Environ. Toxicol. Chem.* **5**, 387–392 (1986).

J.P. Knezovich and D.G. Crosby, "The Fate and Metabolism of *o*-Toluidine in the Marine Bivalve Molluscs *Mytilus edulis* and *Crassostrea gigas*," *Environ. Toxicol. Chem.* **4**, 435–446 (1985).

F.L. Harrison, J.P. Knezovich, and D.W. Rice, Jr., "The Toxicity of Copper to the Adult and Early Life Stages of the Freshwater Clam, *Corbicula manilensis*," *Arch. Environ. Contam. Toxicol.* **13**, 85–92 (1984).

J.P. Knezovich, F.L. Harrison, and J.S. Tucker, "The Influence of Organic Chelators on the Toxicity of Copper to Embryos of the Pacific Oyster, *Crassostrea gigas*," *Arch. Environ. Contam. Toxicol.* **10**, 241 (1981).

Dominic M. Di Toro, Ph.D.
Department of Civil and Environmental Engineering
University of Delaware
Newark, Delaware



Dominic M. DiToro is the Edward C. Davis Professor of Civil and Environmental Engineering at the University of Delaware. He was elected to the National Academy of Engineers in February 2005. His other awards include the Institute of Scientific Information Highly Cited Researcher in 2003 and The Founders Award of the Society of Environmental Toxicology and Chemistry in 1997.

Dr. DiToro has specialized in the development and application of mathematical and statistical models to stream, lake, estuarine and coastal water and sediment quality problems.. He has published over one hundred technical papers, as well as Sediment Flux Modeling, published by J. Wiley & Sons. He has participated as Expert Consultant, Principal Investigator and Project Manager on numerous water quality studies for industry, research foundations and governmental agencies. Recently, his work has focused on the development of water and sediment quality criteria for the EPA, sediment flux models for nutrients and metals, and integrated hydrodynamic, sediment transport and water quality models.

Dr. DiToro received his B.E.E. in electrical engineering with honors from Manhattan College in 1963, his M.A. in electrical engineering from Princeton University in 1965 and his Ph.D. in Civil and Geological Engineering from Princeton in 1967. He joined the faculty of Manhattan College and became the Donald J. O'Connor Professor of Environmental Engineering in 1999. In 2003, he joined the faculty at the University of Delaware.

Dr. DiToro also served as a Senior Research Consulting Engineer at Hydroscience, Inc. from 1969-1980 and was a founding partner of the successor firm HydroQual, Inc, a consulting firm that specializes in water quality modeling, where he was Principal Consultant from 1980 to 2004.

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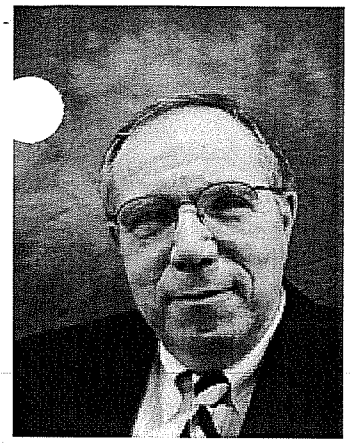

Dominic M. Di Toro

Edward C. Davis Professor of Civil and Environmental Engineering
Department of Civil and Environmental Engineering
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University of Delaware
Newark, DE 19716
Telephone: (302) 831-4094
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Email: dditoro@ce.udel.edu

Election to National Academy of Engineering (February 2005)

Education

Manhattan College: B.E.E., Electrical Engineering (with honor) , 1963

Princeton University: M.A., Electrical Engineering, 1965

Princeton University: Ph.D., Civil and Geological Engineering, 1967

Professional History

03 - present	Edward C. Davis Professor of Civil and Environmental Engineering, University of Delaware

1999 - 2003	Donald J. O'Connor Professor of Environmental Engineering, Manhattan College
1986 - 1999	Research Professor of Environmental Engineering, Manhattan College
1980 - Present	Principal Consultant, HydroQual, Inc.
1974 - 1986	Adjunct Associate Research Professor, Environmental Engineering
1969 - 1974	Adjunct Assistant Professor, Environmental Engineering
1969 - 1980	Senior Research Consulting Engineer, Hydroscience, Inc.
1967 - 1969	Research Associate, Environmental Engineering and Science Program

Representative Experience

Dr. Di Toro has specialized in the development and application of mathematical and statistical models to stream, lake, estuarine, and coastal water and sediment quality problems. He has published over one hundred technical papers, as well as *Sediment Flux Modeling*, published by J. Wiley & Sons. He has participated as Expert Consultant, Principal Investigator, and Project Manager on numerous water quality studies for industry, research foundations, and governmental agencies. Recently his work has focused on the development of water and sediment quality criteria for the EPA, sediment flux models for nutrients and metals, and integrated hydrodynamic, sediment transport and water quality models.

Honors

Member, National Aacdemy of Engineering
Institute of Scientific Information Highly Cited Researcher, 2003
Gordon Conference Chairman (Elected) Environmental Sciences Water - 2002
Sigma Xi - Manhattan College Chapter, Distinguished Alumnus Award - 2000
Society of Environmental Toxicology and Chemistry, The Founders Award - The Society's Highest Award - 1997
New York Water Environment Association, Kenneth Allen Memorial Award - 1994
Department of the Army, Certificate of Achievement - 1991
International Association for Great Lakes Research, The Chandler Misener Award - 1983
American Society of Civil Engineers, Wesley W. Horner Award, 1980
International Association for Great Lakes Research, The Chandler Misener Award - 1978
American Society of Civil Engineers, Samuel A. Greely Award - 1974
American Society of Civil Engineers, Met Section Prize Paper Award - 1970
NSF Cooperative Fellowship, Princeton University 1963-1966
Institute of Radio Engineers - AIEE, Prize Paper Contest - 1963

Professional Affiliations

American Chemical Society
American Geophysical Union
American Society of Civil Engineers
American Society of Limnology and Oceanography
Association of Environmental Engineering and Science Professors
Estuarine Research Federation
Institute of Electrical and Electronic Engineers
International Association for Great Lakes Research
International Water Association

Society of Toxicology and Environmental Chemistry
The Geochemical Society

Courses Taught

Mathematical Water Quality Models
Mathematical Methods
Engineering Statistics
Simulation Analysis
Special Topics in Water Quality

Publications

Books

Di Toro, D.M. Sediment Flux Modeling. J. Wiley and Sons., New York: (2001), 624p.

Edited Books

Paquin, P. R., K. Farley, R. C. Santore, C. D. Kavvadas, K. G. Mooney, R. P. Winfield, K. B. Wu, and D. M. Di Toro, eds. (2003). Metals in Aquatic Systems: A Review of Exposure, Bioaccumulation, and Toxicity Models, SETAC Press, Pensacola, FL.

Peiley, M. C., W. A. Stubblefield, W. J. Adams, D. M. Di Toro, P. V. Hodson, R. J. Erickson, and E. J. Keating Jr., s. (2003). Reevaluation of the State of the Science for Water Quality Criteria Development, SETAC Press, Pensacola, FL.

Water Quality Modeling

Bisceglia, K. J., Rader, K. J., Carbonaro, R. F., Farley, K. J., Mahony, J. D., and Di Toro, D. M. "Iron(II)-Catalyzed Oxidation of Arsenic(III) in a Sediment Column." Environ. Sci. Technol, 39(23) (2005): 9217-9222.

Carbonaro, R., Mahony, J., Walter, A., Halper, E., and Di Toro, D. "Experimental and Modeling Investigation of Metal Release from Metal-Spiked Sediments." Environ. Toxicol. Chem., 24(12) (2005): 3007-3019.

Dombrowski, P. M., Long, W., Farley, K. J., Mahony, J. D., Capitani, J. F., and Di Toro, D. M. "Thermodynamic analysis of arsenic methylation." Environ. Sci. Technol., 39(7) (2005): 2169-2176.

Hellweger, F., K. J. Farley, U. Lall, and D. M. Di Toro (2003). Greedy algae reduce arsenate. Limnol. Oceanogr 48: 2275.

Di Toro, D.M., S.A. Lowe, and J.J. Fitzpatrick. "Application of a water column-sediment eutrophication model to a mesocosm experiment. I. Calibration." J. Environ. Engr. ASCE (submitted)

Lowe, S.A. and D.M. Di Toro. "Application of a water column-sediment eutrophication model to a mesocosm experiment. II. Analysis." J. Environ. Engr. ASCE (submitted)

Di Toro, D.M., J.D. Mahony, D.J. Hansen, and W.J. Berry. "A model of the oxidation of iron and cadmium sulfide in sediments." Environ. Toxicol. Chem. 15 (1996): 2168-2186.

Di Toro, D.M., J.D. Mahony, and A.M. Gonzalez. "Particle Oxidation Model of Synthetic FeS and Sediment AVS." Environ. Toxicol. Chem. 15 (1996): 2156-2167.

Mueller, J.A and D.M. Di Toro. "Multicomponent adsorption of volatile organic chemicals from air stripper offgas. Water Environment Research 65 (1993): 15-25.

Di Toro, D. M., J A. Hallden, and J L. Plafkin. "Modeling Ceriodaphnia Toxicity in the Naugatuck River. II. Copper, Hardness and Effluent Interactions." Environmental Toxicology and Chemistry 10 (1991): 261-274.

Blumberg, A.F and D.M Di Toro. "Effect of climate warming on dissolved oxygen concentrations in Lake Erie." Trans. American Fisheries Society 119 (1990): 210-223.

Di Toro, D. M., P R. Paquin, K Subburamu, and D A. Gruber. "Sediment Oxygen Demand Model: Methane and Ammonia Oxidation." J. Environ. Engr. ASCE 116(5) (1990): 945-986.

Di Toro, D. M., J A. Hallden, and J L. Plafkin. "Modeling Cerodaphnia Toxicity in the Naugatuck River Using Additivity and Independent Action." In Toxic Contaminants and Ecosystem Health; A Great Lakes Focus, 403-425. New York, N.Y.: J. Wiley & Sons, 1988.

Di Toro, D. M., N A. Thomas, C E. Herdendorf, R P. Winfield, and J P. Connolly. "A Post Audit of a Lake Erie Eutrophication Model." J. Great Lakes Res. 13(4) (1987): 801-825.

Di Toro, D. M. "A Diagenetic Oxygen Equivalents Model of Sediment Oxygen Demand." In Sediment Oxygen Demand. Processes, Modeling, and Measurement, 171-208. Athens, GA.: University of Georgia, (1986).

Di Toro, D. M., J S. Jeris, and D Ciarcia. "Diffusion and Partitioning of Hexachlorobiphenyl in Sediments." Enviro Sci. & Technol. 19 (1985): 1169.

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Statistical Models

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Research Projects

University of Delaware

Delaware Research Infrastructure Improvement Program, State of Delaware, EPSCoR Seed Grant Program

Integrated Water Quality Monitoring, Habitat Mapping, and Fish Tracking with an Automated Underwater Vehicle, National Oceanic and Atmospheric Administration

A Prototype System for Multi-disciplinary Shared Infrastructure? Chesapeake Bay Environmental Observatory (CBEO): Concept Development Toward a Collaborative Large Scale Engineering Analysis Network for Environmental Research (CLEANER) with Focus on the Chesapeake Bay, National Science Foundation

CHRP: Linking Water Quality Models with Individual-based Models to Investigate Impacts of Diel-cycling Hypoxia on Nursery Habitat Quality for Estuarine Dependent Fishes, National Oceanic and Atmospheric Administration

oxicity and Mobilization of Metals and Metal Mixtures in Sediments, National Institute of Environmental Health and Safety

Developing a Unit World Model for Metals in Streams and Rivers, Center for the Study of Metals in the Environment. EPA Center

Collaborative Research: Concept Development Toward a Collaborative Large Scale Engineering Analysis Network for Environmental Research (CLEANER) with Focus on the Chesapeake Bay, National Science Foundation

Mechanisms of Genetic and Epigenetic Susceptibility to Superfund Chemicals, NIEHS Superfund Hazardous Substances Research Program (New York University)

Developing a Unit World Model for Metals in Aquatic Environments, Center for the Study of Metals in the Environment. EPA Center

Developing a Model to Predict the Persistence of Metals in Aquatic Environments, Center for the Study of Metals in the Environment. EPA Center

Quantitative Structure Activity Relationships for Toxicity and Fate Parameters of Metal and Metal Compounds, Center for the Study of Metals in the Environment. EPA Center

Manhattan College

Water-Sediment Model and Criteria for Arsenic and Chrome, NIEHS Superfund Hazardous Substances Research Program (New York University, Manhattan College, Rutgers University)

Development of fate and transport models for exposure assessment, Center for the Study of Metals in the Environment, EPA Center

Oxidation of Sediment Bound Silver Sulfide and Application of Sediment Flux Model to Silver, Silver Coalition - Photographic Imaging Manufacturing Association

A Modeling and Experimental Investigation of Metal Release from Contaminated Sediments: The Effects of Metal Sulfide Oxidation and Resuspension, EPA STAR Grant

Bioavailability, Trophic Transfer and Fate of Pollutants in the Aquatic Environment, EPA Cooperative Agreement

Experimental Determination and Modeling of Flux of Copper from Sediments, International Copper Association

Investigating the Toxicity of Silver in Sediments, Silver Coalition

Application of a Modern Eutrophication Model to the MERL Mesocosm Experiments, National Science Foundation

Predicting Toxic Heavy Metal Adsorption and Desorption from Contaminated Soils and Suspensions, NIEHS perfund Hazardous Substances Research Program

HydroQual: 1995 - Present

Development of a Contaminant Fate, Transport, and Toxicity Model for New York Harbor, Hudson River Foundati

Investigation of the Toxicity of Weathered and Non-weathered Oil, ExxonMobil Corporation, USA

Analysis of the Persistence of Metals in Aquatic Systems, Kennecott Copper Company

Review of Nutrient Criteria, Association of Municipal Sewerage Agencies

Development of a Biotic Ligand Model for Silver, Water Environment Research Foundation

Development of Biotic Ligand Model, EPA Office of Water

Technical Support Document of Sediment Quality Criteria, U.S. EPA, Criteria and Standards Division

Development of Sediment Quality Criteria for PAH Mixtures, U.S. EPA, Criteria and Standards Division

Sediment Quality Criteria for PAHs using Narcosis Theory, U.S. EPA, Criteria and Standards Division

Impact of Chromium Contaminated Sediments in Tannery Bay, Cypress AMAX

Long-Range Transport And Deposition: The Role Of Henry's Law Constant, Dow Corning Chemical Company

Review of a Model of the Lagoon of Venice, Delft Hydraulics Laboratory

Silver Risk Assessment, Eastman Kodak Company

Analysis of Cadmium in the Sediments of the Neponset Reservoir, Foxboro Co.

Biotic Ligand Model Review for EPA Science Advisory Board, EPA Office of Water

Development of a New York Harbor Eutrophication Model, New York Department of Environmental Protection

Development of a Biotic Ligand Model for Copper Toxicity, International Copper Association

Sediment Criteria for Zinc: Application to Risk Assessment, International Lead Zinc Research Association

Upper Mississippi River Eutrophication Study - Development of Coupled Eutrophication - Sediment Transport Model, Metropolitan Council Wastewater Services

Development of a Eutrophication Model for the Croton Reservoir Filtration Study, Medcalf and Eddy - Hazen and Sawyer

Investigation of the Impact of the Boston Harbor Outfall. Development of a Eutrophication Model, Massachusetts Water Resources Agency

Fate and Transport of Mine Tailings and Copper from a Copper Mine, Freeport - McMoRan

Model of Calcium Carbonate Precipitation in Onondaga Lake, AlliedSignal Corp.

luation of a PCB Model for Green Bay, State of Wisconsin Department of Environmental Quality

Development of a Wetlands Water Quality Model of the Everglades, South Florida Water Management District

Development of a Sediment Flux Model for Iron and Manganese, U.S. Army Corps of Engineers-Waterways Experiment Station

Development of a Model of Bivalves in Chesapeake Bay, U.S. Army Corps of Engineers-Waterways Experiment Station

Selected Projects - pre-1995

Chesapeake Bay Water Quality Model - Development of Sediment Flux Model, U.S. Army Corps of Engineers-Waterways Experiment Station/U.S. EPA Chesapeake Bay Program

Upper Mississippi River Eutrophication Study - Development of Coupled Eutrophication - Sediment Transport Model, Metropolitan Council Wastewater Services

Development of a Wetlands Water Quality Model of the Everglades, South Florida Water Management District

Development of a Dissolved Oxygen/ Eutrophication Model of New York/New Jersey Harbor (HEM), New York City Department of Environmental Protection, Bureau of Environmental Engineering

/NJ Toxic Metal Wasteload Allocation Model, U.S. EPA, Region II

Long Island Sound Eutrophication Study - Development of a Three Dimensional Eutrophication - Dissolved Oxygen Model, U.S. EPA Regions I and II

Urban Stormwater Manual - Statistical Models for Stormwater Treatment Systems, U.S. EPA, Office of Water

PCB Fate and Transport in Watts Bar Reservoir, McKenna & Cuneo, Washington, D.C. (representing Union Carbide)

Toxicity Modeling Feasibility Study, Naugatuck River, U.S. EPA, Monitoring and Data Support Division

Evaluate Suitability of Toxic Criteria Procedure for Complex Wastewater Discharges in the Naugatuck River, U.S. EPA, Office of Water, Office of Water Regulations and Standards

Development of Sediment Quality Criteria for Metals, U.S. EPA, Office of Water, Health and Ecological Criteria Division, Off ice of Science and Technology

Determination of Water-Sediment Partition Coefficients for Priority Heavy Metals, U.S. EPA, Environmental Research Laboratory

Metals Sediment Quality Criteria Methodology Development, U.S. EPA, Criteria and Standards Division

velopment of Interim Sediment Quality Criteria, U.S. EPA, Criteria and Standards Division

Technical Guidelines Supporting Establishment of Sediment Quality Criteria, U.S. EPA, Office of Water, Health and

Ecological Criteria Division, Off ice of Science and Technology

Sediment Quality Criteria For Five Nonionic Organic Chemicals, U.S. EPA, Office of Water, Health and Ecologic Criteria Division, Off ice of Science and Technology

SQC Science Advisory Board Briefing Document, U.S. EPA, Criteria and Standards Division

Sediment Criteria Workshops, U.S. EPA, Criteria and Standards Division

Waukegan Harbor PCB Project, U.S. EPA, Region V

Professional Activities

Academic Year 2001-2002

Invited Lectures and Seminars

"The Biotic Ligand Model"
International Copper Association Conference.
Woods Hole Oceanographic Institution. Woods Hole, MA. July 2001

"Numerical Water Quality Standards"
Association of Metropolitan Sewerage Agencies (AMSA) Developments in Water & Wastewater Law. Savannah GA November 2001

"Modern Water Quality and Sediment Criteria: Toxicological Interactions"
Environmental Sciences Department. Rutgers University, October 2001

"Modern Water and Sediment Quality Criteria: Toxicological and Chemical Interactions - How Much Is Too Much"
Department of Earth and Environmental Engineering. Columbia University, November 2001

"TMDL Listings and Modern Water Quality Criteria"
Metropolitan Water Reclamation District of Greater Chicago. Cicero IL, March 2002.

Workshops

"Evaluating persistence: suspended solids and sediments"
Workshop on Metals Persistence, Bioaccumulation and Toxicity in Aquatic Systems.
University of Quebec, CA. March 2002

Short Courses

"Understanding Total Maximum Daily Loads, Tools and Techniques for Achieving Reasonable TMDL-Based Limits"
D. Katz, D. M. Di Toro, T. W. Gallagher, A. Thuman, Government Institutes Division, ABS Group Inc. Washington, DC , October 2001

Papers Presented

"The Intrinsic Toxicity of Narcotic Chemicals and PAHs in Pure Phases and Mixtures"
SETAC 22nd Annual Meeting, Baltimore MD. Nov. 2001

Presented Papers Co-authored

"Alternative Approaches for Modeling the Physiological Response of Aquatic Organisms to Acute Metal Toxicity"
P. R. Paquin, V. Zoltay, K.B. Wu, V. Navab, R. Mathew, R. C. Santore, and D. M. Di Toro, SETAC 22nd Annual Meeting, Baltimore MD. Nov. 2001

"Predicting the Effects of Weathering on Crude Oil Using Narcosis Theory: Case Studies"
J. A. McGrath, F. L. Hellweger, W. Stubblefield, D. M. Di Toro, SETAC 22nd Annual Meeting, Baltimore MD. Nov. 2001

"An Application of the Biotic Ligand Model (BLM) Framework for Cadmium"
K.B. Wu, V. Navab, R. C. Santore, P. R. Paquin, D. M. Di Toro, SETAC 22nd Annual Meeting, Baltimore MD. Nov. 2001

"The Partitioning of Silver at Picomolar Concentrations to Humic Material"
J. Mahony, D. M. Di Toro, T. Shadi, K. Rader, SETAC 22nd Annual Meeting, Baltimore MD. Nov. 2001

"An Alternative Approach to PBT for Assessing Hazard of Metals and Metal Compounds"
W. Adams, K. Brix, D. M. Di Toro, P. R. Paquin, H. Allen, P. Campbell, D. DeForest, A. Green, SETAC 22nd Annual Meeting, Baltimore MD. Nov. 2001

Posters Co-authored

"Arsenic Fate and Transport Modeling in Lakes: Approach and Preliminary Results"
F. L. Hellweger, K. Farley, U. Lall, D. M. Di Toro,
Arsenic in Drinking Water - An International Conference at Columbia University. November, 2001

"Estimating the Competition of Other Metals to the Binding of Copper to NOM"
R. Mathew, R. C. Santore, P. R. Paquin, D. M. Di Toro, J. Mitchell
SETAC 22nd Annual Meeting, Baltimore MD. Nov. 2001

"Application of the Biotic Ligand Model to Acute Metal Toxicity for Aquatic Organisms"
R. C. Santore, R. Mathew, V. Navab, V. Zoltay, P. R. Paquin, K.B. Wu, D. M. Di Toro,
SETAC 22nd Annual Meeting, Baltimore MD. Nov. 2001

"Dissolution, Weathering and Toxicity of Exxon Valdez Crude Oil"
F. L. Hellweger, J. A. McGrath, W. Stubblefield, D. M. Di Toro
SETAC 22nd Annual Meeting, Baltimore MD. Nov. 2001

"The Chemical Immobilization of Silver in Sediments when Acid Volatile Sulfide is not Present"
J. Mahony, D. M. Di Toro, T. Shadi, K. Rader, P. Dombrowski
SETAC 22nd Annual Meeting, Baltimore MD. Nov. 2001

Academic Year 2000-2001

Invited Lectures and Seminars

"Review and Comparison of Existing and Developing Standards/Criteria/Screening Guidelines for MGP Sites"
Electric Power Research Institute (EPRI) Conference
Jacksonville FL, October 2000

"Theoretical Approaches to Sediment Quality Guidelines Development and their Applications"
A Short Course on the Collection, Analysis, and Interpretation of Sediment Quality Data
Southern California Coastal Water Research Project (SCCWRP)
Long Beach, CA. October 2000

"Reflections on the History of SETAC. Virtues and Faults. Sins of Omission, Sins of Commission"
Plenary Lecture.
Society of Environmental Toxicology and Chemistry (SETAC)
21st Annual Meeting, Nashville, TN November 2000

"The Chesapeake Bay Eutrophication Model"
Johns Hopkins University, Department of Geography and Environmental Engineering
February 2001

"Modern Water Quality Criteria in the TMDL Modeling Process"
Keynote Speaker
TMDL Science Issues Conference.
Water Environment Federation and ASIWPCA
St. Louis MO, March 2001

"Rational Criteria and Remediation"
Keynote Speaker
33rd Mid-Atlantic Industrial and Hazardous Waste Conference
Manhattan College, Riverdale NY June 2001

Workshops

"Current Structure of the BLM Model"
The Biotic Ligand Model (BLM): Current Status and Future Directions Colloquium sponsored by the Electric Power Research Institute (EPRI)
January 2001, Wash. DC

Short Courses

The Safe Drinking Water Act & Clean Water Act:
1. Understanding the Basics of How Water Quality Standards Are Developed
2. Wet Weather and Nutrients: Special Concerns for Special Problems

The Association of Metropolitan Sewerage Agencies and the Association of Metropolitan Water Agencies (AMSA)
Phoenix, AZ. November 2000

Advanced Study Institute on Recent Developments in Coastal Eutrophication Research: Prediction, Decision Support Systems, and Management
1. Modern Eutrophication Models
2. Sediment Flux Modeling
Supported by the Croucher Foundation

The University of Hong Kong, Hong Kong. February 2001

anhattan College 47th Institute in Water Pollution Control. Water Quality Modeling. A omputer-Based Workshop with Applications to TMDLs. June 2001

Papers Presented

"Sediment Toxicity Prediction"
Conference on Dredged Material Management: Options and Environmental Considerations
Massachusetts Institute of Technology , Cambridge, MA December 3-6, 2000

"Determining Site-Specific Water Quality Criteria for Copper"
WERF 2001 Subscriber Meeting
Washington DC, April 2001

Panel Member

Expert Advisory Panel
Canadian Network of Toxicology Centre
Metals in the Environment Research Program (MITE-RN) March, 2001

Academic Year 1999-2000

Invited Lectures and Seminars

Modeling Contaminant Fate in Aquatic Systems in the New Millennium"
Invited Paper: Gordon Conference, Environmental Sciences: Water, June 2000

"Modeling the Environmental Impacts of Copper Mining in Indonesia"
Department of Civil and Environmental Engineering
University of Delaware, March 2000

Workshops

"Bioavailability of Organic Chemicals and Metals in the Water Column and in Sediments"
Experts Workshop on Review of the State of the Science, PBT Concepts and Metals and Metal Compounds. US EPA and International Council of Metals in the Environment (ICME), January, 2000 Arlington VA

Short Courses

Manhattan College 46th Institute in Water Pollution Control. Water Quality Modeling. A Computer-Based Workshop . June 2000

Papers Presented

"Narcosis and PAH Sediment Criteria"
Electric Power Research Institute (EPRI) Conference, New Orleans, September 1999

"A Mass Balance Model for Use in Evaluating Exposure Levels and Effects of Metals Downstream of Point Source Discharges"

Society of Environmental Toxicology and Chemistry (SETAC)
20th Annual Meeting, Phil. PA November 1999

"Long-Range Transport and Deposition: The Role of Henry's Law Constant"
Society of Environmental Toxicology and Chemistry (SETAC)
20th Annual Meeting, Phil. PA November 1999

"Mechanism of hydrogen sulfide oxidation I. Methodology"
American Chemical Society National Meeting, Computational Methods in Environmental Chemistry
Division of Chemistry in Computers, Division of Geochemistry
San Francisco, CA March 2000

"A Sediment Flux Model for Manganese"
American Chemical Society National Meeting, Division of Environmental Chemistry.
Chemical Speciation and Reactivity in Water Chemistry and Water Technology: A Symposium in Honor of James J. Morgan
Washington DC, August 2000

Presented Papers Co-authored

"MARS: Model for the Assessment and Remediation of Sediments"
Society of Environmental Toxicology and Chemistry (SETAC)
20th Annual Meeting, Phil. PA November 1999, 1999

"Extension of the Biotic Ligand Model of Acute Toxicity of Copper and Silver to Invertebrates"
Society of Environmental Toxicology and Chemistry (SETAC)
20th Annual Meeting, Phil. PA November 1999

"Mechanism of hydrogen sulfide oxidation II. Application"
American Chemical Society National Meeting, San Francisco, CA
Computational Methods in Environmental Chemistry Division of Chemistry in Computers, Division of Geochemistry, March 2000

Posters Co-authored

"Predicting the Toxicity of Metals in Sediments"
Society of Environmental Toxicology and Chemistry (SETAC)
20th Annual Meeting, Phil. PA November 1999
"Defining total PAH concentrations in Field Collected sediments"
Society of Environmental Toxicology and Chemistry (SETAC)
20th Annual Meeting, Phil. PA November 1999
"Orthogonal Distance Regression: An Alternative to Ordinary Least Squares."
Society of Environmental Toxicology and Chemistry (SETAC)
20th Annual Meeting, Phil. PA November 1999
"Assessing the Importance of Environmental Ligands in Determining Metal Speciation and Bioavailability"
Society of Environmental Toxicology and Chemistry (SETAC)
20th Annual Meeting, Phil. PA November 1999
"Sediment Transport Modeling in Green Bay: A precursor to Addressing PCB Fate and Transport"
Society of Environmental Toxicology and Chemistry (SETAC)
20th Annual Meeting, Phil. PA November 1999

Panel Member

rcury Source-Receptor Relationships Expert Panel
ponsored by EPRI. Madison WI, May 2000

Expert Review Panel: Channel Deepening Project. Modeling Review.
Port of New York and New Jersey Authority

Academic Year 1998-1999

Invited Lectures and Seminars

"PAH Sediment Quality Criteria: Narcosis Theory and EPA Guidelines"
PSE&G. Newark, NJ. Sept. 1998

Debate: "Equilibrium Partitioning vs. Empirically Based Criteria"
SETAC Conference Charlotte, NC. Nov. 1998

"The Biotic Ligand Model and its Applicability to Water Quality Criteria"
EPA Science Advisory Board: Wash. DC, April 1999

Workshops

Hudson River Foundation
RP Workshop. NYC. Oct. 1998
A Sponsored Workshop: Dissolved Oxygen Criteria.
Annapolis, MD. Nov. 1998
Hudson River Foundation
CARP Workshop. NYC. Dec. 1998
Silver Water and Sediment Criteria Workshop.
Kodak. Rochester, NY. May 1999

Short Courses

Manhattan College 45th Institute in Water Pollution Control. Water Quality Modeling. A Computer-Based Workshop. June 1999

Papers Presented

"PAH Mixture Criteria and the Narcosis Model"
SETAC Regional Meeting. Presented Paper Newark, NJ. Sept. 1998

"Biotic Ligand Model and Silver Water Quality Criteria"
SETAC Conference Charlotte, NC. Nov. 1998

"Metals Criteria and Environmental Impacts"
ternational Corrosion Conference Galveston TX, Feb. 1999

"Bioavailability of Metals in the Water Column and Sediment"
SETAC Europe Conference. Brussels. May 1999

Department of CEE | College of Engineering | University of Delaware

Linda C. Schaffner

- **Associate Professor of Marine Science**
- **B.A., Drew University**
- **M.A., Ph.D., College of William and Mary**

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Research Interests

My research program focuses on the ecology of benthic systems and benthic processes of estuarine and coastal ecosystems. Within this context and working together with my students and staff, I have developed and pursued a number of major research themes. We are interested in how natural processes and anthropogenic alterations of coastal ecosystems influence the structure and function of benthic communities, including meiofauna, macrofauna and associated nekton, via processes such as disturbance (mortality) and recruitment. Important factors we have considered include salinity, sediment type and transport regime, eutrophication, hypoxia and sediment contamination. We also are interested in the factors that regulate the productivity of estuarine food webs, such as hypoxia, benthic-pelagic coupling and the population dynamics of estuarine species, especially polychaetes. Much of our research has been interdisciplinary, especially my investigations of organism-sediment-flow interactions and implications of these interactions for the transport, fate and effects of particles, organic matter, nutrients and contaminants in benthic systems. I will soon begin studies of benthic boundary layer processes and organism-sediment-flow interactions using a real-time benthic observing system to gain insight into the timing and magnitude of events taking place at the sediment-water interface, and the real time responses of benthic organisms to those events. I will be assessing the relative importance of resistance to stressors by individuals versus resilience to disturbance processes as manifested primarily at the population level. My studies have taken me to estuarine and coastal ecosystems throughout the U.S. and Europe, including the Chesapeake Bay, Gulf of Mexico, Long Island Sound, Baltic Sea, Andaman Sea, Gulf of Thailand, East China Sea and coastal Korea. In recent years I have become increasingly interested in how society, science and economics interact to influence resource management, science policy and funding for science and science and math education.

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Current Projects

- Collaborative Research: A Real-Time and Rapid Response Observing System for the Study of Physical and Biological Controls on Muddy Seabed Deposition, Reworking and Resuspension. Funded by National Science Foundation.
- An Integrated Approach to Assess the Effects of Watershed Activities on Benthic Community Structure and Function. Funded by Strategic Environmental Research and Development Program (SERDP)

- Research Experience for Undergraduates (REU) at the Virginia Institute of Marine Science. Funded by National Science Foundation.
- Hall-Bonner Program for Minority Scholars in the Ocean Sciences. Funded by National Science Foundation.

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Selected Publications

Lim, Hyun-Sig, R. J. Diaz, Hong, Jae-Sang and **L. C. Schaffner**. Hypoxia and benthic community recovery in Korean coastal waters. (Marine Pollution Bulletin, in press)

Hinchey, E. K., **L. C. Schaffner**, L. Batte, C. Hoar and B. Vogt. 2005. Effects of sediment burial on juvenile and adult benthic invertebrates of estuaries. Hydrobiologia 00:1-14 (in press).

Hinchey, E.K. and **L. C. Schaffner.** 2005. An evaluation of electrode insertion techniques for measurement of sediment redox potential in estuarine sediments. Chemosphere 59:703-710.

Dellapenna, T. M., S. A. Kuehl and **L. C. Schaffner**. 2003. Ephemeral deposition, sea-bed mixing and fine-scale strata formation in the York River estuary, Chesapeake Bay. Estuarine, Coastal and Shelf Science 58(3): 621-643.

Sagasti, A., J. E. Duffy, and L. C. Schaffner. 2003. Effects of stress on recruitment: estuarine epifauna recruit depsite hypoxic episodes. Marine Biology 142:111-122.

Thompson, M. L. and **L. C. Schaffner**. 2001. Population biology and secondary production of the suspension feeding polychaete *Chaetopterus variopedatus:* implications for benthic-pelagic coupling in lower Chesapeake Bay. Limnology and Oceanography 46: 1899-1907.

Schaffner, L. C., T. M. Dellapenna, E. K. Hinchey, C. T. Friedrichs, M. Thompson Neubauer, M. E. Smith and S. A. Kuehl. 2001. Physical energy regimes, seabed dynamics and organism-sediment interactions along an estuarine gradient. pp. 161-182 in J. Y. Aller, S. A. Woodin and R. C. Aller (eds.) Organism-Sediment Interactions. University of South Carolina Press, Columbia, SC.

Sagasti, A., **L. C. Schaffner** and J. E. Duffy. 2001. Effects of periodic hypoxia on mortality, feeding and predation in an estuarine epifaunal community. Jour. Exp. Mar. Biol. Ecol. 258: 257-283.

Sagasti, A., **L. C. Schaffner** and J. E. Duffy. 2000. Epifaunal communities thrive in an estuary with hypoxic episodes. Estuaries 23: 474-448.

Thompson, M. T. and **L. C. Schaffner**. 2000. Demography of the polychaete *Chaetopterus pergamentaceus* within the lower Chesapeake Bay and relationships to environmental gradients. Bulletin of Marine Science 67: 209-219.

Dellapenna, T. M., S. A. Kuehl and **L. C. Schaffner**. 1998. Seabed mixing and particle residence times in biologically and physically dominated estuarine systems: a comparison of lower Chesapeake Bay and the York River subestuary. Est. Coast. Shelf Sci. 46: 777-795.

Kane-Driscoll, S. B., **L. C. Schaffner** and R. M. Dickhut. 1998. Toxicokinetics of fluoranthene to the amphipod, *Leptocheirus plumulosus*, in water-only and sediment exposures. Marine Environmental Research 45: 269-284.

Schaffner, L. C., R. M. Dickhut, S. Mitra, P. W. Lay and C. Brouwer-Riel. 1997. Effects of physical chemistry and bioturbation by estuarine macrofauna on the transport of hydrophobic organic contaminants in the benthos. Environ. Sci. Technol. 31: 3120-3125.

Wright, L. D., **L. C. Schaffner**, and J. P.-Y. Maa. 1997. Biological mediation of bottom boundary layer processes and sediment suspension in the lower Chesapeake Bay. Marine Geology 141: 27-50.

Weisburg, S. B., J. A. Ranasinghe, D. M. Dauer, **L. C. Schaffner**, R. J. Diaz and J. B. Frithsen. 1997. An estuarine benthic index of biotic integrity (B-IBI) for Chesapeake Bay. Estuaries 20: 149-158.

Mayer, M. M., **L. C. Schaffner** and W. M. Kemp. 1995. Nitrification potentials of benthic macrofaunal tubes and burrow walls: effects of sediment NH4+ and animal irrigation behavior. Marine Ecology Progress Series 121: 157-169.

Seitz, R. D. and **L. C. Schaffner**. 1995. Population ecology and secondary production of the polychaete *Loimia medusa* (Terebellidae). Marine Biology 121: 701-711.

Diaz, R. J. and **L. C. Schaffner.** 1990. The functional role of estuarine benthos. pp. 25-56 in M. Haire and E. C. Krome (eds.), Perspectives on the Chesapeake Bay, 1990. Advances in Estuarine Science. Chesapeake Bay Program, Chesapeake Research Consortium Publication #CBP/TRS41/90.

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Current Students

- David Gillett. Ph.D. The influence of habitat degradation on benthic secondary production and trophic transfer efficiency in shallow, unvegetated areas
- William Metcalfe, M.S. Meiofauna abundance and distribution in Chesapeake Bay: Relationships with eutrophication, sediment toxicity and macrofauna
- Erin Morgan, W&M undergraduate. Factors influencing benthic community integrity in shallow subtidal regions of a highly urbanized estuary.
- Treda Smith, Ph.D. Developing an ecological basis for indicators and biocriteria in estuarine waters.

Past Students - Graduate Program

- Elizabeth K. Hinchey, Ph.D. 2002. Physical disturbance effects on benthic community structure and function along an estuarine gradient. Recipient of *Craig Smith Award* (1999), *Dean's Prize for Advancement of Women in Science* (2001) and *Thatcher Prize* (2003)
- Michelle Horvath, M.S.1997. Effects of epibenthic predators and macrofauna on sediment resuspension and bioturbation.
- Patrick Lay, Ph.D. 1996. Direct effects of macrofauna on transport of organic contaminants to demersal fish.
- Alessandra Sagasti, Ph.D. 2000, Ecology of fouling communities in the York River ecosystem: interacting effects of environmental variation and biotic interactions on community structure and function. Recipient of *John and Marilyn Zeigler Student Achievement Award* (1999) and *Dean's Prize for Advancement of Women in Marine Science* (1999) and *Best Ph.D. Oral Presentation, Atlantic Estuarine Research Society* (co-advisor with Emmett Duffy)
- Michelle L.Thompson Neubauer, Ph.D. 2000, Benthic-pelagic coupling in lower Chesapeake Bay: effects of a benthic suspension feeding polychaete, *Chaetopterus pergamentaceus (Chaetopterus cf. variopedatus*, sensu Enders 1909). Recipient of *Mathew Fontaine Maury Student Fellowship Award* (1999) and *Best Student Poster Award, International Estuarine Research Federation Conference '99, New Orleans, LA*
- Rochelle Seitz, M.S. 1991. Population biology of the polychaete *Loimia medusa* (Savigny) on a tidal sand flat of the York River.
- Bruce Vogt, M. S. Student, Sublethal effects of sediment-associated contaminants on the burrowing behavior of the amphipod, *Leptocheirus plumulosus*

Past Students - Undergraduates and High School

- Lauren Batte, Department of Biology, The College of William and Mary, B.S. with High Honors, 2001.
- Undergraduates who have done internships in my laboratory: William O'Connell (1989), Doug Gantt (1990), Sharon Williams (1991), Michelle Rudoy and George Anderson (1992), Rebecca Born (1993), Simone Brooks (1994), Sam Jones and Charles Shimooka (1995), Alvaro Dompe (1996), Jennifer Lindsey and Allison Castellan (1998), Tara Spitzer and Scott Lundin (1999), Stephanie Babb and Christine Tallamy (2000), Patrice Longshaw and Barbara Garcia (2001), Theresa Childress (2002)
- High School students who have done internships in my laboratory in recent years: Jennifer Shontz (1998-99), Benjamin Ritter (1997-98), Kelly Dorgan (1995-97)

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Courses Taught

- MS 502: Coastal and Estuarine Processes and Issues
- MS 572: Estuarine Benthic Processes
- MS 503: Biological Oceanography
- MS 510: Marine and Freshwater Invertebrates
- MS 647: Marine Benthos
- MS 698: Special Topics - History of Benthic Ecology

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Awards

- 2005 - Dean's Prize for Advancement of Women in Science
- 2003 - Outstanding Faculty Award, State Council of Higher Education of Virginia
- 2001 - The Thomas Jefferson Teaching Award, College of William and Mary
- 1994 - Outstanding Teaching Award, School of Marine Science, College of William and Mary

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Positions of Distinction

- Past President, Estuarine Research Federation (2005-2007)
- President, Estuarine Research Federation (2003-2005)
- Secretary, Council of Scientific Society Presidents (2004-2005)
- Estuarine Research Federation President Elect (2001-2003)
- Estuarine Research Federation Governing Board, Secretary (1999-2001)
- Estuarine Research Federation Governing Board, Member-at-Large (1997-1999)
- Estuarine Research Federation Education Committee (1997- present)
- Associate Editor, Estuaries, 1998-2001

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Professional Memberships

- Estuarine Research Federation (ERF)
- American Society of Limnology and Oceanography (ASLO)
- American Geophysical Union (AGU)

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President Schaffner's House Testimony
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Written Testimony of
Linda C. Schaffner, Ph.D.
Associate Professor, Virginia Institute of Marine Science

"Progress in Safeguarding the Chesapeake Bay"
Committee on Government Reform
U.S. House of Representatives
Field Hearing, Hampton, Virginia
August 20, 2004

Chairman Davis, Congressman Schrock, and Members of the Committee, my name is Linda Schaffner. I am an Associate Professor of the School of Marine Science, College of William and Mary and the Virginia Institute of Marine Science (VIMS). I also serve as the President of the Estuarine Research Federation (ERF), an international scientific society with a membership of over 2000 scientists, educators, and managers who are committed to the acquisition and application of sound scientific knowledge to sustain the integrity of estuarine and coastal systems. Thank you for inviting me to speak to you today.

I will begin by diagnosing the current health of the Chesapeake Bay estuarine ecosystem based on the many indicators available. I also want to comment on the importance of monitoring and modeling as tools in the scientific toolbox and the importance of science-informed management in the Chesapeake Bay restoration efforts. Finally, I will reflect on what is needed to move us forward towards our goal of a healthy, sustainable Chesapeake Bay.

An Estuary Under Stress

The Chesapeake Bay is one of the world's largest, most diverse and productive estuarine systems. Its watershed is home to a significant percentage of the U.S. population. We all understand the key role the Bay has played in supporting bountiful harvests of commercial and ecologically valuable species, such as crabs, oysters and fish. We also recognize the Bay's importance in support of transportation and industry and the need for its ports and harbors. Tourists and recreational fishermen enjoy the Bay and contribute to local economies. Many of us value the Bay for its natural beauty. In addition, scientific research has highlighted the important ecological services provided by the Chesapeake Bay and other estuaries. Unfortunately, the very features that promote high productivity and facilitate its use, make the estuary highly vulnerable to human effects, which in turn jeopardizes these goods and services.

Just four months ago the U.S. Commission on Ocean Policy[1] (USCOP) released its draft findings and recommendations for a coordinated and comprehensive national ocean and

coastal policy. The USCOP found abundant evidence of degraded water quality, depleted fishery resources, and vanishing wetlands throughout the Nation's coastal and estuarine areas and determined that these problems require urgent attention. In a study released in 2003, the Pew Oceans Commission[2] independently reached a very similar conclusion that our oceans and coastal systems are in severe distress. I can assure you that we are not alone in our concerns about the state of our estuary.

Human alteration of the Chesapeake and its watershed began hundreds of years ago, but the most significant activities have been during our lifetime. When I first arrived to the Bay community as a graduate student in 1976, a favorite late fall activity was roasting oysters over an open fire with a group of friends on a Saturday night. Over-harvest, disease, and habitat alteration have now resulted in the near demise of the native oyster. The oysters I buy in my local grocery store come from the Gulf of Mexico or the west coast. The once clear, shallow waters of the Bay are now turbid, and the submerged grasses that once flourished there, providing critical habitat for juvenile fishes and crabs, are 60% less abundant than they were 40 to 50 years ago[3]. Each summer, a blanket of water that is devoid of essential oxygen smothers communities of small bottom dwelling (benthic) invertebrates throughout the deeper waters of the Bay. This is important because these benthic communities support the Bay's food web and also play a role in helping to cleanse the Bay of excess nitrogen, a key nutrient fueling eutrophication. For 2002, scientists estimated that about 50% of the Chesapeake Bay and 65% of the Maryland tidal waters failed to meet the restoration goals set for these communities.[4]

For most of the indicators we use to gauge the health of the Bay, the available monitorin data allow us to examine trends over only the last few decades, not the last 100 years or more. When we look back even further -- for example, using markers preserved in the accumulated muds of the deep floor of the Bay -- we find evidence of the longer history of human alteration of the Bay's structure and function. This record tells us that sediment loading to the Bay increased when farmers began extensive clearing of the watershed, that the composition of pollutants entering the estuary has changed over time and that a record of increasing hypoxia and anoxia in bottom waters parallels a trend of increasing nutrient fertilization. Just as we expect a doctor to diagnose our health using multiple indicators, these indicators of Bay health lead me to conclude that the Chesapeake Bay is a significantly degraded ecosystem. To continue with the medical analogy, the Bay has cancer, not a common cold.

But, there is always room for more positive thinking. Like many of my colleagues, I have seen evidence of the Chesapeake Bay's resilience -- its natural capacity to recover from disturbances. Each year scientists working in and around the Bay's meadows of submerged aquatic vegetation (SAV) report the presence of grass seedlings in the deeper waters outside of the existing beds[5]. The production of seeds and subsequent growth of seedlings are examples of the natural processes that help to make populations resilient despite environmental variations. Under present Bay conditions, the grass seedlings generally don t survive the summer due to light limitation caused by eutrophication and suspended sediments. The expansion of SAV meadows in drought years, when reduced freshwater flow reduces the problematic nutrient loadings, and the declines of SAV in wet years, when nutrient loadings tend to increase, gives us insights into what might happen if we could off the "nutrient faucet."

Every year, and especially during the spring, benthic invertebrates -- clams, worms and small shrimp-like creatures called amphipods -- reproduce and send innumerable larvae into the waters of the Bay. If you dredge a channel in the lower Bay, where the water quality is still relatively good, you will see initial colonization of the bottom in only a few weeks, and most of the natural community will be completely restored in only a year or two. Many of these larvae also reach the deepest channels where they settle and grow until the summertime levels of dissolved oxygen in the overlying waters become limiting. While restoration of dissolved oxygen to the deepest bottom waters is considered to be one of the most difficult problems we face, it seems likely that these areas would rapidly recover their productivity if given a chance.

Modeling and Monitoring

Scientists in the estuarine science community, including those working as a part of the Chesapeake Bay Program, have repeatedly demonstrated that the combined use of powerful modeling approaches and good observational data can lead to rapid advances in scientific understanding. The ever-increasing power of today's computers allows us to model the complexities of natural systems in ways that were unthinkable only a decade ago. Models help us to understand how aquatic systems respond to various scenarios, such as variations in rainfall or changes in land use, independent of what is happening at any given time in the "real world." They can be used to forecast future changes in an ecosystem, and to test, for example, whether implementation of specific policies and management strategies will be successful. Conversely, monitoring data document trends in the "real world" and give us a needed reality check for our models. The data obtained via well-designed monitoring programs can be used to constrain the models and to verify model predictions.

Attempts to weigh the relative merits of modeling or monitoring are misguided they are two sides of the same coin. We need both and they should be used in concert to understand and verify where we are in our efforts to restore the Bay. Good communication and exchange of information between monitoring and modeling efforts is essential. Although this needed level of communication may be relatively easily established and maintained when a program is small, it can be considerably more difficult to attain when a program is large or when different agencies are responsible for modeling versus monitoring programs. The current discussions should make everyone more sensitive to the need to maintain good communication and present a consistent overview of the findings of the monitoring and modeling efforts.

The Importance of Science-Informed Management

In its April 2004 draft report, the USCOP called for ecosystem-based management of ocean and coastal resources and recommended that management "... reflect the relationships among all ecosystem components, including human and nonhuman species and the environments in which they live." This has always been a major goal of the Chesapeake Bay Program (CBP), which since its inception has been admired and emulated throughout the U.S., and worldwide, as a model for ecosystem-based management. The CBP, working in partnership with the states and various agencies, has provided both a structural framework and leadership that helped to focus one of the world's strongest estuarine science communities, build well-designed and executed environmental monitoring and modeling programs, create an environmentally-informed public and spearhead new approaches to

environmental policy development and governance. The program has successfully brought scientists, managers, industry and citizens to the table to discuss complex environmental issues and develop strategies for dealing with these issues.

When I met with colleagues at the Virginia Institute of Marine Science earlier this week in preparation for this testimony, they reflected positively on their interactions with the CBP. We agreed that program has done a good job of soliciting science input on the issues, asking scientists to review programs, recommendations and strategies, and practicing science-informed management. When a CBP manager wants something from you, he or she will find you. The CBP program helps to keep us focused. The holistic view that many of us working in the Bay's science community have of the Bay and its ecosystem can be attributed, in my opinion, to the structure and synthesis the CBP has promoted.

I also want to emphasize that academic scientists, many employed at the major state universities around the Bay, have significantly contributed to the success of the CBP objectives. They provide the CBP with unbiased, credible and up-to-date scientific information. The Bay's scientists have led the way in the development of state-of-the-art modeling approaches, experimental approaches in the lab and the field and well-designed monitoring programs to address both the basic and applied questions posed by managers. Many have been exemplary "scientist-citizens," working in service to the Chesapeake Bay Program for the greater good.

Much of the focus today will be on the funding need to support nutrient reduction in support of efforts to restore the Bay's water quality. I also want to use this opportunity to stress the importance of funding for science research efforts. Much of the research conducted by the Bay's scientists has been supported by funding coming from outside the CBP, via other mission-oriented agencies, such as NOAA, ONR, DoD and USGS, other parts of EPA, and the NSF, which plays a critical role in supporting basic research. A number of recent reports and analyses, including those by the American Association for the Advancement of Science (AAAS), indicate that these agencies could see budget declines of 5 to 10% or more annually over the coming years[6]. In their draft report, the USCOP expressed concern that the federal agencies supporting ocean and estuarine research are, in fact, chronically under-funded. We in the Bay community cannot afford these declines in research support at a time when we face increasingly complex scientific questions and management issues. You, our Members of Congress, can help by voting for increased appropriations for science funding in these agencies. I strongly encourage you to support the doubling of the budget for the National Science Foundation, an authorization that was passed by the 107th Congress and signed into law by the President.

There is no question that achieving the ambitious goal of restoring the Chesapeake Bay to a healthy, sustainable ecosystem will require increased scientific capacity, including:

- utilization of the latest technologies and approaches, such as real-time data collection and observing systems to increase monitoring capacity and ensure the collection of the highest quality data, while improving the cost efficiency
- expansion of monitoring programs to evaluate impacts and guide research, not just in the Bay's main stem, but in the tributaries and extensive shoal areas that remain understudied
- support of basic research that will lead to rapid improvement in the integration and

synthesis of existing and new information using the most advanced techniques and the most powerful modeling approaches this will allow scientists to turn data systems into knowledge systems
- improvement in our ability to integrate across the disciplines of natural science, economics, and social systems, and at larger spatial scales and greater temporal resolution
- improvement in our ability to rapidly and effectively share an ever growing body of knowledge, in order to facilitate wise decisions by all about use of the Bay's resources.

Moving Forward for a Healthy, Sustainable Chesapeake Bay

Recognizing the challenges we face in managing our ocean and coastal resources, the USCOP called for the creation of a new national ocean policy framework, better coordination among federal agencies, a doubling of federal research investments in ocean science, and improved environmental education. All of these recommendations have relevance in our discussion of how to accelerate the restoration and protection of the Chesapeake Bay. Others have or will speak in a more informed way on the specific policies and levels of funding needed to attain the Chesapeake 2000 goals. It is clear that both political will and strengthened financial commitments are necessary. We need the public and all of our elected representatives to recognize the true value of the Chesapeake Bay to the Nation. There is no time like the present for action, particularly for those of us concerned with the future of the Chesapeake Bay.

Notes

1. http://www.oceancommission.gov/
2. http://www.pewoceans.org/
3. Robert Orth and Ken Moore, Virginia Institute of Marine Science, communication on August 16, 2004
4. Llansó, R. J., L. C. Scott and F. S. Kelley. 2003. Chesapeake Bay Water Quality Monitoring Program, Long-term Benthic Monitoring Component Level 1 Comprehensive Report, Prepared by Versar, Inc. for Maryland Department of Natural Resources, September 2003.
5. Robert Orth and Ken Moore, Virginia Institute of Marine Science, communication on August 16, 2004
6. Schaffner, L.C. 2004. Science Advocacy: The 10% Solution. *Estuarine Research Federation Newsletter* 30: 1, 13-14. and additional articles by D.M. Allen, R. Magnien, and J. Bartholomew. Available on the web at: www.erf.org.