Summary Professional Vitae

Richard B. Deriso

Inter-American Tropical Tuna Commission
Scripps Institution of Oceanography
La Jolla, CA 92093-0203

Formal Education

University of Washington
Ph.D. in Biomathematics (Quantitative Ecology) 1978

University of Florida
M.S. in Mathematics 1975

Auburn University
B.S. in Industrial Engineering 1972

Academic Honors

Tau Beta Pi, Pi Alpha Mu (scholastic honor societies)
1981 W. F. Thompson Award from American Institute of Fishery Research Biologists for publication (Deriso, 1980 CJAFS).

Major Research Interests

Fisheries Population Dynamics, Quantitative Ecology, applied mathematics, statistics.

Recent Professional Experience

Chief Scientist, Inter-American Tropical Tuna Commission, 2009 - present; 1988 - 2009 Chief Scientist of Tuna and Billfish Group.

Associate Adjunct Professor, Scripps Institution of Oceanography, UCSD, 1990 - 2006.

Ocean Studies Board member, U.S. National Research Council. 2002 - 2004.

Affiliate Associate Professor of Fisheries, University of Washington, 1987 - 2006; 1982 - 1986, Assistant Professor.

Scientific and Statistical Committee member, Western Pacific Regional Fisheries Management Council, 1993 - present.

Population Dynamicist, International Pacific Halibut Commission, Seattle, WA, 1980 - 1988.

Visiting Research Assistant Professor, Marine Sciences, University of North Carolina at Chapel Hill, 1979 - 1980.

Consultant to several agencies and institutions, including US Minerals Management Service, Metro Water District Southern California, ExxonMobil, Essa Technologies Ltd., Australian Fisheries Management Agency, Great Lakes Fishery Commission, Ontario Ministry of Natural Resources, University of Alaska at Juneau, Applied Biomathematics Inc., Living Marine Resources Inc., Marine Stewardship Council, National Marine Fisheries Service, North Carolina Sea Grant Program, US Environmental Protection Agency, New York State Department of Environmental Conservation, Metropolitan Water District of Southern California, and Public Service Electric and Gas Company of New Jersey.

Other Professional Activities

Over 30 seminars given at various universities, agencies, and conferences.

Taught several graduate courses, including FISH 557 course (Theoretical Models of Exploited Animal Populations, University of Washington) , QSCI 598 (Decision analysis for exploited populations, University of Washington), SIO 276 (Quantitative theory of populations and communities, Scripps Institution of Oceanography, with G. Sugihara).

Served on several committees and working groups, including groups with ICES, FAO, NAS, OSB, and NRC. Past co-chairman, NRC Committee on Fish Stock Assessment Methods.

Publications And Reports

Over 50 publications and reports, including

Maunder, M.N. and Deriso, R.B. 2011. A state-space multi-stage lifecycle model to evaluate population impacts in the presence of density dependence: illustrated with application to delta smelt. Can. J. Fish. Aquat. Sci. 68: 1285-1306.

Deriso, R.B., Maunder, M.N., Pearson, W.H. 2008. Incorporating covariates into fisheries stock assessment models with application to Pacific herring. Ecol. App. 18(5): 1270-1286.

Deriso, R.B., Maunder, M.N., and Skalski, J.R. 2007. Variance estimation in integrated assessment models and its importance for hypothesis testing. Can. J. Fish. Aquat. Sci. 64: 187-197.

Quinn, T.J. II and R.B. Deriso. 1999. Quantitative Fish Dynamics. Oxford University Press, NY, NY. 542p.

Lenny Grimaldo, Ph.D.

620 Folsom St, Suite 200, San Francisco, CA 94107 • lenny.grimaldo@icfi.com • Office: (415) 677-6785 • Mobile: (415) 823 -1372

Program Manager and Senior Fisheries Biologist

19 + year career of progressively increased responsibility, experience, and leadership in aquatic fisheries science and management, entrainment impact assessment, water resource management, ecosystem restoration, community ecology, food web analysis, entrainment studies, early life history of fish research, water quality, and ESA regulatory compliance.

Key Skills

- Team leadership and mentoring
- Applied and published research
- Expert witness testimony
- Technical writing
- Contract management
- Adaptive management
- Applied ESA regulatory experience
- Diverse field and laboratory experience
- Independent peer-review referee
- Skilled facilitator and conference organization
- Applied knowledge of numerous statistical methods
- Hydrodynamic modeling interpretation

Work Experience

ICF International **2013-Present**

Water Resources Manager

Provides leadership in ecosystem research related to restoration, ESA species life history ecology, estuarine ecology, food webs, water quality, and water diversions and builds upon established relationships with local, state, and federal governments to develop new business opportunities with a focus in the San Francisco Bay Estuary and adjacent riverine and coastal ecosystems. Serve as a lead for regional strategic teaming, proposal development, subcontracting, project management, and field research; and maintain the highest quality standards for technical accuracy and timeliness of deliverables. Designs and conducts field monitoring and research to better understand biological responses to ecosystem impacts and changes. Represent the firm and its clients before state and federal resource agencies.

Key achievements:

- Led tidal marsh investigations in the Upper San Francisco Estuary. This study identified longfin smelt spawning and rearing habitat and will be used to guide restoration designs in the estuary. Client: Metropolitan Water District of Southern California (MWD)
- Serving as science lead for Collaborative Adaptive Management Team (CAMT) entrainment investigations for delta smelt. In this role, I oversee a team of seven independent scientists,

serve as the liaison with policy makers, conduct statistical analyses on delta smelt entrainment, and lead communication with progress of studies to state and federal agencies, public water agency stakeholders, and NGO's. Client: State and Federal Water Contractors Agency.

- Worked closely with state and federal agencies to develop a method for revising the USFWS Incidental Take Limit. Client: MWD

United States Bureau of Reclamation **2008-2013**

Fish Biologist

Served as the program manager for the Fall X2 Adaptive Management Plan of the 2008 USFWS Biological Opinion on the coordinated impacts of the SWP and CVP water projects to delta smelt. Provided leadership within Reclamation and with outside entities (public water agencies, environmental organizations, state and federal agencies) on how to resolve complex and controversial water operation management actions for ESA species, including delta smelt, longfin smelt, and steelhead. Served on Interagency Ecological Program (IEP) management and coordinator teams, providing technical and management guidance on research and monitoring activities in the Sacramento-San Joaquin Delta. Published peer-review manuscripts on research related to restoration, early life history of fishes, and water diversions. Served as an independent advisor and reviewer of a number of restoration projects, including Dutch Slough, Prospect Island, Yolo Bypass, Liberty Island, and Sherman Island.

Key achievements:

- *Developed an adaptive management plan for the USFWS 2008 Fall X2 RPA using a consensus driven process with stakeholders and agency scientists.*
- *Published a peer-review manuscripts and technical reports on delta smelt migration patterns, fish communities in restored habitats, larval fish feeding and day/night behaviors, and impacts of harmful algal blooms to aquatic ecosystems.*
- *Completed an effects analysis for the 2008 USFWS Biological Opinion on the coordinated operations of the SWP and CVP for delta smelt.*
- *Served as the program chair for the 2012 Bay-Delta Conference (1,200 attendees) and the IEP Annual Workshop (2012 and 2013, 400 attendees).*
- *Provided expert testimony on behalf of Interior on water quality, entrainment, and delta smelt (ESA species) at State Board hearings, State Assembly Natural Resources hearing, and in U.S. federal court.*
- *As the IEP Science Advisory Group (SAG) liaison, coordinated independent peer reviews of the Delta Juvenile Fish Monitoring Program and coupled hydrodynamic-biological modeling applications for the San Francisco Estuary.*

California Department of Water Resources (DWR) **1996-2008**

Environmental Scientist

Provided leadership on water management issues, including entrainment of ESA species at the state and federal water projects, water quality, and barrier operations. Developed methods for sampling fish and aquatic invertebrate communities in shallow water habitats in the San Francisco Estuary and developed novel analyses and approaches for evaluating restoration outcomes to native fish communities. Managed and mentored dozens of early career scientists. Collaborated on fish and invertebrate research studies throughout the California, including steelhead/salmon investigations on the Feather River, floodplain research in the Yolo Bypass and San Joaquin River, Lake Davis rotenone project, and quagga mussel invasions into California's aqueduct and reservoir network. Reviewed regulatory compliance documents, including Biological Assessments and Opinions on Water Project impacts to delta smelt and Feather River FERC relicensing impacts to steelhead.

- *Developed a statistical approach for understanding relationships between entrainment of ESA species and environmental factors that was adopted by state and federal agencies and stakeholders during preliminary injunction hearings on USFWS Biological Opinion litigation.*
- *Published several peer-review manuscripts and technical reports on fish communities in restored habitats (BREACH studies), larval fish communities, fish predation, water quality, submerged aquatic vegetation patterns, and methods for morphometric discrimination of delta smelt and wakasagi.*
- *Invited speaker to an Adaptive Management Session at the Estuarine Research Federation Conference in Tampa Bay, FL. (2001).*

CALFED Science Program (on loan from DWR) 2000-2001

Assistant Delta Science Coordinator

Helped the CALFED lead scientist (Sam Luoma) develop a region-wide restoration strategy for the San Francisco Estuary. Coordinated independent peer-review panels on hydrodynamic issues and restoration.

- *Coordinated, led, and helped produce independent peer-review reports on the Channel Cross Gates/Georgiana Slough project and Environmental Water Account study.*
- *Authored several sections of the CALFED Bay-Delta Program Ecosystem Restoration Program Programmatic EIS/EIR.*

California Department of Fish and Game 1994-1996

Fish and Wildlife Scientific Aide

Conducted an independent study on the comparison and validity of using fin rays and otoliths to age splittail. Collected and identified larval fish, juvenile fish, and shrimp samples from various monitoring

and research studies in the San Francisco Estuary. Field leader on multi-agency real-time monitoring study.

- *Conducted fish identification classes for multi-agency Real-time Monitoring study staff.*
- *Developed several fish keys for discriminating early juvenile cyprinds and tridentiger gobies.*
- *In conjunction with U.C. Davis, presented research on splittail aging methods at the Annual Undergraduate Research Conference.*

Education

PhD, Ecology, University of California at Davis, Emphasis on management and restoration of freshwater fishes in the San Francisco Estuary, 2009.
M.S., Marine Biology, San Francisco State University, Emphasis on food webs and fish communities in restored habitats of the San Francisco Estuary, 2004
B.S., Wildlife and Fisheries Biology, University of California Davis, 1996. Fisheries biology emphasis, 1996.

Peer-review publications

Feyrer, F.V., J. Hobbs, S.Acuna, B.Marhadja, L.Grimaldo, M.Baerwald, R.C. Johnson, S.Teh. Metapopulation structure of a semi-anadromous migratory fish (Sacramento splittail *Pogonichthys macrolepidotus*) shaped by climate-induced dynamic habitat fragmentation. In press. Canadian Journal of Fish and Aquatic Sciences.

Grimaldo, L.F., N. Van Ark, T. Sommer, G.Jones, K. Clark, E. Holland. Feeding Patterns of Ichthyoplankton in a Highly Modified Tidal Freshwater Estuary. In press, San Francisco Estuary and Watershed Science.

Grimaldo, L.F., R.E. Miller, C.D. Peregrin, and Z. Hymason. 2012. Fish Assemblages in Reference and Restored Tidal Freshwater Marshes of the San Francisco Estuary. San Francisco Estuary and Watershed Science 10: 1-21.

Sommer, T., M. Nobriga, F.Feyrer, F. Mejia, L.Grimaldo. 2011. The Spawning Migration of Delta Smelt in the Upper San Francisco Estuary. San Francisco Estuary and Watershed Science 9: 1-16.

Grimaldo, L.F., A.R. Stewart, and W. Kimmerer. 2009. Dietary segregation of pelagic and littoral fish assemblages in a highly modified tidal freshwater estuary. Marine and Coastal Fisheries 1:200–217.

Grimaldo, L.F., T.Sommer, N.Van Ark, E.Holland, G.Jones, B.Herbold, P.Smith, and P. Moyle. 2009. Factors affecting fish entrainment into massive water diversions in a freshwater tidal estuary: Can fish losses be managed?" North American Journal of Fisheries Management 29:1253–1270.

Kimmerer, W., S. Avent, S. Bollens, F. Feyrer, L. Grimaldo, P. Moyle, M. Nobriga, and T. Visintainer. 2005. Variability in length-weight relationships used to estimate biomass of estuarine fishes from survey data. Transactions of the American Fisheries Society 134:481-495.

Grimaldo, L.F, R.E. Miller, C.M. Peregrin, and Z.P Hymanson. 2004. Spatial and temporal distribution of ichthyoplankton in three habitat types of the Sacramento-San Joaquin Delta. Pages 81-96 in F. Feyrer, L.R. Brown, R.L. Brown, and J.J. Orsi, editors. Early Life History of Fishes in the San Francisco Estuary and Watershed. American Fisheries Society, Symposium 39, Bethesda, Maryland.

Toft, J.D., C.A. Simenstad, J.A. Cordell, and L.F. Grimaldo. 2003. The effects of introduced water hyacinth on habitat structure, invertebrate assemblages, and fish diets. Estuaries 26:746-758.

Technical reports

Baxter, R., L.F. Grimaldo, and others. An updated conceptual model for delta smelt: Our evolving understanding of an estuarine fish by Management Analysis and Synthesis Team. 2013.

Baxter, R. , Breuer R., Brown L, Conrad L, Feyrer F., Fong S, Gehrts K., Grimaldo L., Herbold B., Hrodey P., Mueller-Solger A., Sommer T., and K. Souza. 2011 Interagency Ecological Program 2010 Pelagic Organism Decline Work Plan and Synthesis of results.

Wang, J.C.S., L.Lynch, B.Bridges, and L. Grimaldo. 2005. Using morphometric characteristics to identify the Early Stages two sympatric Osmerids (Delta smelt and Wakasagi-Hypomemus transpacificus and H. nipponensis) in the Sacramento-San Joaquin Delta, California. U.S. Department of the Interior, Bureau of Reclamation, Volume 30.

Grimaldo, L.F., R.E. Miller, C. Peregrin. 2000. Examining the Relative Predation Risks of Juvenile Chinook Salmon in Shallow Water Habitats of the Central Delta: The Effect of Submerged Aquatic Vegetation on Predation Risk. IEP Newsletter 13(1):55–59.

Simenstad C, Toft J, Higgins H, Cordell J, Orr M, Williams P, Grimaldo L, Hymanson Z. 1999. Preliminary results from the Sacramento-San Joaquin Delta breached-levee wetland study (BREACH). IEP Newsletter 12(4):15–21.

Grimaldo, L.F. and Z. Hymanson. 1999. What is the impact of the introduced Brazilian Waterweed Egeria densa to the Delta Ecosystem? IEP Newsletter 12(1): 43-45.

Grimaldo, L.F., B. Harrell, R. Miller, Z. Hymanson. 1998. Determining the Importance of Shallow-Water Habitat in the Delta to Resident and Migratory Fishes: A New Challenge for the IEP. IEP Newsletter 11(3) 4:27.

Grimaldo, L.F., D. Sweetnam, and B. Ross. 1998. Preliminary Results on the Age and Growth of Delta Smelt (Hypomesus transpacificus) from Different Areas of the Estuary using Otolith Microstructure Analysis. IEP Newsletter 11(1): 25-28.

Baxter R., W. Harrell, and L. Grimaldo. 1996. Splittail Spawning Investigations. IEP Newsletter (9) 4:27.

Awards

San Francisco State University, Romberg Tiburon Center, 2013, Outstanding Alumnus Award

United States Bureau of Reclamation, 2011, Star Award for outstanding performance on review of the 2-Gates Demonstration Project

United States Bureau of Reclamation, 2010, Star Award for outstanding work for providing expert testimony and technical support on the Preliminary Injunction case for the biological opinion for the Central Valley Project and State Water Project

Cal-Neva American Fisheries Society, 2009, Award for Distinguished Professional Achievement for participating on the Delta Smelt Workgroup

Cal-Neva American Fisheries Society, 2008, Award for Distinguished Professional Achievement for participation on the 2007 Annual Conference Committee.

California Department of Water Resources, 2008, Outstanding Superior Accomplishment Directors Award for technical assistance related to the delta smelt workgroup and food web research

California Department of Water Resources, 2008, Outstanding Service Award for technical assistance on Pelagic Organism Decline (POD) research efforts

California Department of Water Resources, 2004, Outstanding Service Award 2004 for larval fish research publication in book symposia

CALFED Science Program, 2001, Best Student Speaker Award

California Department of Water Resources, 1995, Outstanding Service Award for assistance on the Interagency Ecological Program Real-time Monitoring Survey

Professional Societies

American Fisheries Society
Estuarine Research Federation
California Estuarine Research Society

Professional references

Dr. Peter B. Moyle, Professor, Department of Wildlife, Fisheries, and Conservation Biology, University of California, Davis, CA 95616
Phone: (530) 752-6355
e-mail: pbmoyle@ucdavis.edu

Dr. Ted Sommer, Scientist, California Department of Water Resources, Sacramento, CA
Phone (916) (916) 376-9759
Email: tsommer@water.ca.gov

Dr. Wim Kimmerer, Professor, San Francisco State University, Tiburon, CA
Phone (415) 338-3515
Email: Kimmerer@sfsu.edu

Sue Fry, Bay-Delta Office Chief, Bureau of Reclamation, Sacramento, CA
Phone (916) 414-2401
Email: sfry@usbr.gov

Dr. Anke Mueller-Solger, IEP Lead Scientist, CALFED Bay-Delta Office, Sacramento, CA
Phone (916) 445-0147
Email: anke.mueller-solger@calwater.gov

Edward S. Gross, Ph.D.

Resource Management Associates, Inc.
2039 Shattuck Avenue, #300
Berkeley, CA 94704
Tel: 510-847-4061
edward.s.gross@gmail.com

Education

U.C. Los Angeles, B.S., summa cum laude, Civil Engineering, 1990
Stanford University, M.S., Civil Engineering, 1992
Stanford University, Ph.D., Civil and Environmental Engineering, 1998

Positions Held

Associate, Resource Management Associates 2011-present
Consulting Associate Professor, Civil and Environmental Engineering, Stanford University, 2000-present
Independent Consultant, 2000-2011
Senior Consulting Engineer**,** Quantitative Environmental Analysis, LLC, 1999-2000
Postdoctoral Research Fellow, Environmental Fluid Mechanics Laboratory, Stanford University, 1998-1999
University of Trento, Applied Mathematics Laboratory, Visiting Scientist, 1996
Research Assistant, Environmental Fluid Mechanics Laboratory, Stanford University, 1991-1997
Research Assistant, United States Geological Survey, 1992

Publications

MacWilliams, M.L., Gross, E.S., and Kimmerer, W.J., "Three-dimensional modeling of hydrodynamics and salinity in the San Francisco Estuary", submitted to San Francisco Estuary and Watershed Science.

Kimmerer, W.J., Gross, E.S., and MacWilliams, M.L., "Tidal migration of estuarine zooplankton investigated using a particle-tracking model", accepted by Limnography and Oceanography.

Kimmerer, W.J., MacWilliams, M.L., and Gross, E.S., "Variation of fish habitat and extent of the low-salinity zone with freshwater flow in the San Francisco Estuary", San Francisco Estuary and Watershed Science, **11(4)**, 2013.

Kokubu, Y., Yamazaki, H., Nagai, T., and Gross, E.S., "Mixing observations at a constricted channel of a semi-closed estuary: Tokyo Bay", Continental Shelf Research, **69**, 1-16, 2013.

MacWilliams, M.L., and Gross, E.S., “Hydrodynamic Simulation of Circulation and Residence Time in Clifton Court Forebay”, San Francisco Estuary and Watershed Science, **11(2)**, 2013.

Wang, B., Giddings, S.N., Fringer, O.B., Gross, E.S., Fong, D.A., and Monismith, S.G., “Modeling and Understanding Turbulent Mixing in a Macrotidal Salt Wedge Estuary”, Journal of Geophysical Research, **116**, 23p, 2011.

Gross, E.S., MacWilliams, M.L. and Kimmerer, W.J., “Three-dimensional Modeling of Tidal Hydrodynamics in the San Francisco Estuary”, San Francisco Estuary and Watershed Science. **7(2)**, 2009.

Kimmerer, W.J., Gross, E.S. and MacWilliams, M.L., “Is the Response of Estuarine Nekton to Freshwater Flow in the San Francisco Estuary Explained by Variation in Habitat Volume?” *Estuaries and Coasts*, **32(2)**, 375-389, 2009.

Gross, E.S., Bonaventura, L. and G. Rosatti, “Consistency with Continuity in Conservative Advection Schemes for Free-Surface Models,” *International Journal for Numerical Methods in Fluids*, **38**, 307-327, 2002.

Gross, E.S., Koseff, J.R. and S.G. Monismith, “Three-dimensional salinity simulations of South San Francisco Bay,” *Journal of Hydraulic Engineering*, **125(11),** 1199-1209, 1999.

Gross, E.S., Koseff, J.R. and S.G. Monismith, “Evaluation of advective transport schemes for simulation of salinity in a shallow estuary,” *Journal of Hydraulic Engineering*, **125(1),** 32-46, 1999.

Gross, E.S., Casulli, V., Bonaventura, L. and J.R. Koseff, “A semi-implicit method for vertical transport in multidimensional models,” *International Journal for Numerical Methods in Fluids*, **28**, 157-186, 1998.

Wang, P.F., Cheng, R.T., Richter, K., Gross, E.S., Sutton, D. and J.W. Gartner, “Modeling tidal hydrodynamics of San Diego Bay, California,” *Journal of the American Water Resources Association*, **34(5)**, 1123-1140, 1998.

Gross, E.S., Numerical modeling of hydrodynamics and scalar transport in an estuary, Ph.D. Thesis, Stanford University, 1998.

Synergistic Activities

Collaborator on the Stanford Unstructured Nonhydrostatic Terrain-following Adaptive Navier Stokes Simulator (2004-present)

Josh Korman, Ph.D.

Ecometric Research Inc.

3560 W. 22nd Avenue
Vancouver, BC, V6S 1J3
tel: (604) 737-8314, fax: (604) 737-8324
e-mail: jkorman@ecometric.com

Professional Experience

2011 - Present **Adjunct Professor, Fisheries Centre, University of British Columbia**

1993 - Present **Fish Ecologist, Ecometric Research Inc.**

- statistical analysis of fisheries data;
- development of computer simulation models for resource management;
- experimental design for environmental monitoring;
- fisheries stock assessment (analysis and field work); and

1993 - 1994 **Research Associate,** Dr. Randall M. Peterman, School of Resource and Environmental Management, Simon Fraser University.

- performed numerous statistical analyses using fisheries/environmental data;
- applied decision theory and bayesian approaches to fisheries problems;
- developed and refined computer simulation models;
- summarized research in primary publications and oral presentations; and
- assisted graduate students in their research.

1990 - 1993 **Systems Ecologist,** ESSA Environmental and Social Systems Analysts Ltd.

- developed quantitative tools and methods for fisheries management and habitat assessment;
- designed and implemented data analyses to resolve complex management problems and evaluate environmental monitoring programs;
- facilitated workshops and technical meetings concerning modelling, environmental impact assessment, monitoring design, and multi-user natural resource conflicts; and
- managed projects, prepared project budgets, and supervised project team members.

1984 **Field Technician,** Department of Biology, McGill University, Bryants Cove, Newfoundland. Through an NSERC Undergraduate Fellowship, I joined a multi-year project investigating the effects of meteorological conditions and water mass changes on the survival of egg and larval stages of Atlantic Capelin.

Education

- **PhD Zoology,** Department of Zoology, University of British Columbia, Vancouver, B.C., 2005-2009. Thesis supervisors: Dr.'s Steve Martell and Carl Walters. Early life history dynamics of rainbow trout in a large regulated river.

- **MSc Biological Oceanography,** Department of Oceanography, University of British Columbia, Vancouver, B.C., 1987 - 1989. Thesis supervisor: Dr. T.R. Parsons. Studies focused on phytoplankton ecology, eutrophying effects of salmon farms, and statistical and simulation modelling of nutrient dispersion and harmful phytoplankton blooms.

- **BSc Biology (honours)**, Department of Biology, McGill University, Montreal, Quebec, 1981-1984. Thesis supervisor: Dr. V.H. Smith. Areas of specialization included fisheries biology, phytoplankton ecology and biostatistics.

Awards and Advisory Work

- NSERC Postgraduate Scholarship, 1987 - 1989
- NSERC Undergraduate Fellowship, 1984
- Faculty Scholar, McGill University, 1982 – 1983

- Science Advisor, Trinity River Restoration Program (2004-present)
- Independent Science Advisor, Dunvegan Hydro Electric Project, Peace River, Alberta (2009-present)
- Research Science Panel (Chair), Herring Conservation Research Society (2003-2008)

References

Dr. Carl Walters, University of British Columbia - (604) 822-6320
Dr. Randall Peterman, Simon Fraser University - (604) 291-4683
Dr. Gilles Lacroix, Department of Fisheries and Oceans - (506) 529 -8854

Primary Publications

Korman, J., Martell, S.J.D., Walters, C.J., Makinster, A.S., Coggins, L.G., Yard, M.D., and W.R. Persons. 2012a**.** Estimating recruitment dynamics and movement of rainbow trout (Oncorhynchus mykiss) in the Colorado River in Grand Canyon using an integrated assessment model. Can. J. Fish. Aquat. Sci. 69: 1827-1849.

Korman, J., Walters, C.J., Martell, S.J.D., Pine, W.E. III., and D. Dutterer. 2011a. Effects of flow fluctuations on habitat use and survival of age-0 Rainbow trout in a large regulated river. Can. J. Fish. Aquat. Sci. 68:1097-1109

Korman, J., Martell, S.J.D., and C.J. Walters. 2011b. Describing population dynamics for early life stages of rainbow trout using a stock synthesis model. Can. J. Fish. Aquat. Sci. 68:1110-1123.

Korman, J., Kaplinski, M., and T.S. Melis. 2011c. Effects of fluctuation flows and a controlled flood on incubation success and early survival rates and growth of age-0 rainbow trout in a large regulated river. Trans. Am. Fish. Soc. 140: 487-505.

Korman, J., Decker, A.S., Mossop, B., and J. Hagen. 2010. A comparison of electrofishing- and snorkelling-based mark-recapture methods for estimating detection probability and abundance of juvenile steelhead in a medium-sized river. Nor. Am. J. Fish. Manage. 30: 1280-1302.

Korman, J., Yard, M., Walters, C., and L.G. Coggins. 2009. Effects of fish size, habitat, flow, and density on capture probabilities of age-0 rainbow trout estimated from electrofishing at discrete sites in a large river. Trans. Am. Fish. Soc. 138:58-75.

Korman, J., and S.E. Campana. 2009. Effects of hydropeaking on nearshore habitat use and growth of age-0 rainbow trout in a large regulated river. Trans. Am. Fish. Soc. 138:76-87.

Korman, J. 2009. Early life history dynamics of rainbow trout in a large regulated river. Ph.D. thesis. Department of Zoology, University of British Columbia. 214 pp. http://hdl.handle.net/2429/4127

Korman, J., Melville, C.C., and P.S. Higgins. 2007. Integrating multiple sources of data on migratory timing and catchability to estimate escapement for steelhead trout (*Oncorhynchus mykiss*). Can. J. Fish. Aquat. Sci. 64:1101-1115.

Korman, J., Wiele, S.M., and M. Torizzo. 2003. Modelling effects of discharge on habitat quality and dispersal of juvenile humpback chub (*Gila Cypha*) in the Colorado River, Grand Canyon. Riv. Res. Applic. 12: 1-23.

Korman, J., Ahrens, R.N.M., Higgins, P.S., and C.J. Walters. 2002. Effects of observer efficiency, arrival timing, and survey life on estimates of escapement for steelhead trout (O*ncorhynchus mykiss*) derived from repeat mark-recapture experiments. Can. J. Fish. Aquat. Sci. 59: 1116-1131.

Korman, J. and P.S. Higgins. 1997. Utility of escapement time series data for monitoring the response of salmon populations to habitat alteration. Can. J. Fish. Aquat. Sci. 54:2058-2097.

Korman, J., R.M. Peterman and C.J. Walters. 1995. Empirical and theoretical analyses of time-series bias in stock-recruitment relationships of Sockeye salmon (Oncorynchus nerka). Can. J. Fish. Aquat. Sci. 52:2174-2189.

Korman, J., D.R. Marmorek, G. Lacroix, P.G. Amiro, J.A. Ritter, W.D. Watt, R.E. Cutting, and D.C.E. Robinson. 1994. Development and evaluation of a biological model to assess regional scale effects of acidification on Atlantic salmon. Can. J. Fish. Aquat. Sci. 51: 662-680.

Melnychuk, M., Korman, J., Hausch, S., Welch, D., McCubbing, D., and C. Walters. 2014. Marine survival difference between wild and hatchery-reared steelhead trout determined during early downstream migration. Can. J. Fish. Aquat. Sci. 71: 831-846.

Yackulic, C.B., Yard, M.D., Korman, J., and D.R. Van Haverbeke. 2014. A quantitative life history of endangered humpback chub that spawn in the Little Colorado River: variation in movement, growth, and survival. Ecology and Evolution, In Press.

Bradford, M.J., Higgins, P.S., Korman, J., and J. Sneep. 2011. Does more water mean more fish? Test of an environmental flow release in the Bridge River, British Columbia. Freshwater Biology 56:2119-2134.

Melis, T.S., Korman, J., and T.A. Kennedy. 2011. Abiotic and biotic responses of the Colorado River to a March 2008 controlled flood experiment at Glen Canyon Dam, AZ. River Res. Appl.

Yard, M.D. Coggins. L.G., Baxter, C.V., Bennett, G.E., and J. Korman. 2011. Trout piscivory in the Colorado River, Grand Canon: effects of turbidity, temperature, and fish prey availability. Trans. Am. Fish. Soc. 140:471-486.

Hagen, J, Decker, A.S., Korman, J., and R.G. Bison. 2010. Effectiveness of night snorkelling for estimating steelhead parr abundance in a large river basin. Nor. Am. J. Fish. Manage. 30: 1303-1314.

Walters, C.J., Martell, S.J.D., and J. Korman. 2006. A stochastic approach to stock reduction analysis. Can. J. Fish. Aquat. Sci. 63:212-223.

Bradford, M.J., Korman, J., and P.S. Higgins. 2005. Using confidence intervals to estimate the response of salmon populations (Oncorhunchus spp.) to experimental habitat alterations. Can. J. Fish. Aquat. Sci. 62: 2716-2726.

Walters, C.J. and J. Korman. 2001. Analysis of stock and recruitment data for deriving spawning threshold levels: models, fitting, precision, diagnostics, pitfalls. *In* Prévost, E. and G. Chaput [*Editors*]. Stock, recruitment and reference points: Assessment and management of Atlantic salmon. INRA Paris 2001.

Walters, C., J. Korman, L. E. Stevens, and B. Gold. 2000. Ecosystem modeling for evaluation of adaptive management policies in the Grand Canyon. Conservation Ecology 4(2): 1.

Walters, C.J. and J. Korman. 1999. Linking recruitment to trophic factors: revisiting the Beverton-Holt recruitment model from a life history and multispecies perspective. Rev. Fish. Biol. Fisheries**.** Vol 9: 1-16.

Walters, C.J. and J. Korman. 1999. Cross-scale modeling of riparian ecosystem responses to hydrologic management. Ecosystems 2:411-421.

Lacroix, G.L. and J. Korman. 1996. Timing of episodic acidification in Atlantic salmon rivers influences evaluation of mitigative measures and recovery forecasts. Can. J. Fish. Aquat. Sci. 53: 589-599.

Marmorek, D.R., Macqueen, R.M., Wedeles, C.H.R., Korman, J., P.J. Blancher and D.K. McNicol. 1996. Improving pH and alkalinity estimates for regional scale acidification effects: Incorporation of dissolved organic carbon. Can. J. Fish. Aquat. Sci. 53: 1602-1608.

Adkison, M.D., Peterman, R.M., Lapointe, M.F., D.M. Gillis and J. Korman. 1996. Alternative models of climatic effects on sockeye salmon (*Oncorhynchus nerka*) productivity in Bristol Bay, Alaska, and the Fraser River, British Columbia. Fish. Oceanogr. 5:137-152.

Marmorek, D.R. and J. Korman. 1993. The use of zooplankton in a biomonitoring program to detect lake acidification and recovery. Water, Air, and Soil 69: 223-241.

Korman, J. 1989. Enriching effects of salmon farms in British Columbia coastal waters and the influence of flushing and seasonality. Department of Oceanography, University of British Columbia, Vancouver, BC. MSc Thesis. 94 pp.

Selected Reports

Korman, J. Parken, C., Chamberlain, M., Winther, I., Candy, J. and D. Gillespie. 2012b. Estimation of the escapement of the South Thompson 0.3 chinook aggregated in 2010 and 2011 using a Bayesian mdoel that combines data on coded wire tag recoveries, genetic stock identification, and scale identification in a distant fishery. Report prepared fro the Pacific Salmon Commission Sentinel Stocks Committee.

Korman, J. 2008. Cheakamus River steelhead adult abundance, juvenile habitat use and abundance monitoring 2007-2008. Final Report. Reported prepared by Ecometric Research for BC Hydro. 99 p. http://www.bchydro.com/etc/medialib/internet/documents/environment/pdf/wup_-_cheakamus_cmsmon-03.Par.0001.File.CMSMON_03_Cheakamus_Steelhead_Adult_Abundance_2007.pdf

Korman, J., and A. Tompkins. 2008. Estimating regional distributions of freshwater stock productivity, carrying capacity, and sustainable harvest rates for coho salmon using a hierarchical Bayesian modelling approach. PSARC report (in review) prepared by Ecometric Research for Fisheries and Oceans, Canada. 59 p.

Korman, J., and A. Tompkins. 2008. Comparison of the fishery and conservation performance of fixed- and abundance-based exploitation regimes for coho salmon in Southern BC. PSARC report (in review) prepared by Ecometric Research for Fisheries and Oceans, Canada. 47 p.

Korman, J., and J. Grout. 2008. Cultus Lake sockeye population viability analysis. Canadian Science Advisory Secretariat Research Document 2008/072. 51 p.

Wood, C.C., Sneep. D., McAdam, S., Korman, J., and T. Hatfield. 2007. Recovery potential assessment for white sturgeon populations listed under the Species at Risk Atc. Canadian Science Advisory Secretariat Research Document 2007/003.

Walters, C.J., Korman, J., and S. McAdam. 2005. An assessment of white sturgeon stock status and trends in the Lower Fraser River. Canadian Science Advisory Secretariat Research Document 2006/066.

Korman, J. 2002. Simulating the response of aquatic and riparian productivity to reservoir operations: Description of the Vegetation and Littoral Components of BC Hydro's Integrated Response Model (IRM). Report prepared by Ecometric Research Inc. for B.C. Hydro, Burnaby, B.C.

Korman, J. and C.J. Walters. 2001. Nechako River white sturgeon recovery planning: Summary of stock assessment and Oct 2-3, Workshop. Report prepared by Ecometric Research Inc. for B.C. Fisheries, Victoria, B.C.

Korman, J. 2001. Report of the BC Herring stock assessment review workshop, June 12-14, 2001. Report prepared by Ecometric Research Inc. Dept. of Fisheries and Oceans, Nanaimo, B.C.

Decker, A.S., J.M. Bratty, S.C. Riley, and J. Korman. 1999. Estimating standing stock of juvenile coho salmon (Oncorhynchus kisutch) and cutthroat trout (O. clarki) in a small stream: a comparison of sampling designs. Canadian Technical Report of Fisheries and Aquatic Sciences. No. 2282.

Lacroix, G., J. Korman, and D.D. Heath. 1998. Genetic introgression of the domestic Atlantic salmon genome into wild populations: A simulation of requirements for conservation. Canadian Stock Assessment Secretariat Research Document 98/158.

Korman, J., B. Bravender, and C.D. Levings. 1997. Utilization of the Campbell River estuary by juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in 1994. Canadian Technical Report of Fisheries and Aquatic Sciences. No. 2169.

ESSA. 1993. Review of salmon framing in British Columbia. Report prepared by ESSA Ltd. For BC Ministry of Agriculture, Fisheries, and Food. 109 pp.

Korman, J., Webb, T., Walters, C.J., Digisi, J., and J. Sawada and L. Huato. 1993. Small Lakes Integrated Management Model, SLIMM Version 1.0, User's Guide. Prepared by ESSA Ltd.for B.C. Ministry of Environment, Lands, and Parks, Fisheries Branch. 26 pp.

Korman, J. and E. Parkinson. 1993. Application of the Large Lakes Kokanee Model to Kootenay Lake, Okanagan Lake, and the Williston Reservoir. Prepared by ESSA Ltd for B.C. Ministry of Environment, Lands, and Parks, Fisheries Branch. 21 pp.

Korman, J., T.M. Webb and E. Parkinson. 1993. Large Lakes Kokanee Model, version 2.0, user's guide. Prepared by ESSA Ltd for B.C. Ministry of Environment, Lands, and Parks, Fisheries Branch. 70 pp.

Korman, J., W.A. Kurz, and D.R. Marmorek. 1992. Fish/forestry interaction model: workshop summary and model design. Prepared by ESSA Ltd., Vancouver, B.C. for Ministry of Forests, Research Branch, Vancouver, B.C., 79 pp.

Korman, J., C.J. Perrin, and R.C. Wiegand. 1990. The feasibility of fertilization of Kootenay Lake, North Arm. Limnotek Research and Development Inc. Prepared for B.C. Ministry of Environment, 108 pp.

Resume for Dr. Mark N. Maunder

Dr Maunder, a graduate of the School of Fisheries, University of Washington, is recognized internationally as a leader in the development of methodology for fisheries stock assessment and population dynamics modeling. He has been the team leader in the stock assessments of ten different species and part of the stock assessment team for eighteen other stocks. Dr Maunder has been a main developer for three general stock assessment models used by several organizations around the world. He has taught several courses in stock assessment and ecological modeling, including a graduate course at Scripps Institution of Oceanography. Dr Maunder is currently a senior scientist and head of the stock assessment program at the Inter-American Tropical Tuna Commission and has served as a consultant for several national and international governmental and non-governmental organizations. He is a founding member and former president of the ADMB Foundation and cofounder of the Center for the Advancement of Population Assessment Methodology (CAPAM). Dr Maunder has been an invited speaker on many occasions, reviewed stocks assessments for several national and international organizations, has over 80 peer reviewed publications, numerous reports, attended many international conferences and workshops on fisheries, ecology, and statistics, has obtained US$180,000 in external funding as lead PI and US$1,366,000 as co-PI, is on the editorial board of the ICES Journal of Marine Science and acted as the managing guest editor and a guest editor for special issues of the journal Fisheries Research. He has mentored several young scientists of different nationalities through the research and publication process. Dr Maunder's research focuses on the development of statistical methodology for fisheries stock assessment, protected species, and ecological modeling. He organizes and chairs the successful Fall workshop series on stock assessment methodology held at the Inter-American Tropical Tuna Commission and now part of CAPAM for the past 10 years.

Collaborators (48 months): Wang, S.P., M.N. Maunder, Crone, P. R., Valero, J. L., Semmens, Carvalho, F., Aires-da-Silva, A., Piner, K.R. Lee, H. H., Waterhouse, L., Sampson, D. B., Hyun, S.Y., Deriso, R.B, Lennert-Cody, C.E., Punt, A.E.,

Recent publications

Wang, S.P., **M.N. Maunder**, T. Nishida, T., Y. R. Chen, In press. Influence of model misspecification, temporal changes, and data weighting in stock assessment models: Application to swordfish(Xiphias gladius) in the Indian Ocean. Fisheries Research.

Sippel, T., Eveson, J.P., Galuardi, B., Lam, C., Hoyle, S., **Maunder, M.,** Kleiber, P., Carvalho, F., Tsontos, V., Teo, S.L.H., Aires-da-Silva, A., Nicol, S. (in press) Using movement data from electronic tags in fisheries stock assessment: A review of models, technology and experimental design. Fisheries Research.

Maunder, M.N. and Piner, K.R. (in press) Contemporary fisheries stock assessment: many issues still remain. ICES Journal of marine Science doi: 10.1093/icesjms/fsu015

Aires-da-Silva, A., **Maunder, M.N.,** Schaefer, K.M., Fuller, D.W. (in press). Improved growth estimates from integrated analysis of direct aging and tag-recapture data: an illustration with bigeye tuna (Thunnus obesus) of the eastern Pacific Ocean with implications for management. Fisheries Research.

Hyun, S.Y., **Maunder, M.N.**, Rothschild, B.J., (in press) Importance of modeling hetero-scedasticity of survey index data in fishery stock assessments. ICES JMS

Wang, S. P., **Maunder, M. N**., Aires-da-Silva, A. 2014. Selectivity's distortion of the production function and its influence on management advice from surplus production models. Fisheries Research, 158: 181-193.

Wang, S. P., **Maunder, M. N.,** Piner, K. R., Aires-da-Silva, A. Lee, H. H. 2014. Evaluation of virgin recruitment profiling as a diagnostic for selectivity curve structure in integrated stock assessment models. Fisheries Research, 158: 158-164.

Waterhouse, L., Sampson, D. B., **Maunder, M.** Semmens, B. X. 2014. Using areas-as-fleets selectivity to model spatial fishing: Asymptotic curves are unlikely under equilibrium conditions. Fisheries Research, 158: 15-25.

Lee, H. H., Piner, K. R., Methot, R. D., **Maunder, M. N.** 2014. Use of likelihood profiling over a global scaling parameter to structure the population dynamics model: An example using blue marlin in the Pacific Ocean. Fisheries Research, 158: 138-146.

Maunder, M. N., Crone, P. R., Valero, J. L., Semmens, B. X. 2014. Selectivity: Theory, estimation, and application in fishery stock assessment models. Fisheries Research, 158: 1-4.

Carvalho, F., Ahrens, R., Murie, D., Ponciano, J.M., Aires-da-Silva, A., **Maunder, M.N**., and Hazin, F. (2014). Incorporating specific change points in catchability in fisheries stock assessment models: An alternative approach applied to the blue shark (Prionace glauca) stock in the south Atlantic Ocean. Fisheries Research 154: 135-146.

Crone, P. R., **M. N. Maunder**, J. L. Valero, J. D. McDaniel?, and B. X. Semmens (2013). Selectivity: theory, estimation, and application in fishery stock assessment models. Workshop Series Report 1. Center for the Advancement of Population Assessment Methodology (CAPAM). NOAA/IATTC/SIO, 8901 La Jolla Shores Dr., La Jolla, CA 92037. 46 p.

Bolker, B.M., Gardner, B., **Maunder, M.,** Berg, C.W., Brooks, M., Comita, L., Crone, E., Cubaynes, S., Davies, T., de Valpine, P., Ford, J,. Gimenez, O, Kéry, M., Kim, E.J., Lennert-Cody?, C., Magnusson, A., Martell, S., Nash, J., Nielsen, A., Regetz, J., Skaug, H., Zipkin, E. (2013) Strategies for fitting nonlinear ecological models in R, AD Model Builder, and BUGS. Methods in Ecology and Evolution 4: 501-512.

Maunder, M.N. and Deriso, R.B (2013) A stock–recruitment model for highly fecund species based on temporal and spatial extent of spawning. Fisheries Research, 146: 96–101.

Punt, A.E., Huang, T-C, and **Maunder, M.N.** (2013) Review of Integrated Size-structured Models for Stock Assessment of Hard-to-age Crustacean and Mollusc Species. ICES Journal of Marine Science 70(1): 16-33.

Punt, A.E. and **Maunder, M.N.** (2013) Stock Synthesis: advancing stock assessment application and research through the use of a general stock assessment computer program. Fisheries Research 142: 1– 2.

Matthew L. (Matt) Nobriga
U.S. Fish and Wildlife Service
Bay-Delta Fish and Wildlife Office (BDFWO)
650 Capitol Mall, Suite 8-300
Sacramento, CA 95814

Email: matt_nobriga@fws.gov Phone: (916) 930-5609

Education: ***Bachelor of Science***, Biological Sciences, Stanislaus State University, 1993

Master of Science, Biological Sciences (degree concentration in Biological Conservation), Sacramento State University, 1998

Thesis: Trends in the food habits of larval delta smelt, *Hypomesus transpacificus*, in the Sacramento-San Joaquin Estuary, California, 1992-1994

Full-Time Professional Positions:

***March 2010-Present* – Fish Biologist, GS-482-13, BDFWO, Sacramento, CA, Full-time, permanent**

Duties: I am a senior level biologist in Region 8's BDFWO. Much of my work revolves around the litigated Biological Opinion (ESA Section 7) for operations of the Central Valley Project and the proposed Habitat Conservation Plan (ESA Section 10) known as the Bay Delta Conservation Plan (BDCP). My work has involved data analysis and interpretation and a large variety of written products including federal Court declarations, management briefs, technical reports, written reviews of draft documents, etc. [numerous specific examples are listed below]. I also advise office management about fish and aquatic science issues, mentor and assist junior staff with their work products, and engage a number of other stakeholders in a variety of settings like professional meetings, and workshops hosted by entities like the State Water Resources Control Board and the Delta Science Program. I have temporarily acted in several supervisory roles during my employment including a 60-day detail as Deputy Field Supervisor of the BDFWO during November-December 2013, a 30-day detail as Assistant Field Supervisor of BDFWO's Regulatory Division during February 2012, and several short (1-day to 1-week) details as Assistant Field Supervisor of the BDFWO's Water Operations and Water Science Applications Division.

***September 2008-March 2010* – Senior Environmental Scientist, California Department of Fish and Game (now Department of Fish and Wildlife; DFW) Water Branch, Sacramento, CA, Full-time, permanent**

Duties: I was the supervisor of the Water Branch's Ecosystem Performance Measures Unit, where I oversaw the work of two Environmental Scientists. In addition to supervising, my other job duties were similar to the position I now hold at BDFWO in that I served as a senior scientist advising Water Branch executives and the Department's Director regarding fishery issues in the Bay-Delta system. I also served as the Department's expert witness in a lawsuit involving

DFW's management of the San Francisco Bay Delta striped bass fishery. Numerous specific examples of my work are listed below.

***December 2006-August 2008* – Environmental Scientist C/Staff Environmental Scientist, CALFED Science Program, Sacramento, CA, Full-time, 20-month term**

Duties: My major duties were to develop and manage contracts to support scientific research in the San Francisco Bay-Delta and to develop and sometimes participate in topical scientific workshops hosted by the Science Program. The latter involved scheduling the participation of, and contracting with, established scientists from throughout the U.S. and Canada. I also had a variety of technical writing assignments [numerous specific examples are listed below].

***June 1998-December 2006* – Environmental Scientist B-C, California Department of Water Resources, Division of Environmental Services, Sacramento, CA, Full-time, permanent**

Duties: In this position, I was mainly a fisheries science researcher for the Interagency Ecological Program for the San Francisco Estuary (IEP). I helped design, implement, and conduct field, laboratory, and desktop research projects and develop Biological Assessments (per ESA Section 7) for operations of the State Water Project and Central Valley Project [numerous specific examples are listed below]. From 2002-2006, I was also a member of the IEP's Management Team and Pelagic Organism Decline Management Team. As a member of these teams, I worked with scientists from several other State and Federal agencies to prioritize and fund IEP research and monitoring.

***August 1995-January 1997* – Fish Biologist, GS-482-5, U.S. Fish and Wildlife Service, Stockton Fish and Wildlife Office, Stockton, CA, Full-time, one-year term**

Duties: My major duties in this position were to help conduct field, laboratory and data entry work in support of the Service's Delta Juvenile Salmon Monitoring Program (now known as the Delta Juvenile Fishes Monitoring Program).

Peer-reviewed Publications:

Culberson, S.D., C.B. Harrison, C. Enright, and M.L. Nobriga. 2004. Sensitivity of larval fish transport to location, timing, and behavior using a particle tracking model in Suisun Marsh, California. American Fisheries Society Symposium 39:257-268.

Feyrer, F., K. Newman, M. Nobriga, and T. Sommer. 2011. Modeling the effects of future outflow on the abiotic habitat of an imperiled estuarine fish. Estuaries and Coasts 34:120-128.

Feyrer, F., M.L. Nobriga, and T.R. Sommer. 2007. Multi-decadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, USA. Canadian Journal of Fisheries and Aquatic Sciences 64:723-734.

Herbold, B., D.M. Baltz, L. Brown, R. Grossinger, W. Kimmerer, P. Lehman, P.B. Moyle, M. Nobriga, and C.A. Simenstad. 2014. The role of tidal marsh restoration in fish management in the San Francisco Estuary. San Francisco Estuary and Watershed Science 12: http://escholarship.org/uc/item/1147j4nz

Kimmerer, W.J., S.R. Avent, S.M. Bollens, F. Feyrer, L.F. Grimaldo, P.B. Moyle, M. Nobriga, and T. Visintainer. 2005. Variability in length-weight relationships used to estimate biomass of estuarine fish from survey data. Transactions of the American Fisheries Society 134:481-495.

Kimmerer, W.J., and M.L. Nobriga. 2008. Investigating particle transport and fate in the Sacramento-San Joaquin Delta using a particle tracking model. San Francisco Estuary and Watershed Science 6: http://escholarship.org/uc/item/547917gn

Lehman, P.W., S. Teh, G. Boyer, M. Nobriga, E. Bass, and C. Hogle. 2010. Initial impacts of *Microcystis aeruginosa* blooms on the aquatic food web in the San Francisco Estuary. Hydrobiologia 637:229-248.

Nobriga, M.L. 2002. Larval delta smelt diet composition and feeding incidence: environmental and ontogenetic influences. California Fish and Game 88:149-164.

Nobriga, M.L. 2009. Bioenergetic modeling evidence for a context-dependent role of food limitation in California's Sacramento-San Joaquin Delta. California Fish and Game: 95:111-121.

Nobriga, M.L., and F. Feyrer. 2007. Shallow-water piscivore-prey dynamics in California's Sacramento-San Joaquin Delta. San Francisco Estuary and Watershed Science 5: http://escholarship.org/uc/item/387603c0

Nobriga, M.L., F. Feyrer. 2008. Diet composition in San Francisco Estuary striped bass: does trophic adaptability have its limits? Environmental Biology of Fishes 83: 495-503.

Nobriga, M.L., F. Feyrer, and R.D. Baxter. 2006. Aspects of Sacramento pikeminnow biology in nearshore habitats of the Sacramento-San Joaquin Delta, California. Western North American Naturalist 66:106-114.

Nobriga, M.L., F. Feyrer, R.D. Baxter, and M. Chotkowski. 2005. Fish community ecology in an altered river delta: spatial patterns in species composition, life history strategies and biomass. Estuaries 28:776-785.

Nobriga, M.L., E. Loboschefsky, and F. Feyrer. 2013. Common predator, rare prey: exploring juvenile striped bass predation on delta smelt in California's San Francisco Estuary. Transactions of the American Fisheries Society 142: 1563-1575.

Nobriga, M.L., Z. Matica, and Z.P. Hymanson. 2004. Evaluating entrainment vulnerability to agricultural irrigation diversions: a comparison among open-water fishes. American Fisheries Society Symposium 39:281-295.

Nobriga, M. L., T. R. Sommer, F. Feyrer, and K. Fleming. 2008. Long-term trends in summertime habitat suitability for delta smelt, *Hypomesus transpacificus*. San Francisco Estuary and Watershed Science 6: http://escholarship.org/uc/item/5xd3q8tx

Sommer, T., C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga, and K. Souza. 2007. The collapse of pelagic fishes in the upper San Francisco Estuary. Fisheries 32(6):270-277.

Sommer, T., W.C. Harrell, and M.L. Nobriga. 2005. Habitat use and stranding risk of juvenile Chinook salmon on a seasonal floodplain. North American Journal of Fisheries Management 25:1493-1504.

Sommer, T., B. Harrell, M. Nobriga, R. Brown, P. Moyle, W. Kimmerer and L. Schemel. 2001. California's Yolo Bypass: evidence that flood control can be compatible with fisheries, wetlands, wildlife, and agriculture. Fisheries 26(8):6-16.

Sommer, T., W. Harrell, M. Nobriga, and R. Kurth. 2003. Floodplain as habitat for native fish: lessons from California's Yolo Bypass. P. 81-87 in Faber, P.M. (ed.) California riparian systems: processes and floodplain management, ecology, and restoration. 2001 Riparian habitat and floodplains conference proceedings, Riparian Habitat Joint Venture, Sacramento, CA.

Sommer, T., F. Mejia, M. Nobriga, F. Feyrer, and L. Grimaldo. 2011. The spawning migration of delta smelt in the upper San Francisco Estuary. San Francisco Estuary and Watershed Science 9: http://escholarship.org/uc/item/86m0g5sz

Sommer, T.R., M.L. Nobriga, W.C. Harrell, W. Batham, and W.J. Kimmerer. 2001. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58:325-333.

Selected Presentations and Written Contributions (not peer-reviewed):

[Unpublished Technical Report] Nobriga, M., T. Veldhuizen, and Z. Hymanson. 1999. Delta smelt concerns result in changes in SWP and CVP operations. Interagency Ecological Program Newsletter 12(3):33-34. http://www.water.ca.gov/iep/newsletters/1999/summer/Delta%20Smelt%20concerns%20Result%20in%20Changes%20in%20SWP%20and%20CVP%20Operations.pdf

[Federal Endangered Species Act Consultation] California Department of Water Resources and U.S. Bureau of Reclamation. 2000. Biological Assessment of State Water Project and Central Valley Project impacts on spring-run chinook salmon and steelhead. (Editor and co-author)

[Unpublished Technical Report] Nobriga, M., and M. Chotkowski. 2000. Recent historical evidence of centrarchid increases and tule perch decrease in the Delta. Interagency Ecological Program Newsletter 13(1):23-27. http://www.water.ca.gov/iep/newsletters/2000/2000winter.pdf

[Unpublished Technical Report] Nobriga, M., Z. Hymanson, and R. Oltmann. 2000. Environmental factors influencing the distribution and salvage of young delta smelt: a comparison of factors occurring in 1996 and 1999. Interagency Ecological Program Newsletter 13(2):55-65. http://www.water.ca.gov/iep/newsletters/2000/IEPNewsletter_Spring2000.pdf

[Unpublished Technical Report] Kurth, R., and M. Nobriga. 2001. Food habits of larval splittail. Interagency Ecological Program Newsletter 14(3):40-42. http://www.water.ca.gov/iep/newsletters/2001/IEPNewsletterSummer2001.pdf

[Presentation] Nobriga, M.L. 2001. Ontogenetic patterns in the feeding ecology and habitat use of larval delta smelt. California-Nevada Chapter of the American Fisheries Society Annual Meeting, Sacramento, CA.

[Unpublished Technical Report] Nobriga, M., and P. Cadrett. 2001. Differences among hatchery and wild steelhead: evidence from Delta fish monitoring programs. Interagency Ecological Program Newsletter 14(3):30-38. http://www.water.ca.gov/iep/newsletters/2001/IEPNewsletterSummer2001.pdf

[Unpublished Technical Report] Nobriga, M., Z. Hymanson, K. Fleming, and C. Ruhl. 2001. Spring 2000 delta smelt salvage and Delta hydrodynamics and an introduction to the Delta Smelt Working Group's decision tree. Interagency Ecological Program Newsletter 14(2):42-46. http://www.water.ca.gov/iep/newsletters/2001/IEPNewsletterSpring2001.pdf

[Unpublished Technical Report] Matica, Z., and M. Nobriga. 2002. Modifications to an agricultural water diversion to permit fish entrainment sampling. Interagency Ecological Program Newsletter 15(3):32-35. http://www.water.ca.gov/iep/newsletters/2002/IEPNewslettersummer2002.pdf

[Presentation] Nobriga, M.L., Z. Matica, and Z.P. Hymanson. 2002. Evaluating entrainment vulnerability to agricultural irrigation diversions: a comparison among open-water fishes. CALFED Bay-Delta Science Conference, Sacramento, CA. Also presented as *Patterns of fish entrainment through screened and unscreened agricultural diversion siphons* at the 2002 Interagency Ecological Program Annual Meeting, Pacific Grove, CA, and (by Z. Hymanson) at the 2003 American Fisheries Society Larval Fishes Conference, Santa Cruz, CA.

[Presentation] Fleming, K., M. Nobriga, and M. Dege. 2004. Status of delta smelt: multi-decade trends in abundance, distribution, and entrainment mortality. Western Division of the American Fisheries Society Annual Meeting, Salt Lake City, UT.

[Presentation] Nobriga, M.L., F. Feyrer, R. Baxter, and M. Chotkowski. 2004. An evaluation of factors influencing fish assemblages in nearshore habitats of the delta. CALFED Bay-Delta Science Conference, Sacramento, CA. Also presented as *Fish community ecology in the delta: the profound role of submerged aquatic vegetation* at the 2005 Interagency Ecological Program Annual Meeting, Pacific Grove, CA.

[Presentation] Nobriga, M.L., F. Feyrer, R. Baxter, and M. Chotkowski. 2004. Ecological evaluation of young piscivores in nearshore habitats of the Delta. CALFED Bay-Delta Science Conference, Sacramento, CA.

[Unpublished Technical Report] Kimmerer, W., and M. Nobriga. 2005. Development and evaluation of bootstrapped confidence intervals for the IEP fish abundance indices. Interagency Ecological Program Newsletter 18(2):68-75. http://www.water.ca.gov/iep/newsletters/2005/IEPNews_spring2005final.pdf

[Presentation] Feyrer, F., M. Nobriga, and T. Sommer. 2006. Multidecadal habitat trends: patterns and mechanisms for three declining fish species in the San Francisco Estuary. CALFED Bay-Delta Science Conference, Sacramento, CA.

[Presentation] Nobriga, M., F. Feyrer, and R. Baxter. 2006. Aspects of Sacramento squawfish…er, pikeminnow biology in nearshore habitats of the Sacramento-San Joaquin Delta. California-Nevada Chapter of the American Fisheries Society Annual Meeting. Ventura, CA.

[Presentation] Nobriga, M.L., T.R. Sommer, and F. Feyrer. 2006. Long-term change in summertime habitat for pelagic fishes in the San Francisco Estuary. American Fisheries Society Annual Meeting, Lake Placid, NY.

[Unpublished Technical Report] Enos, C., J. Sutherland, and M. Nobriga. 2007. Results of a two-year fish entrainment study at the Morrow Island Distribution System in Suisun Marsh. Interagency Ecological Program Newsletter 20(1):10-19. http://www.water.ca.gov/iep/newsletters/2007/IEPNewsletterfinal3_winter2007.pdf

[Unpublished Technical Report] Baxter, R., R. Breuer, L. Brown, M. Chotkowski, F. Feyrer, M. Gingras, B. Herbold, A. Mueller-Solger, M. Nobriga, T. Sommer, and K. Souza. 2008. Pelagic Organism Decline progress report: 2007 synthesis of results. http://www.water.ca.gov/iep/docs/pod/synthesis_report_031408.pdf

[Unpublished Technical Report] Kimmerer, W., L. Brown, S. Culberson, M. Nobriga, and J. Thompson. 2008. Aquatic ecosystem. In Healey, M, Dettinger, M, and Norgaard, R. (eds). State of Science

for the Bay-Delta System. CALFED Science Program report. http://www.science.calwater.ca.gov/publications/sbds.html

[Unpublished Technical Report] Kneib, R.T., C.A. Simenstad, M.L. Nobriga, and D.M. Talley. 2008. Tidal marsh biological conceptual model - Delta Regional Ecosystem Restoration and Implementation Plan (DRERIP). https://www.dfg.ca.gov/erp/cm_list.asp

[Unpublished Technical Report] Nobriga, M. 2008. Fish habitat linkages conceptual model. Delta Regional Ecosystem Restoration and Implementation Plan. https://www.dfg.ca.gov/erp/cm_list.asp

[Presentation] Nobriga, M, and B. Herbold. 2008. Applying the DRERIP Smelt Model Evolving Learning Tool (SMELT) to small marshes, energetic limitations, and transport (SM, EL, T). CALFED Bay-Delta Science Conference.

[Federal Endangered Species Act Consultation] U.S. Fish and Wildlife Service. 2008. Biological Opinion for delta smelt *Hypomesus transpacificus*, for the coordinated operation of the Central Valley Project and State Water Project. (Co-author) http://www.fws.gov/sfbaydelta/documents/SWP-CVP_OPs_BO_12-15_final_OCR.pdf

[California Endangered Species Act Consultation] Baxter, R. D., M. L. Nobriga, S. B. Slater, and R. W. Fujimura. 2009. Effects analysis for the California Endangered Species Act Incidental Take Permit for longfin smelt (*Spirinchus thaleichthys*) for the State Water Project, available online at http://www.delta.dfg.ca.gov/data/longfinsmelt/documents/LongfinSmeltIncidentalTakePermitNo.2081-2009-001-03.asp

[Court document] Nobriga, M. L. 2009. A synopsis of the state of science regarding the feeding ecology of San Francisco Estuary striped bass and its effects on listed fishes. Expert Report prepared for the California Department of Fish and Game regarding case #.CV 08-397-OWW, Dated October 1, 2009.

[Court document] Nobriga, M. L. 2009. An evaluation of "Striped bass predation on listed fish within the Bay-Delta estuary and tributary rivers" by Charles Hanson, Ph.D., submitted as an expert report in Coalition for a sustainable Delta et al. vs. Koch; California case # .CV 08-397-OWW, Expert Report prepared for the California Department of Fish and Game regarding case #.CV 08-397-OWW, Dated November 19, 2009.

[Unpublished Technical Report] Nobriga, M, and B. Herbold. 2009. Conceptual model for delta smelt (*Hypomesus transpacificus*) for the Delta Regional Ecosystem Restoration and Implementation Plan (DRERIP). https://www.dfg.ca.gov/erp/cm_list.asp

[Unpublished Technical Report] Sommer, T., K. Reece, F. Mejia, and M. Nobriga. 2009. Delta smelt life-history contingents: a possible upstream rearing strategy? Interagency Ecological Program Newsletter 22(1):11-13. http://www.water.ca.gov/iep/newsletters/2009/IEPNewsletter_FINALWinter2009.pdf

[Testimony to the State Water Resources Control Board] California Department of Fish and Game. 2010. Development of an estuarine fish habitat suitability indicator based on Delta outflow and other factors. California Department of Fish and Game Exhibit 2 submitted to the State Water Resources Control Board Informational Proceeding on Delta Flows, March 2010. (Principal author). http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/dfg/dfg_exh2.pdf

[Invited Expert Advice to the State Water Resources Control Board] Delta Environmental Flows Group. 2010. Key points on Delta environmental flows for the State Water Resources Control Board,

February 2010. (Co-author) http://www.swrcb.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/

[Presentation] Nobriga, M. L. 2010. The little fish in California's water supply: delta smelt "DRERIP" conceptual model overview. National Academy of Science Panel on the OCAP Biological Opinions, January 25, 2010, Sacramento, CA.

[Court document] Nobriga, M. L. 2011. Declaration of Matthew L. Nobriga in support of Federal Defendants' opposition to Plaintiffs' motion for interim injunctive relief regarding case # 1:09 cv 00407-OWW-DLB. Dated February 11, 2011.

[Court document] Nobriga, M. L. 2011. Declaration of Matthew L. Nobriga in support of Federal Defendants' opposition to Plaintiffs' motion for interim injunctive relief regarding case # 1:09 cv 00407-OWW-DLB. Dated July 1, 2011.

[Presentation] Nobriga, M, E. Loboschefsky, and F. Feyrer. 2011. Does predator abundance predict prey loss? Application of a simple model to striped bass in California's Bay-Delta estuary. American Fisheries Society Annual Meeting, Seattle, WA.

[Presentation] Nobriga, M. 2012. Tastes great, less filling: delta smelt in a pelagic food web past, present, and future (a synthesis of other people's work). Delta Science Program Bay-Delta Science Conference. Sacramento, CA.

[Unpublished Technical Report] Brown, L., R. Baxter, G. Castillo, L. Conrad, S. Culberson, M. Dekar, M. Dekar, F. Feyrer, K. Gehrts, L. Grimaldo, T. Hunt, K. Jones, J. Kirsch, A. Mueller-Solger, M. Nobriga, S. Slater, T. Sommer, and K. Souza. 2014. An updated conceptual model for delta smelt: our evolving understanding of an estuarine fish. Interagency Ecological Program Technical Report (in preparation).

[Presentation] Nobriga, M., K. Sun, and E. Gleason. 2014. Old and Middle river flow and delta smelt. State Water Resources Control Board Interior Delta Flows Workshop, April 16, 2014. http://deltacouncil.ca.gov/sites/default/files/documents/files/03-Matt-Nobriga-Old-and-Middle-River-Flow-and-Delta-Smelt.pdf

[Unpublished Technical Report] Polansky, L., M. Nobriga, K. Newman, M. Dekar, K. Webb, and M. Chotkowski. 2014. Early warning of delta smelt movement during an extreme drought: intensive springtime Kodiak trawling at Jersey Point. Interagency Ecological Newsletter (in press).

AFFILIATIONS:

American Fisheries Society: 2000-present, Chair of the California-Nevada Chapter's Conservation Committee, 2012-present

Peter E. Smith

Research Hydrologist, Davis, CA

1. **DATE UPDATED:** November 12, 2014
2. **PRESENT STATUS**: Research Hydrologist, U.S. Geological Survey (retired)
3. **SUMMARY OF RESEACH EXPERIENCE:** Thirty-eight years working as a Research Hydrologist. Thirty-one years with the the U. S. Geological Survey (USGS) in California, Mississippi, and New York specializing in hydrodynamics of estuaries, three-dimensional numerical modeling, mixing in coastal and inland waters, ecological applications of hydraulics, hydroacoustics, watershed hydrology, mathematics, and water quality. Active part-time in environmental consulting for nearly seven years after retirement from USGS in January of 2008.
4. **EDUCATION**:

INSTITUTION	MAJOR	MINOR(S)	DEGREE
University of Calif., Davis	Civil and Environmental Engineering	Environmental Hydraulics/Fluid Mechanics/Mathematics	Ph.D. (06/97)
Colorado State University	Civil Engineering	Hydraulics	M.S. (05/76)
Villanova University	Civil Engineering	Water Resources	B.S. (05/74)

5. **PROFESSIONAL EXPERIENCE:**

A. MOST RECENT POSITION:

DATES: From: January 3, 2008 To: present

PROJECT TITLE: San Francisco Bay-Delta Hydrodynamic and Ecological Investigations

POSITION DESCRIPTION: Retired research hydrologist remaining active in environmental consulting

EMPLOYER: Self employed (e-mail address: pesmith07@comcast.net)

SOURCES OF FUNDING: U.S. Bureau of Reclamation
U.S. Fish and Wildlife Service
Delta Science Program (DSP)

DESCRIPTION OF WORK: Research on the effects of hydrodynamics on the distribution and losses due to entrainment of the threatened species delta smelt (*Hypomesus transpacificus*). Member of a USFWS-led team developing a statistical delta smelt life-history model to be used as a decision support tool to assess and to predict the effects of various management actions in the San Francisco Estuary on the delta smelt population. Service on a variety of DSP and

Federal-agency review panels and teams related to hydrodynamics and ecology of the San Francisco Bay-Delta Estuary.

B. LAST USGS POSITION:

DATES: From: June, 1, 1983 To: January 3, 2008 (*date of retirement from USGS*)
PROJECT TITLE: San Francisco Bay-Delta Hydrodynamic Investigations
POSITION TITLE: Project Chief, Research Hydrologist
EMPLOYER: U.S. Geological Survey, California Water Science Center, Placer Hall, 6000 J Street, Sacramento, California 95819-2605 (still active USGS e-mail address: pesmith@usgs.gov)

SOURCES OF FUNDING: U.S. Geological Survey (USGS) Cooperative Program
Interagency Ecological Program (IEP) for the San Francisco Bay-Delta Estuary
California Department of Water Resources
U.S. Bureau of Reclamation
California Bay-Delta Authority (CalFed)
California State Water Resources Control Board (SWRCB)

DESCRIPTION OF PROJECT: This project was part of a long-term hydrodynamic study of the San Francisco Bay-Delta Estuary begun by the IEP, USGS, and SWRCB in 1983. The general objective has been to understand biologically important variations in hydrodynamics (water currents and salinity) within the estuary that result from changes in freshwater inflows and the diversions of water by the two large state and federal water projects in the south Delta. One component of the study was to develop a three-dimensional (3D) hydrodynamic computer model and to apply it to studies of the estuary.

FINAL FIVE YEARS ACTIVITY ON THE PROJECT: Principal investigator on four studies: (1) CalFed-initiated study of South Delta Hydrodynamics and Fish Transport to understand the role of delta flows, circulation, and fish behavior on the transport and entrainment of fish (primarily delta smelt) at the State and Federal pumping facilities in the south Delta; (2) IEP-funded modeling study of the three-dimensional (3D) circulation in San Francisco Bay to understand the density-driven circulation and salt transport in the lower portion of the estuary; (3) IEP-funded modeling study of the 3D circulation in the vicinity of the Delta Cross Channel (DCC) to understand the mechanisms that affect the entrainment of outmigrating juvenile salmon on the Sacramento River into the DCC and Georgiana Slough; (4) CalFed-funded study of

Hydrodynamics and Oxygen Modeling of the Stockton Deep Water Ship Channel aimed at understanding what physical and biogeochemical conditions lead to hypoxia in the reach of the San Joaquin River near the City of Stockton, California.

C. PREVIOUS USGS PROFESSIONAL POSITIONS:

- 9/82 to 6/83 -- USGS Graduate School Training Program , University of California, Davis.
- 9/78 to 8/82 – Research Hydrologist with the USGS National Research Program, Bay St. Louis, Mississippi. Research on 1-D unsteady flow and rainfall-runoff modeling. Developed (along with a USGS co-worker) the USGS rainfall-runoff and runoff-quality models called DR3M and DR3M-QUAL.
- 9/76 to 8/78 -- Hydrologist with the New York District of USGS, Albany, New York. Hydraulic analyses for flood insurance studies on several river systems using the USGS WSPRO computer model for steady-state water surface profile computation.

6. MOST RECENT RESEARCH ACCOMPLISHMENTS WHILE AT USGS:

I developed 3D hydrodynamic and particle tracking models for use on the San Francisco Bay and Delta Estuary. The hydrodynamic model, called Si3D (semi-implicit 3D), is a public-domain code that uses a novel numerical formulation that is mass conservative, computationally efficient, and numerically accurate. Although the Si3D model was designed mostly for application to estuaries, it has also been applied succesfully to studies of lakes by the University of California Davis. The particle tracking model, which was programmed in Java (by a computer science co-worker), reads large data files containing space- and time- dependent velocity, water-level, and turbulence data output from the Fortran-based hydrodynamic model. By applying the PTM in a post-processing step rather than in a coupled simulation with the hydrodynamic model, greater flexibility is allowed in conducting multiple experiments for forward or backward tracking of particles under the same hydrodynamic conditions and for interactive visualizations of particle movements.

In my last five years at USGS, my research concentrated mostly on applications of the 3D models to different portions of the Bay-Delta estuary and to studies of Delta ecology. See the studies mentioned above under "Final Five Years Activity on the Project."

Working with a computer science co-worker, I have also collaborated in the development of new interactive graphic software using the Java language and OpenGL (open graphics library) for use in visualizing 3-D numerical model output and hydrodynamic field data.

7. SCIENTIFIC LEADERSHIP:

* Served as a control member of the Computational Hydraulics Committee for the Environmental and Water Resources Institute (EWRI) of the American Society of Civil Engineers (ASCE) from 1998 through 2009.
* Served as a member of a task committee for the EWRI of ASCE to prepare a comprehensive monograph on "Verification and Validation of 3-D Free-Surface Hydrodynamic Models" from 1990 through 2008. (The monograph from this task commmittee was published by the ASCE in 2009.)
* USGS representative (from 1997-2005) to the Management Team overseeing the Interagency Ecological Program (IEP) of the San Francisco Bay-Delta Estuary. This program involves nine federal and state agencies and oversees 15 million dollars in funding for monitoring and special studies.
* USGS representative (1995-2007) to the Steering Committee of the California Bay-Delta Modeling Forum. (Although offcially a member of this committee, I was not particularly active in attending regular meetings.)
* Advisor (during 2001) to the California Water and Environmental Modeling Forum peer review of 1-D Delta Hydrodynamic Models
* Served as Chairman (from June 1998 to 2004) of the IEP Hydrodynamics Project Work Team.
* Served on the organizing committee (from 1989 to 2005) for the annual IEP scientific workshop on the San Francisco Bay and Delta held each February at the Asilomar Conference Center in Monterey, CA.
* Led the development of the original USGS hydrodynamic study of San Francisco Bay in the 1980's.

8. SCIENTIFIC AND PUBLIC SERVICE:

A. CURRENT MEMBERSHIP IN PROFESSIONAL SOCIETIES:

- <u>Society name</u>: American Society of Civil Engineers (ASCE) (member since 1974)
  Elective Office held: Secretary (1980) and Vice President (1981), Gulf Coast Branch.
  Important committee and leadership assignments:
  i. Control member of the Computational Hydraulics Committee for the Environmental and Water Resources Institute (1998 to 2009)
  ii. On the advisory committee of ASCE's prestigious biannual Estuarine and Coastal Modeling Conferences (1989-present)
  iii. Control member of a Task Committee to prepare a monograph on "Verification and Validation of 3-D Free-Surface Hydrodynamic Models" (1990 to 2008).
  iv. Corresponding member of a Tidal Hydraulics Task Committee on Intra-Annual Variation in Coastal Water Levels (from 1992-95)

* <u>Society name</u>: American Geophysical Union (AGU) (member since 1979)

* <u>Society name</u>: American Water Resources Association (AWRA) (member since 1982)

B. TECHNICAL PRESENTATIONS AT SCIENTIFIC MEETINGS:

OMR Flows, Turbidity, and Delta Smelt. April 16, 2014. Delta Science Program Workshop on Delta Interior Flows. Park Tower Building, Sacramento, CA.

Effects of Turbidity and Hydrodynamics on Distributions of Delta Smelt. April 17, 2012. Annual Workshop of the California Water and Environmental Modeling Forum, Lake Natoma Inn, Folsom, CA.

Data Analyses and Modeling to Understand the Effects of Hydrodynamics on Delta Smelt Distributions and Abundance. May 27, 2009. Physical Modeling and Fish Management Workshop sponsored by the Interagency Ecological Program of the Sacramento-San Joaquin Delta, California, Sacramento, CA.

Using 3D Hydrodynamic and Particle-Tracking Models to Explore Fish Movements and Distributions. February 24, 2009. Hugo Fischer Award presentation at the Annual Workshop for the California Water and Environmental Modeling Forum. Asilomar Conference Center, Pacific Grove, CA.

Overview of Modeling Approaches Used for Studies of Delta Conveyance. April 3, 2008. CalFed Science Program workshop on "Delta Conveyance Modeling" in support of the California Governor's Delta Vision Blue-Ribbon Task Force, Sacramento, CA.

Hydrodynamic Issues Related to Options for Through-Delta Conveyance. September 11, 2007. CalFed Science Program workshop on "Science Issues Related to Delta Conveyance Infrastructure: Through Delta Options," Sacramento, CA.

Using 3D Hydrodynamic and Particle-Tracking Models to Simulate Fish Transport and Entrainment Zones in the Sacramento-San Joaquin River Delta, California. (ABST.) September 3, 2007. 137th Annual Meeting of the American Fisheries Society, Marriott Hotel, San Francisco, California.

Hydroacoustic Measurements Used to Calibrate and Validate a 3D Hydrodynamic Model for the Delta Cross Channel Region of the Sacramento River, California. (ABST.) April 4, 2007. USGS National Surface Water and Hydroacoustics Workshop, St. Louis, MO.

Hydrodynamic Clues for Solving the Mystery of the Declining Delta Smelt Poulation in the San Francisco Bay-Delta Estuary. April 3, 2007. (ABST.) USGS National Surface Water and Hydroacoustics Workshop, St. Louis, MO.

Data and Modeling Analyses of the Possible Effects from Entrainment of Delta Smelt on the Population Decline. November 28, 2006. CalFed Workshop on the Environmental Water Account for the Sacramento-San Joaquin Delta, Sacramento, California.

Hydrodynamic Influences on Historical Patterns in Delta Smelt Salvage. (ABST.) October 24, 2006. Biannual CalFed Science Conference, Sacramento Convention Center, Sacramento, California.

Hydrodynamic and Particle Tracking Modeling for the San Francisco Bay-Delta Estuary, California. (ABST.) November 15, 2005. 1st All-USGS National Modeling Conference, Olympic Park Institute, Port Angeles, Washington.

Three-dimensional Hydrodynamic Modeling of the Stockton Deep-Water Ship Channel, California. (ABST.) October 31, 2005. 9th International Conference on Estuarine and Coastal Modeling, ASCE, October 31-November 2, 2005, Charleston, SC.

Applications of 3D Hydrodynamic and Particle Tracking Models in the San Francisco Bay-Delta Estuary. (PAPER.) May 17, 2005. ASCE's 2005 World Water and Environmental Resources Congress, May 15-19, 2005, Anchorage, AK.

A New Look at Suisun Bay Circulation. March 3, 2005. Annual Conference for the Interagency Ecological Program of the San Francisco Bay-Delta Estuary, Asilomar Conference Center, Pacific Grove, CA.

Three-dimensional Hydrodynamic Modeling of the Stockton Deep Water Ship Channel. March 2, 2005. Annual Conference for the Interagency Ecological Program of the San Francisco Bay-Delta Estuary, Asilomar Conference Center, Pacific Grove, CA.

Influence of Horizontal Momentum Diffusion on 3D Hydrodynamic Simulations of the Sacramento-San Joaquin River Delta. (ABST.) March 1, 2005. Annual Workshop of the California Water and Environmental Modeling Forum, Asilomar Conference Center, Pacific Grove, CA.

Computation of the Daily Value for Publication at USGS Tide-Affected Discharge Monitoring Stations. March 25, 2004. USGS National Hydroacoustics Workshop, San Diego, California.

Use of Acoustic Doppler Current Profilers in 3D Model Studies of the San Francisco Bay-Delta Estuary. March 23, 2004. USGS National Hydroacoustics Workshop, San Diego, California.

Three-dimensional Lagrangian Residual Circulation in San Francisco Bay. (ABST.) Annual Wokshop of the California Water and Environmental Modeling Forum. February 25, 2004, Asilomar Conference Center, Pacific Grove, CA.

Three-dimensional Hydrodynamic and Particle Tracking Modeling of the San Francisco Bay and Delta. November 19, 2003. USGS National Surface Water Conference, San Antonio, Texas.

Three-dimensional Particle Tracking in the San Francisco Bay and Delta. (ABST.) 8th International Conference on Estuarine and Coastal Modeling, November 3-5, 2003, Monterey, CA.

Applications of 3D Hydrodynamic and Particle Tracking Models to the San Francisco Bay and Delta. February 26, 2003. Annual Conference for the Interagency Ecological Program of the San Francisco Bay-Delta Estuary, Asilomar Conference Center, Pacific Grove, CA.

Modeling the 3D Density-driven Circulation and Salt Transport in San Francisco Bay. (ABST.) November 6, 2001. Seventh International Conference on Estuarine and Coastal Modeling, November 5-7, 2001, St. Pete Beach, FL.

Three-dimensional hydrodynamic simulations of the lower San Francisco Bay. February 29, 2000. Bay-Delta Modeling Forum Annual Workshop, Asilomar Conference Center, Pacific Grove, CA.

A 3D Model of Estuarine Hydrodynamics with Application to San Francisco Bay, California (ABST.). November 3, 1999. Sixth International Conference on Estuarine and Coastal Modeling, New Orleans, LA.

Verification and Validation of a 3D Hydrodynamic Model. (ABST.) August 8, 1999. ASCE's International Water Resources Engineering Conference, Seattle, WA.

Semi-implicit Numerical Schemes for 3D Flow Modeling (PAPER). August 10, 1997. 27th Congress of the International Association for Hydraulic Research, San Francisco, CA. (INVITED)

San Francisco Bay Test Case for 3D Model Verification (PAPER). August 2, 1994. ASCE's 1994 National Conf. on Hydraulic Engineering, Buffalo, NY. (INVITED)

Verifying a 3D Hydrodynamic Model of Carquinez Strait, California (ABST.). June 8, 1994. Int'l Conf. on Hydroscience and Engineering, Washington, D.C. (INVITED)

A Finite-Difference Model for 3D Flows in Bays and Estuaries (PAPER). July 30, 1993. ASCE 1993 National Conference on Hydraulic Engineering. San Francisco, CA. (PRESENTED)

Data set for verification of 3D free-surface hydrodynamic models, Carquinez Strait, CA (PAPER). ASCE Water Forum '92. August 5, 1992, Baltimore, MD. (INVITED)

A 3D model for tidal currents and salinity in San Pablo Bay, CA (ABST.). Workshop on Hydrodynamics of San Francisco Bay. May 21, 1991, Sausalito, CA. (PRESENTED)

Simulations of the 3D nontidal circulation in San Pablo Bay, California (ABST.). State of the Estuary Conference for San Francisco Bay/Delta Estuary. U.S. Environmental Protection Agency. May 31, 1991, Berkeley, CA. (PRESENTED)

Gravitational circulation in a tidal strait (PAPER). ASCE 1991 National Conference on Hydraulic Engineering. July 31, 1991, Nashville, TN. (PRESENTED)

Practical considerations in 3-D modeling of San Pablo Bay, CA (ABST.). ASCE 1990 National Conf. on Hydraulic Engr. August 3, 1990, San Diego, CA. (PRESENTED)

Recent progress on San Francisco Bay hydrodynamic modeling (PAPER). 1st International Conference on Estuarine and Coastal Modeling. ASCE, November 17, 1989, Newport, RI. (PRESENTED)

High resolution two-dimensional advective transport (PAPER). ASCE 1989 National Conf. on Hydraulic Engineering. August 18, 1989, New Orleans, LA. (PRESENTED)

Rainfall-runoff-quality model for urban watersheds (PAPER). Int'l Symposium on Rainfall-Runoff Modeling. May 1981, Mississippi St. Univ., MS. (PRESENTED)

Accumulation and washoff of pollutants from urban watersheds (ABST.). AGU fall meeting. December 1979, Washington, D.C. (PRESENTED)

C. RENDERING SCIENTIFIC JUDGEMENT:

* Served February-May 2014 on an independent science panel sponsored by the Delta Science Program and the State Water Resources Control Board (SWRCB) to identify the best available science to inform the SWRCB's decisions regarding Delta outflow

requirements for San Francisco Bay. (The panel report is available online at: http://deltacouncil.ca.gov/sites/default/files/documents/files/Delta-Outflows-Report-Final-2014-05-05.pdf)

* Served September-October 2012 on an independent science panel sponsored by the State Water Resources Control Board to review the scientific and technical basis for potential changes to the Water Quality Control Plan for the San Francisco/Sacramento-San Joaquin Delta Estuary. This was workshop 3 on "Analytical Tools for Evaluating Water Supply, Hydrodynamic, and Hydropower Effects." (The panel report is available online at: http://www.swrcb.ca.gov/waterrights/water_issues/programs/bay_delta/docs/comments111312/jay_lund.pdf)
* Served November-December 2010 on an independent panel sponsored by the Delta Science Program to review the actions related to the Reasonable and Prudent Alternatives (RPA) affecting the State/Federal Water Operations. (The panel report is available online at: http://deltacouncil.ca.gov/sites/default/files/documents/files/workshop_OCAP_2010_IRP_RPA_Final_Report_121310.pdf)
* Served March-April 2010 on a panel sponsored by the Delta Science Program to provide independent review of the Vernalis Adaptive Management Plan for the Sacramento-San Joaquin Delta. (The panel report is available online at: http://deltacouncil.ca.gov/sites/default/files/documents/files/review_vamp_panel_report_final_051110_0.pdf)
* Served October-November 2009 on a panel sponsored by the U.S. Fish and Wildlife Service to evaluate the Science and Monitoring Plan for the Department of Interior "Two-Gates" Project for the Sacramento-San Joaquin Delta.
* Served during December 2008-January 2009 on a panel convened by the CALFED Science Program to do an independent peer review of the National Marine Fisheries Service's (NMFS) Biological Opinion (BO) on the California Long-Term Central Valley Project (CVP) and State Water Project (SWP) Operations Criteria and Plan (OCAP). The BO, which was released in June 2009, assesses the effects of the continued operations of the CVP and SWP on listed Chinook salmon, steelhead, and green sturgeon. (The panel report is available online at: http://science.calwater.ca.gov/pdf/reviews/OCAP_NMFS_BO_final_review2.pdf)
* Served July-October 2008 on a panel convened by the CALFED Science Program to do an independent peer review of the "Analytical Framework " for the NMFS BO on the CVP/SWP OCAP effects on salmon, steelhead, and green sturgeon. The Analytical Framework specified the technical analyses that NMFS planned to use in producing the BO. (The panel report is available online at: http://science.calwater.ca.gov/pdf/reviews/OCAP_NMFS_AF_review_final.pdf)
* Served July-November 2008 on a U.S. Fish and Wildlife (USFWS)-sponsored team to develop a list of actions in the Sacramento-San Joaquin Delta needed to protect the threatened species delta smelt (*Hypomesus transpacificus*). These actions became part of the "Reasonable and Prudent Alternative" included in the Biological Opinion for the CVP/SWP OCAP effects on delta smelt that was released by the USFWS in December 2008.

* Served May-June 2008 on a CalFed review panel to evaluate approaches to linking physical and biological (ecological) models of the Sacramento-San Joaquin Delta. This review was done as part of a May 20, 2008 workshop entitled "Linking Physical and Biological Modeling for Ecosystem Predicion, Planning and Performance." It was Part II of a two-part discussion on Delta conveyance modeling requested by the "Delta Vision Blue Ribbon Task Force" commissioned by the Governor of California. (The panel report is available online at: http://science.calwater.ca.gov/events/workshops/workshop_dcm.html#dcm1)
* Served April 2008 on a CalFed review panel to assess the capability of existing hydrodynamic models and modeling studies to provide necessary information regarding a dual conveyance system (peripheral canal and through Delta) for the Sacramento-San Joaquin Delta. This review was done as part of an April 3, 2008 workshop entitled "Physical-Process Modeling Approaches." It was Part I of a two-part discussion on Delta conveyance modeling requested by the "Delta Vision Blue Ribbon Task Force" commissioned by the Governor of California. (The panel report is available online at: http://science.calwater.ca.gov/events/workshops/workshop_dcm.html#dcm1)
* Served as an invited speaker on the following panel discussions at professional society conferences:

    i. Panel Discussion on 'Integrated Modeling and Hydraulic Engineering.' ASCE's 2005 World Water and Environmental Resources Congress, May 15-19, 2005, Anchorage, Alaska.
    ii. Panel Discussion on an 'ASCE Monograph for 3D Free-Surface Flow Model Verification and Validation.' ASCE's 2001 World Water and Environmental Resources Congress, May 21,2001, Orlando, FL.
    iii. Panel Discussion on 'Free Surface Flow Model Verifications.' ASCE 1998 Int'l Water Resources Engineering Conf., August 4, 1998, Memphis, TN
    iv. Panel Discussion on 'Three-Dimensional Free Surface Flow Modeling.' ASCE First Int'l Conf. on Water Resources Engineering. August 18, 1995, San Antonio, TX.
    v. Panel Discussion on '3-D Hydrodynamic Model Validation.' Plenary session of the Int'l Conf. on Hydroscience and Engineering. June 8, 1993, Washington, D.C.

* Regular reviewer for the editors of the Journal of Hydraulic Engineering, Journal of Environmental Engineering, and the International Journal of Numerical Methods in Fluids.

D. LECTURESHIPS AND OTHER ACADEMIC SERVICE:

University of California, Davis. Hydrodynamics of the Delta. October 19, 2009. (Lecture to a graduate-level class on San Francisco Bay-Delta Hydrology.)

University of California, Davis. Hydrodynamic clues for solving the mystery of the declining delta smelt population in the San Francisco Bay-Delta Estuary. January 8, 2007. (Department of Civil and Environmental Engineering, Water Resources Engineering seminar series)

U.S. Geological Survey. 3D simulations of flow in the Delta Cross Channel Region of the Sacramento River with implications for fish passage. April 27, 2006. (USGS Western Region Office, Water Resources Research seminar series, Menlo Park, California)

University of California, Davis. Some experiences and lessons learned with computational hydraulics in the USGS. December, 9, 2004. (Lecture to graduate-level class on Computational River Mechanics I)

University of California, Davis. Three-dimensional hydrodynamic and particle-tracking modeling of the San Francisco Bay and Delta. May 10, 2004. (Department of Civil and Environmental Engineering, Water Resources Engineering seminar series)

University of California, Davis. A 3-D finite difference model for circulation in estuaries. April 21, 1998. (Department of Civil and Environmental Engineering, Water Resources Engineering seminar series)

University of Virginia, Charlottesville. Hydrodynamic measurements and modeling of the San Francisco Bay-Delta Estuary. October 24, 1997. (Seminar series for the Department of Civil and Environmental Engineering)

California State University, Sacramento. Hydrodynamic measurements and modeling of the San Francisco Bay-Delta Estuary. October 14, 1997. (USGS/ Geology Department Colloquium)

University of California, Berkeley. The effects of freshwater inflow on circulation and mixing in San Francisco Bay. March 2, 1992. (Seminar for the Department of Civil Engineering)

Stanford University. Three-dimensional hydrodynamic modeling of San Pablo Bay, California. May 21, 1990. (Seminar for the Department of Civil Engineering)

University of California, Davis. Hydrodynamic modeling of San Francisco Bay. February 7, 1990. (Department of Civil Engineering, Water Resources Engineering seminar series)

University of New Orleans. Hydraulic routing of surface runoff. May, 1980. (Classroom lecture)

E. TECHNICAL TRAINING PROVIDED:

I lectured at the following training workshops provided to the USGS:

Workshop on Computation of the Daily Mean for Tidally Affected Data. USGS National Surface Water and Hydroacoustics Conference, St. Louis, MO. April 2, 2007.

Workshop on Unsteady Flow and Transport in Rivers and Estuaries. University of North Carolina, Chapel Hill, NC. April 2-4, 1991.

Western Region Surface Water Modeling Workshop. Portland, OR. Oct. 31-Nov 2, 1989.
Estuarine Modeling Workshop. Reston, VA. May 2, 1988.
Western Region Surface Water Seminar. April 19-22, 1982.
Southeast Region One- and Two-dimensional Flow and Sediment Modeling Workshop. Bay St. Louis, MS. April 12-16, 1982.
Watershed Systems Modeling Workshop. USGS National Training Center, Denver, CO. Two week course, 198l.
USGS NY District Watershed Modeling Workshop. Albany, NY. August 11-13, 1981.
Urban Watershed Modeling Workshop. USGS National Training Center, Denver, CO. One and a half week course, 1980.
Urban Hydrology Workshop. USGS National Training Center, Denver CO. Four day course, 1980.
Stormwater Modeling Workshop. Bay St. Louis, MS. June, 1979.

9. OUTREACH AND INFORMATION TRANSFER:

I collaborated with a USGS computer science colleague (John Donovan) in the development of useful visualization programs for hydrodynamic modeling and field data. See the URLs (accessed January 19, 2010): http://ca.water.usgs.gov/program /sfbay/vpv and http://ca.water.usgs.gov/program/sfbay/gr)

10. HONORS, AWARDS, RECOGNITION, ELECTED MEMBERSHIPS:

* Received the 2009 Hugo B. Fischer Award for scientific achievement in modeling from the California Water and Environmental Modeling Forum (on Feburary 24, 2009).
* Honorable Mention from the National University Council on Water Resources for the 1998 Award for Outstanding Water Resources Dissertation in the Field of Water Processes
* Registered Professional Engineer
* USGS Special Achievement Awards 1989, 1990, and 1992-94
* USGS Graduate School Training Program, 1982-83
* Member, Tau Beta Pi National Engineering Honor Society

11. BIBLIOGRAPHY:

Smith, P.E., 1976, Supercavitation in pipe flow: Master's thesis, Department of Civil Engineering, Colorado State University, Fort Collins, Colo.

McCutcheon, S.C., and Smith, P.E., 198l, Discussion of "Pollutant concentrations from homogeneous land uses," by Irwin Polls and Richard Lanyon, 1980 (*in* Journal of the Environmental Engineering Division, American Society of Civil Engineers, v. 106, no.

1, p. 69-80): Journal of the Environmental Engineering Division, American Society of Civil Engineers, v. 107, no. 1, p. 29l.

Jennings, M.E., Schneider, V.R., and Smith, P.E., 1981, Emergency assessment of Mount St. Helens post-eruption hazards, Toutle and Cowlitz Rivers, Washington: U.S. Geological Survey Circular 850-I.

Jennings, M.E., Schneider, V.R., and Smith, P.E., 198l, Computer assessments of potential flood hazards from breaching of two debris dams, Toutle River and Cowlitz River Systems, in the 1980 eruptions of Mount St. Helens, Washington: U.S. Geological Survey Professional Paper 1250, p. 829-836.

Alley, W.M., and Smith, P.E., 1981, Estimation of parameters for accumulation of water quality constituents on impervious areas: Water Resources Research, v. 14, no. 6, p. 1657-1664.

Smith, P.E., and Alley, W.M., 1982, A rainfall-runoff-quality model for urban watersheds, *in* Singh, V.P., ed., Book 1--Applied Modeling in Catchment Hydrology: Proceedings of the International Symposium on Rainfall-Runoff Modeling, Mississippi State University, Miss., May 18-21, 1981, Water Resources Publications, Littleton, Colo., p. 421-442.

Alley, W.M., and Smith, P.E., 1982, Distributed routing rainfall-runoff model--version II: U.S. Geological Survey Open-File Report 82-344, NSTL, Miss., 201 p.

Alley, W.M., and Smith, P.E., 1982, Multi-event urban runoff model, user's manual: U.S. Geological Survey Open-File Report 82-764, 169 p.

Guay, J.R., and Smith, P.E., 1988, Simulation of quantity and quality of storm runoff for urban catchments in Fresno, California: U.S. Geological Survey Water-Resources Investigations Report 88-4125, 76p.

Smith, P.E., and Larock, B.E., 1989, High resolution two-dimensional advective transport, *in* Proceedings of the 1989 National Conference on Hydraulic Engineering: New Orleans, La., August 14-18, 1989, American Society of Civil Engineers, p. 1005-1010

Cheng, R.T., and Smith, P.E., 1990, A survey of three-dimensional numerical estuarine models: Estuarine and Coastal Modeling, v. 1, p. 1-15.

Smith, P.E., and Cheng, R.T., 1990, Recent progress on hydrodynamic modeling of San Francisco Bay, California: Estuarine and Coastal Modeling, v. 1, p. 502-510.

Ponce, V.M., Jennings, M.E., and Smith, P.E., 1990, Diffusion wave overland flow module, *in* Proceedings of the 1990 National Conference on Hydraulic Engineering: San Diego, Calif., July 30-August 3, 1990, American Society of Civil Engineers, p. 563-568.

Smith, P.E., Cheng, R.T., Burau, J.R., and Simpson, M.R., 1991, Gravitational circulation in a tidal strait, *in* Proceedings of the 1991 National Conference on Hydraulic Engineering: Nashville, Tenn., July 29-August 2, 1991, American Society of Civil Engineers, p. 429-434.

Smith, P.E., Oltmann, R.N., and Simpson, M.R., 1992, Data set for verification of 3-D free-surface hydrodynamic models, Carquinez Strait, California, *in* Proceedings of Water Forum '92, Baltimore, Md., August 2-6, 1992, American Society of Civil Engineers, p.430- 435.

Smith, P.E., and Larock, B.E., 1993, A finite-difference model for 3-D flows in bays and estuaries, *in* Proceedings of the 1993 National Conference on Hydraulic Engineering: San Francisco, Calif., July 25-30, 1993, American Society of Civil Engineers, v. 2, p. 2116- 2122.

Agostini, D., Evans, J., Wen, F. and Smith, P.E., 1993, Visualization and analysis of multi-dimensional velocity measurements in Carquinez Strait, California, *in* Proceedings of the 1993 National Conference on Hydraulic Engineering: San Francisco, Calif., July 25-30, 1993, American Society of Civil Engineers, v. 1, p. 1096-1101.

Cheng, R.T., Smith, P.E., and Casulli, V., 1993, Recent developments in 3-D numerical estuarine models, *in* Proceedings of the 1993 National Conference on Hydraulic Engineering: San Francisco, Calif., July 25-30, 1993, American Society of Civil Engineers, v. 2, p. 1982-1987.

Galvin, C., Fancher, J., Fendig, E., Garcia, A., Holton, J., McCarty, B., and Smith, P. E., 1993, Annual oscillation of mean monthly water levels at U.S. ports, *in* Proceedings of the 1993 National Conference on Hydraulic Engineering: San Francisco, Calif., July 25-30, 1993, American Society of Civil Engineers, v. 1, p. 584-585.

Smith, P.E., 1994, San Francisco Bay test case for 3-D model verification, *in* Proceedings of the 1994 National Conference on Hydraulic Engineering: Buffalo, N.Y., August 1-5, 1994, American Society of Civil Engineers, v. 2, p. 885-889.

Smith, P.E., Oltmann, R.N., and Smith, L.H., 1995, Summary report on the interagency hydrodynamic study of San Francisco Bay-Delta Estuary, California: Interagency Ecological Program for the Sacramento-San Joaquin Estuary, Technical Report no. HYDRO-IATR/95-45, CA Department of Water Resources, Sacramento, Calif., 72 p.

Templin, W.T., Smith, P.E., DeBortoli, M.L., and Schluter, R.C., 1996, Water-resources data network evaluation for Monterey County, California, Phase 2--Northern and Coastal areas of Monterey County: U.S. Geological Survey Water-Resources Investigations Report 95-4210, 102 p.

Smith, P.E., 1997, A three-dimensional, finite-difference model for estuarine circulation: Doctoral dissertation, Department of Civil and Environmental Engineering, University of California, Davis, Calif., 217 p.

Smith, P.E., and Larock, B.E., 1997, Semi-implicit numerical schemes for 3-D flow modeling, *in* Proceedings of the 27th Congress of the International Association for Hydraulic Research: San Francisco, Calif., August 11-15, 1997, v. 1, p. 773-778.

Donovan, J.M., and Smith, P.E., 2002, Hierarchical programming for data storage and visualization: Estuarine and Coastal Modeling: v. 7, p. 86-102.

Smith, P.E., and Donovan, J.M., 2003, Three-dimensional particle tracking in the San Francisco Estuary: Western Water Watch, U.S. Geological Survey, Newsletter of the Western Region Water Resources Discipline, Vol. 1, No. 1, p. 1-6.

Smith, P.E., Donovan, J.M., and Wong, H.F.N., 2005, Applications of 3D hydrodynamic and particle tracking models in the San Francisco Bay-Delta Estuary, *in* Proceedings of the World Water and Environmental Resources Congress, American Society of Civil Engineers, Anchorage, AK, May 15-19, 2005, 8 p.

Smith, P.E., 2006, A semi-implicit, three-dimensional model for estuarine circulation: U.S. Geological Survey Open-File Report 2006-1004, 176 p. (accessed January 19, 2010 at the URL http://pubs.usgs.gov/of/2006/1004/)

Smith, P.E, 2009, San Francisco Bay test case: Section 6.4 in *Verification and Validation of 3D Free-Surface Flow Models*, Book Publication of the Environmental and Water Resources Institute of the American Society of Civil Engineers, Sponsored by the Task Committee on 3D Free-Surface Flow Model Verification and Validation, edited by S.S.Y. Wang, P.J. Roache, R.A. Schmalz, Y. Jia, and P.E. Smith, p. 271-292.

Smith, P.E, Rueda, F., Jia, Y., Wang, S.S.Y, Huang, W., Wu, T.S., Spaulding, M., Janowitz, G., McCutcheon, S.C., 2009, Analytical solutions for mathematical verification: Chapter 3 in *Verification and Validation of 3D Free-Surface Flow Models*, Book Publication of the Environmental and Water Resources Institute of the American Society of Civil Engineers, Sponsored by the Task Committee on 3D Free-Surface Flow Model Verification and Validation, edited by S.S.Y. Wang, P.J. Roache, R.A. Schmalz, Y. Jia, and P.E. Smith , p. 45-119.

Grimaldo, L.F., Sommer, T., Van Ark, N., Jones, G., Holland, E., Moyle, P.B., Herbold, B., Smith, P.E., 2009, Factors Affecting Fish Entrainment into Massive Water Diversions in a Tidal Freshwater Estuary: Can Fish Losses be Managed?: North American Journal of Fisheries Management, American Fisheries Society, v. 29, p. 1253-1270.

Zamani, K., Bombardelli, F.A., Wuertz, S., and Smith, P.E., 2010, Toward a 3-Dimensional Numerical Model of Tidal Currents in San Francisco Bay, Proceedings of the World

Environmental & Water Resources Congress 2010, American Society of Civil Engineers, Environmental and Water Resources Institute, Providence, RI, May 16-20, 2010, 10 p.

Newman, K, Kimmerer, W., Smith, P.E., Baxter, R., Laca, E., Bennett, W. A., and Meiring, W, 2012, Delta Smelt Life History Model Plan, DRAFT contract report prepared for U.S. Bureau of Reclamation, May 19, 2012, 81 p.

Newman K, Polansky L, Mitchell L, Kimmerer W, Smith P.E., Baxter R, Bennett W, Maunder M, Nobriga M, Meiring W, Laca E, Feyrer F. 2014. A Delta Smelt life cycle model. Sept 12, 2014, 64 p. (unpublished DRAFT)