

Dr. Baker (Ph.D., Mathematics) has over 20 years experience in applications of mathematics and statistics to fisheries biology. Dr. Baker is centrally involved in the design of field surveys and experiments for Stillwater Sciences, and the analysis and interpretation of the data produced by these. He has developed or assisted in the development of numerous models for populations of various species of salmonid fishes in California, Washington, Oregon, and Montana. He is co-developer of Stillwater's BasinTemp model for predicting cumulative effects of watershed management actions on water temperature throughout a stream network, and of Stillwater's RIPPLE model for linking landscape-scale physical habitat to salmonid population responses.

AREAS OF EXPERTISE

- Simulation Modeling
- Mathematical Biology and Statistics

EDUCATION

Ph.D., Mathematics, University of California at Berkeley, 1987

B.A., Mathematics, University of Kansas (summa cum laude, honors in mathematics), 1981

PROFESSIONAL AFFILIATIONS

- Bay-Delta Modeling, Forum
- American Mathematical Society
- Mathematical Association of America
- Association for Symbolic Logic

SELECTED PUBLICATIONS

Baker, P. F., and J. E. Morhardt. 2001. **Survival of Chinook salmon smolts in the Sacramento-San Joaquin Delta and Pacific Ocean.** Pages 163–179 in R. L. Brown, editor. Contributions to the Biology of Central Valley Salmonids, Fish Bulletin 179. California Department of Fish and Game.

Baker, P. F. 1997. **The influence of temperature on the survival of Chinook salmon smolts (*Oncorhynchus tshawytscha*) migrating through the Sacramento/San Joaquin River of California.** Presented at the Bay-Delta Modeling Forum.

PROJECT EXPERIENCE

Restoration Plan, San Joaquin River, CA (Clients: Friant Water Users Authority and Natural Resources Defense Council): Dr. Baker has prepared or assisted in the preparation of numerous reports on the survival of Chinook salmon in the Sacramento-San Joaquin River Delta.

Standardized Assessment Methodology, Sacramento River, CA (Client: U.S. Army Corps of Engineers): Dr. Baker developed the mathematical model for a standardized habitat assessment methodology that relates fish response of seven threatened and endangered fish species to bank revetment in the lower Sacramento River.

New Don Pedro Project Relicensing, Tuolumne River, CA (Client: Turlock and Modesto Irrigation Districts): As part of the New Don Pedro Project relicensing efforts, Dr. Baker has extended PHABSIM modeling of Chinook salmon habitat in the Tuolumne River to include water temperature considerations, and has prepared or assisted in the preparation of numerous reports.

Effectiveness Monitoring of Habitat Enhancements, East Fork Rock Creek, OR (Client: PacifiCorp): Dr. Baker developed the sampling plan for the effectiveness monitoring, conducted preliminary power analyses to determine appropriate sample sizes for detecting statistical differences between pre- and post-treatment fish populations, designed and implemented a statistical model, and helped analyze the data from the initial monitoring surveys.

Dennis Halligan (B.S., Fisheries Biology) has extensive experience conducting fish habitat and impact assessments, fish species composition and distribution studies, water temperature monitoring, riparian condition surveys, road-related erosion and sediment source inventories, and culvert risk analysis. Dennis has also conducted surveys for terrestrial, avian, and amphibian species of concern and been a primary or contributing author for various permitting and regulatory documents pursuant to state and federal endangered species acts as well as NEPA and CEQA.

AREAS OF EXPERTISE

- Fish Biology
- Forest Management
- Wildlife Biology
- Integrated Natural Resource Analysis and Management Planning

EDUCATION

- B.S., *Fisheries Biology*, 1980, Humboldt State University, Arcata, CA

RELATED EXPERIENCE

- Staff Fisheries Biologist, Natural Resources Management Corporation, Eureka, CA (1993–2007)
- Biological Technician, Six Rivers National Forest, Willow Creek, CA (1992–1993)
- Owner/Operator, Sea Harvest Shellfish Company, Humboldt Bay, CA (1986–1991)
- Commercial Fisherman, Various fishing companies, Gulf of Alaska and Bering Sea (1979–1991)

PROFESSIONAL AFFILIATIONS

- Salmonid Restoration Federation
- American Fisheries Society

PERMITS AND TRAINING

- California Scientific Collection Permit #2635

PROJECT EXPERIENCE

Sacramento/San Joaquin River Projects

San Joaquin River Restoration Plan PEIS/EIR, CA (*Client: U.S. Bureau of Reclamation*): Mr. Halligan assisted in the analysis of impacts to fisheries resources for this combined NEPA/CEQA document. Tasks included review of critical documents and assessment of impacts to state and Federally listed fish species and species of special concern along the 140-mile long reach between Friant Dam and the Merced River.

Furlan Mitigation Project Draft EA/IS, Sacramento River, CA (*Client: USACE and Central Valley Flood Protection Board*). Assisted in the development of a combined NEPA/CEQA document for a mitigation project that creates aquatic and riparian habitat to provide compensation for unavoidable habitat losses incurred at past and future levee improvements and bank protection sites under the Sacramento River Bank Protection Project (SRBPP).

Document Review, Sacramento/San Joaquin River Delta Conveyance, CA (*Client: Confidential Delta Water Interests*). Assisted in the review of several documents relating to current and potential future Delta water conveyance systems. Deliverables included an identification of critical issues and key questions relating to the planned isolated facility to convey Sacramento River water around the Delta and toward the Jones and Banks pumping plants.

Fish Population Study, Tuolumne River, CA (*Client: Turlock Irrigation District and Modesto Irrigation District*): Mr. Halligan conducted underwater direct observation data collection and contributed to technical report development for an *Oncorhynchus mykiss* population study in the lower Tuolumne River. This study is ongoing and was designed to support the Don Pedro Hydroelectric Project (FERC No. 2299) relicensing process.

Fish Population and Instream Flow Studies, McCloud River, CA (*Client: Pacific Gas & Electric Company*): Mr. Halligan conducted underwater direct observation data collection, fish habitat criteria

- CDFG Certified Southern Torrent Salamander habitat surveyor, 1995
- CDF&G Stream Habitat Typing Course, 1994.
- Trained in conducting timber inventories, 1994
- Conference on vineyard land use planning, fish friendly farming and erosion control techniques, 2001
- Numerous workshops on watershed rehabilitation, sediment source inventories, watershed analysis, water temperatures, and fisheries monitoring techniques, 1992–present
- CDFG training on habitat identification, capture, and handling of California freshwater shrimp, 2009

mapping, spawning habitat mapping, and methods comparison between direct observation and electrofishing on the lower McCloud River. This study is ongoing and was designed to support the McCloud-Pit Hydroelectric Project (FERC No. 2106) relicensing process.

Biological Assessment for Central Valley Steelhead, CA (*Client: Pacific Gas & Electric Company*): Mr. Halligan was the technical lead and primary author for a BA analyzing potential impacts to steelhead trout from operation and maintenance of the DeSabra-Centerville Hydroelectric Project (FERC No. 233), located on Butte Creek and the West Branch Feather River.

Other Select Projects

Federal Watershed Analysis, Humboldt and Trinity Counties, CA (*Client: USDA Forest Service*): Project leader and fisheries and riparian analyst for the 78,000-acre mainstem Trinity River Watershed Analysis for the U.S. Forest Service on the Six Rivers National Forest. He was the lead fisheries analyst for the Hidden Valley and Middle Hayfork/Salt Creek watershed analyses in the Shasta-Trinity National Forest.

Watershed Management Plan, Mad River, CA (*Client: Redwood Community Action Agency*): Mr. Halligan is the fisheries analyst on the Mad River Watershed Management Plan development team. Mr. Halligan's responsibilities include landowner/stakeholder outreach, fish passage barriers, assessment of instream habitat trends, fish species composition and distribution, development of land use practices recommendations, and identification of data gaps that can be used to develop a monitoring program.

St. Helena Comprehensive Flood Control Project, Napa River, CA (*Client: Waterways Consulting, Inc.*): Mr. Halligan is the lead biologist and author for a salmonid and California freshwater shrimp BA for a joint restoration and flood control project on the Napa River. He also conducts surveys for salmonids, amphibians, and raptors as part of the project. He is also responsible for the development and implementation of a dewatering and aquatic species rescue plan, construction monitoring, and contractor training to protect California red-legged frogs, steelhead, and California freshwater shrimp during instream construction operations.

Fish Passage Survey, Northern CA (*Client: USFS*): Mr. Halligan was the Project leader for the U.S. Forest Service Region 5 fish passage survey. Specific project elements included fish passage assessment data collection and analysis of all road stream crossings within fish bearing range of anadromous watersheds in the Klamath, Six Rivers, Shasta-Trinity, Lassen, Mendocino, and Los Padres National Forests.

Dr. Noah Hume (Ph.D., Civil and Environmental Engineering) has over 20 years experience in aquatic sciences and engineering spanning ecology, water quality, water supply and treatment. Dr. Hume's areas of expertise include engineering, water quality management, wetlands ecology, limnology, and fisheries biology. Dr. Hume brings his technical expertise to a wide variety of interdisciplinary projects that emphasize physical and water quality impacts to aquatic species, including habitat assessments, created wetland projects, river restoration and fisheries programs, and a number of engineering design projects.

AREAS OF EXPERTISE

- Water Quality
- Wetlands and Aquatic Ecology
- Environmental Engineering
Hydroelectric Relicensing
- Fisheries Biology
- Mechanical Engineering

EDUCATION

Ph.D., *Civil and Environmental Engineering*, University of California at Berkeley, 2000

M.S., *Civil and Environmental Engineering*, University of California at Berkeley, 1989

B.S., *Mechanical and Ocean Engineering*, University of Rhode Island, 1985

SELECTED PUBLICATIONS

Hume, N. P., M. Fleming, and A. Horne
2002. **Denitrification potential and carbon quality of four aquatic plants in wetland microcosms.** *Soil Science Society of America Journal* 66: 1706–1712.

Hume, N. P., M. Fleming, and A. Horne
2002. **Plant carbohydrate limitation on nitrate reduction in wetland microcosms.** *Water Research* 36: 577–584

Kramer, S. H., M. Trso, and N. Hume.
2001. **Timber harvest and sediment loads in nine northern California watersheds based on recent Total**

SELECTED EXPERIENCE

Estuarine, wetland, and creek restoration projects

Dr. Hume has served as Project Manager and scientist on a number of habitat restoration and design projects by evaluating present day and future conditions as well as developing monitoring programs to ensure a balance of aquatic, terrestrial, and human uses. Projects include:

- Humboldt Bay Receiving Water Monitoring Plan (City of Arcata, CA).
- Estuary Enhancement and Constructed Wetland Feasibility Studies (City of Buenaventura, CA).
- Big Lagoon Creek and Wetland Restoration (National Park Service, GGNRA, San Francisco, CA).
- Environmental Assessment and Design Support for the Sacramento River Bank Protection Project (US Army Corps of Engineers, Sacramento, CA).
- John Muir Constructed Wetland Project (San Francisco Public utilities Commission, Lake Merced, San Francisco, CA).
- Port of Sacramento Constructed Wetland Project (Port of Sacramento, West Sacramento, CA).
- Sherman Island Setback Levee Habitat Enhancement Project. (Subcontractor to Hanson Engineering, Sacramento, CA).
- Lead Scientist in Surveys for the Toketee Wetland Habitat Enhancement Project, North Umpqua River Oregon (PacifiCorp, Portland, OR).

Aquatic Ecology

Dr. Hume has served as Project Manager and lead scientist on numerous ecological studies to assess hydroelectric impacts upon invertebrate and fish populations due to changes in flow regime, temperature, instream wood, sediment supply and transport. The purpose of these studies is to develop appropriate mitigation, restoration, and management strategies to support land and water uses in balance with sensitive aquatic species uses. Projects include:

- Project Manager and lead scientist for numerous ongoing

Maximum Daily Load (TMDL) studies.
Watershed Management Council
Networker 10: 17–24.

Hume, N. P. 2000. **Effects of plant carbon quality on microbial nitrate reduction in wetlands.** Doctoral dissertation. University of California, Berkeley.

Smith, D. S., M. Commins, A. Horne, C. Chen, B. Faisst, M. Beutel and N. Hume. 1998. **Control of taste and odor and organic carbon in upper San Leandro Reservoir.** EBMUD Source Water Management Program. Merritt Smith Consulting, Lafayette, California.

ecological studies (since 2001) for the Don Pedro Hydroelectric Project related to Project impacts upon invertebrates and salmonid populations due to changes in flow regime, temperature, sediment supply and transport (Turlock Irrigation District, Turlock CA).

- Project manager for Merced River Ranch Mercury Bioaccumulation Study related to methylation potential of residual mercury in mine tailings used for spawning gravel replenishment in the Merced River, CA (CALFED Bay Delta Authority, Sacramento, CA).
- Project Manager for Sacramento River Standardized Assessment Methodology to address habitat losses to life stages T & E fish species due to ongoing bank revetment by comparison of compensation and enhancement measures implemented in differing locations and times (U.S. Army Corps of Engineers, Sacramento, CA).
- Principal Investigator for Upmigration and Straying Study to examine the effect of fall attraction flows on the upmigration timing and straying of fall run Chinook salmon in tributaries the San Joaquin River basin, California (U.S. Fish and Wildlife Service, Stockton, CA).

Water quality studies

Dr. Hume has served as Project Manager and lead scientist on numerous studies related to the impacts of water quality conditions upon designated beneficial uses including FERC relicensing, mercury bioaccumulation studies, and Clean Water Act Section 401 Certifications. Projects include:

- Carmen-Smith Hydroelectric Project relicensing (Eugene Water and Electric Board, Eugene, OR).
- DeSabra-Centerville Hydroelectric Project relicensing (PG&E, San Francisco, CA).
- McCloud-Pit Hydroelectric Project relicensing (PG&E, San Francisco, CA).
- Merced River Restoration Planning (CALFED Bay Delta Authority, Sacramento, CA).
- San Joaquin River Restoration Plan (Friant Water Users Authority & Natural Resources Defense Council, Fresno, CA).
- Radon Removal Feasibility Studies (American Water Works Association, Denver, CO).
- South Fork Feather Hydroelectric Project relicensing (South Feather Water and Power, Oroville, CA).

Dr. Orr (Ph.D., Entomology) has over 25 years of experience in population and community ecology of aquatic, terrestrial, and riparian/wetland environments in the western United States. His areas of technical expertise include natural resources inventory and management planning, riparian ecology and restoration, wetlands and freshwater ecology, aquatic entomology, and vegetation and flora of the western United States. He is experienced in wetland delineation and functional assessment; threatened and endangered species surveys; vegetation and habitat classification and mapping; mitigation planning; and environmental impact assessment.

AREAS OF EXPERTISE

- Riparian and Wetland Ecology
- Benthic Macroinvertebrate and Stream Ecology
- Integrated Natural Resource Analysis and Management Planning
- TMDLs
- Watershed Analysis
- Restoration Ecology

EDUCATION

Ph.D., Entomology (Ecology/Aquatic Entomology), University of California at Berkeley, 1991

B.A., Biological Sciences and Environmental Studies (high honors), University of California at Santa Barbara, 1979

PROFESSIONAL AFFILIATIONS

- American Institute of Biological Sciences
- California Native Plant Society
- Ecological Society of America
- North American Benthological Society
- Society for Ecological Restoration
- Society of Wetland Scientists
- California Native Plant Society Vegetation Committee

PROJECT EXPERIENCE

Wetland Assessment, San Joaquin River Restoration Plan, CA (*Client: Friant Water Users Authority and NRDC; U.S. Bureau of Reclamation*): Dr. Orr co-managed a unique effort to develop a plan for restoring the San Joaquin River ecosystem in balance with beneficial uses of San Joaquin River water supplies. The Friant Water Users Authority and the Natural Resources Defense Council solicited the services of Stillwater Sciences to develop restoration objectives and strategies to restore the San Joaquin River below Friant Dam to support self-sustaining, naturally reproducing populations of aquatic species, including Chinook salmon. Dr. Orr was the technical team lead for riparian and floodplain wetland assessment and restoration planning, as well as macroinvertebrate drift studies. He is currently a member of the consultant team hired by the U.S. Bureau of Reclamation to provide technical support to the multi-agency team charged with implementing the restoration along 150 miles of the San Joaquin River.

Ecosystem Linkages and Ecological Flows Studies, Sacramento River, CA (*Clients: CALFED and The Nature Conservancy*): Dr. Orr led the Ecosystem Linkages Study and other studies as part of the Sacramento River Ecological Flows Study initiated by The Nature Conservancy in collaboration with ESSA Technologies, Stillwater Sciences, UC Davis, and UC Berkeley. The purpose of this study was to define how flow characteristics (e.g., the magnitude, timing, duration, and frequency) and associated management actions (such as gravel augmentation and changes in bank armoring) influence the creation and maintenance of habitats for a number of native species that occur in the Sacramento River corridor. Dr. Orr was the technical lead for studies focused on riparian and floodplain habitats and ecosystem linkages between river processes and species of interest.

Regional Assessment of Geomorphic and Ecological Processes and Biological Responses, Napa River Basin, CA (*Clients: State Water Quality Control Board and California Coastal Conservancy; U.S. Army Corps of Engineers*): Dr. Orr managed a multi-year, phased project for the Regional Water Quality Control Board to provide technical support for

SELECTED PUBLICATIONS AND PRESENTATIONS

Stella, J. C., J. J. Battles, J. R. McBride, and **B. K. Orr**. In press. **Riparian seedling mortality from simulated water table recession, and the design of sustainable flow regimes on regulated rivers**. Restoration Ecology.

Orr, B. K., C. Riebe, and R. Peek. 2008. **Linking biological responses to river processes: implications for conservation and management of the Sacramento River—a focal species approach**. CALFED Science Conference.

Orr, K. E., J. T. King, B. K. Orr, and M. Singer. 2008. **Aquatic bioassessment as part of the Merced River Alliance Project**. CALFED Science Conference.

Stella, J. C., J. J. Battles, **B. K. Orr**, and J. R. McBride. 2006. **Synchrony of seed dispersal, hydrology and local climate in a semi-arid river reach in California**. Ecosystems 9: 1–15.

Orr, B. K. 2006. **Tools for riparian-floodplain restoration planning along large river corridors: examples from the San Joaquin River, CA**. CALFED Science Conference.

Orr, B. K., N. P. Hume, and T. J. Ford. 2004. **Evaluating the effects of flow on aquatic invertebrate communities in the lower Tuolumne River, California**. CALFED Science Conference.

Stella, J., J. Vick, and **B. K. Orr**. 2003. **Riparian vegetation dynamics on the Merced River**. In P.M. Faber, editor. Proceedings of the Riparian Habitat and Floodplains Conference. The Western Section of the Wildlife Society and the Riparian Habitat Joint Venture, Sacramento, California. 12–15 March 2001.

the development of a sediment TMDL for the Napa River Basin. The first phase of the project focused on assessment of current in-channel and riparian habitat conditions to determine which factors are currently limiting production of Chinook salmon, steelhead trout, and California freshwater shrimp in the Napa River Basin. Later phases tested key hypotheses about limiting factors and causal linkages between land and water use activities and their effects on habitats and biological populations of interest.

Restoration Feasibility Study and Riparian Vegetation Dynamics, Classification and Mapping Study, Santa Clara River Parkway, CA (*Client: California Coastal Conservancy*): Dr. Orr led a team that sampled, classified, and mapped over 25,000 areas of riparian vegetation and floodplain habitats along the Santa Clara River in Ventura County. Additional studies explored the physical process drivers and human land and water use impacts on riparian-floodplain dynamics.

Merced Alliance Biological Monitoring and Assessment Project, CA (*Client: East Merced RCD and State Water Resources Control Board*): As a component of the larger Merced River Alliance Project, this effort represents the first comprehensive assessment of fish, bird, and benthic macroinvertebrate (BMI) species composition and distribution along the upper and lower Merced River. The Merced Alliance Project was created to bring together two independent watershed management efforts and to support collaboration by conservation districts and stakeholder groups for the upper and lower Merced River on a variety of watershed-wide issues.

Geomorphic and Ecological Evaluations of Removal of Marmot Dam, Sandy River, OR (*Client: Portland General Electric*): The removal of Marmot Dam represented one of the first large-scale releases of dam-impounded sediment in the United States, and raised numerous ecological concerns. Prior to dam removal, Dr. Orr led Stillwater Sciences' effort to provide geomorphic, sediment transport, and ecological evaluations associated with the potential release of approximately 1 million cubic yards of sand and gravel stored behind the dam. The analyses permitted stakeholders to agree upon an ecologically and economically acceptable dam removal alternative, based on a single season deconstruction schedule, followed by natural fluvial erosion of the formerly-impounded sediment. Removal of Marmot Dam occurred in 2007.

Mr. Wooster is a geomorphologist with over ten years experience applying process based hillslope and fluvial geomorphology to study riverine ecosystems. His areas of technical expertise include sediment transport analyses, geomorphic characterization and classification of stream channels, conducting physical model experiments, hydrologic monitoring and analyses, using acoustic doppler current profilers (ADCP) to characterize aquatic habitat, and restoration design. He has designed and led a variety of geomorphic projects throughout Oregon and California. His diverse background includes projects related to dam removal, hydroelectric relicensing, streambank stabilization, gravel augmentation, and watershed scale sediment and LWD budgets. Many of his projects have involved an interdisciplinary approach towards linking geomorphology, hydrology, engineering, and anadromous fisheries habitat and restoration.

AREAS OF EXPERTISE

- Process hillslope and fluvial geomorphology
- Hydrologic and hydraulic analyses
- LWD and gravel augmentation
- Hydroelectric relicensing

EDUCATION

M.S., Geology, emphasis in Fluvial Geomorphology and Sediment Transport, University of California at Davis, 2003

B.A., Environmental Science and Economics, emphasis in Natural Resources Management, University of California at Santa Barbara, 1994

PROFESSIONAL AFFILIATIONS

- American Geophysical Union (AGU)

SELECTED PUBLICATIONS

Wooster, J., S. Dusterhoff, Y. Cui, L. Sklar, W. E. Dietrich, and M. Malko. 2008. **Sediment supply and relative size distribution effects on fine sediment infiltration into immobile gravels**. *Water Resources Research*, 44, W03424, doi: 10.1029/2006WR005815.

PROJECT EXPERIENCE

Hydrogeomorphic Studies, Carmen-Smith Hydroelectric Project Relicensing, OR (*Client: Eugene Water & Electric Board*): Mr. Wooster was the study lead for three hydrogeomorphic studies conducted in support of the Carmen Smith hydroelectric relicensing on the McKenzie River: (1) Fluvial Geomorphic Processes and Channel Morphology; (2) Hydrologic Regimes of the Upper McKenzie River Basin; and (3) Large Woody Debris Dynamics. These technical studies examined channel conditions downstream of hydroelectric dams and quantified project effects on channel morphology and sedimentation dynamics. Mr. Wooster designed and implemented field investigations, was the primary author on technical reports, and participated with working group resolutions and meetings between agencies, stakeholders and the client. Mr. Wooster conducted numerical analyses on sediment transport, hydrologic regimes of gauged and ungauged basins and project facilities, and a large woody debris budget for the project area. Mr. Wooster continues to work with the client on implementing habitat improvement plans by designing and evaluating LWD and gravel augmentation projects.

Geomorphic Analyses of San Francisquito Creek, CA (*Client: Los Angeles Department of Water and Power*): Mr. Wooster conducted hillslope and fluvial geomorphic investigations in order to evaluate stream crossing alternatives in San Francisquito Creek— a primary tributary to the upper Santa Clara River, Los Angeles County, CA. His analyses included quantification of hillslope sediment production rates, sediment transport modeling, frequency and causes of channel realignment, investigation of the role of wildfire on sediment production and mass wasting, and synthesizing low flow and peak discharge regimes. The

Wooster, J. K., C. S. Riebe, F. K. Ligon, and B.T. Overstreet. 2009. **How coarse is too coarse for salmon spawning substrates?**, *Eos Trans. AGU*, 90(52), Fall Meet. Suppl., Abstract H51D-0790.

Downs, P.W., Cui, Y., Wooster, J.K., Dusterhoff, S.R., Booth, D.B., Dietrich, W.E. and Sklar, L. 2009. **Managing reservoir sediment release in dam removal projects: an approach informed by physical and numerical modelling of non-cohesive sediment.** *International Journal of River Basin Management*, 7, 433-452.

Cui, Y., J. Wooster, J. Venditti, S. Dusterhoff, W. E. Dietrich, and L. Sklar. 2008. **Simulating sediment transport in a flume with forced pool-riffle morphology: examinations of two one-dimensional numerical models.** *Journal of Hydraulic Engineering*, 134: 892-904.

Cui, Y., J. Wooster, P. Baker, S. Dusterhoff, L. Sklar, and W. E. Dietrich. 2008. **Theory of fine sediment infiltration into immobile gravel bed.** *Journal of Hydraulic Engineering*, 134: 1421-1429.

Wooster, J.K., C. S. Riebe, and F. K. Ligon. 2008. **Quantifying Upper Particle-size Limits of Salmonid Spawning Gravel: Analysis of Fall-run Chinook Salmon of the Sacramento River**, *Eos Trans. AGU*, 89(53), Fall Meet. Suppl., Abstract H43B-0988.

Wooster, J.K., J. Venditti, T. Minear, Y. Cui, S. Dusterhoff, R. Humphries, P. Nelson, W. Dietrich, and L. Sklar. 2006. **Investigations of Sediment Pulse Morphodynamics in a Flume with Fixed Bars**, *Eos Trans. AGU*, 87(52), Fall Meet. Suppl., Abstract H51G-0584.

project aimed to characterize the physical processes that would impact engineered stream crossing alternatives in this dynamic, semi-arid watershed that is prone to episodic floods and sediment fluxes.

Lower Deschutes River Gravel Study, OR (*Client: Portland General Electric*): Mr. Wooster is the Deputy Project Manager and Task Lead for a long-term monitoring study of gravel mobility that includes gravel augmentation, channel bathymetric surveys, sediment scour and fill monitoring using scour chains, and measurement of incipient motion of the channel bed using PIT and radio tagged tracer rocks. Mr. Wooster designed and provided implementation oversight of three gravel augmentation sites intended to increase gravel bar and spawning area.

Geomorphic and Aquatic Habitat Investigations, McCloud-Pit Hydroelectric Project Relicensing, CA (*Client: Pacific Gas & Electric Company*): Mr. Wooster participated as a field study lead with geomorphic and aquatic habitat studies related to relicensing of the McCloud Pit Hydroelectric Project. The studies assess potential geomorphic effects of reducing coarse sediment supply and altering coarse sediment transport in the Lower McCloud River. Conducted the sediment transport analyses and developed study site specific regulated and unimpaired hydrology as part of developing a sediment budget for the Lower McCloud River. Mr. Wooster also assisted other studies that characterized aquatic habitat at varying flow discharges using ADCP measurements, and performed hydrologic analyses in support of determining how flow regime dynamics affect amphibian breeding.

Physical Modeling Experiments to Guide Restoration Project, CA (*Client: California Bay-Delta Authority*): Mr. Wooster was a lead scientist in a multi-year, multi-million dollar project that involved conducting a series of physical modeling experiments that address some of the fundamental scientific questions underlying the river restoration strategies of gravel augmentation, dam removal, and channel-floodplain reconstruction. Mr. Wooster was responsible for conducting the flume experiments investigating the downstream impacts of sediment release following dam removal. Dam removal experiments investigated fine sediment infiltration into gravel beds as well as evaluated the routing of sediment pulses in a two-dimensional channel with pool-riffle habitat.

Geomorphic Studies, Sacramento River Ecological Flows Evaluation, CA (*Client: The Nature Conservancy*): Mr. Wooster participated as the field study lead for geomorphic components of a study of how

Venditti, J., T. Minear, P. Nelson, J. Wooster, and W. Dietrich. 2006.

Response of alternate bar topography to variation in sediment supply in gravel-bedded rivers, *Eos Trans. AGU*, 87(52), Fall Meet. Suppl., Abstract H51G-0583.

Wooster, J. K., and S. Hilton. 2004.

Large woody debris volumes and accumulation rates in cleaned streams in southern Humboldt County, California. Res. Note PSW-RN-426. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Wooster, J. K., and E. W. Larson. 2002.

Flume experiments of erosional processes post dam removal. *Eos Trans. AGU*, 83(47), Fall Meeting Supplement, Abstract H21C-0812.

Lassettre, N. S., J. K. Wooster, and J. Stallman. 2006. **Large woody debris dynamics in a large regulated basin bisected by geomorphic terrains with contrasting process rates**. International Conference on Riverine Hydroecology: Advances in Research and Application, Stirling, Scotland.

Stallman, J., R. Bowers, N. Cabrera, R. Real de Asua, and J. Wooster. 2005.

Sediment dynamics in the Upper McKenzie River basin, central Oregon Cascade Range. *Eos Transactions AGU* 86(52), Fall Meeting Supplement, Abstract H51E-0411.

Kondolf, G. M., M. Ferry, N.

A. Gilbreath, P. Miller, and J. Wooster. **Sediment movement following the removal of Saeltzer Dam, Clear Creek, California**. 2005. Page 29 in *Geological Society of America Abstracts with*

management of Sacramento River flow and modifications to the surrounding landscape have affected geomorphic processes, habitats, species distributions and populations, and ultimately the health of the ecosystem as a whole. He conducted several field studies, including investigating how the distribution of suitable spawning gravel has changed with time since the construction of Shasta Dam, mapping and inventorying aquatic habitats out of the main channel, and examining the hydraulic and aquatic habitat effects of bank armoring using Acoustic Doppler Current Profiler measurements.

CEQA Documents for DeSabra-Centerville Hydroelectric Project, CA

(Client: Pacific Gas and Electric): Mr. Wooster is the geologic lead for the Stillwater technical team evaluating project resource impacts under CEQA and performing environmental analyses of this project for the preparation of the Section 401 Water Quality Certificate by the State Water Resources Control Board. Mr. Wooster is conducting the environmental analysis for geologic and soil resources, including developing the Initial Study and Environmental Checklist, and subsequently preparing associated portions of either the Environmental Impact Report or Negative Declaration/Mitigated Negative Declaration.

Baseline Stream Channel Geomorphology Monitoring, Mokelumne River (FERC Project No. 137), CA

(Client: Pacific Gas and Electric): Mr. Wooster was the Project Manager for ongoing geomorphic studies and baseline monitoring in the Mokelumne River watershed in support of the FERC No. 137 Hydroelectric Relicensing. His responsibilities included designing and implementing field studies, primary author on technical reports, and budget and contract oversight. In addition to geomorphic and reservoir sedimentation monitoring, he evaluated the feasibility for restoration projects in a high elevation alpine meadow.

Habitat Enhancement Opportunities for Adult Trout in Mammoth Creek, CA

(Client: Mammoth Community Water District and The Mammoth Creek Collaborative Group): Mr. Wooster completed a field channel survey to assess potential habitat enhancement sites for adult trout in Mammoth Creek, CA. Mr. Wooster authored a technical report identifying potential enhancements, including opportunities to create new deep pool habitats and to enhance existing pool and deep run habitats by adding cover or cover complexity in the form of large wood or boulders to create optimal feeding locations for adult trout.

Upper Tuolumne River Ecosystem Project *(Client: San Francisco Public Utilities Commission)*: Mr. Wooster is serving as the Deputy Project

Programs, Vol. 37, No. 7.

Manager for Stillwater Sciences as part of a diverse, interdisciplinary team. Stillwater Sciences project components include conducting quantitative flow-habitat relationship studies to develop ecologically-based instream flow recommendations, conducting benthic macroinvertebrate surveys, and assisting in developing an adaptive management plan.

Large Woody Debris Frequency in the Salmon and Clearwater Basins, ID (*Client: National Marine Fisheries Service, Idaho State Habitat Office, Boise, ID*): Authored technical report and performed statistical analyses of extensive LWD data sets in the Salmon and Clearwater basins in order to determine wood loading relationships with key geomorphic and geologic variables in managed and reference reaches.

Scientific Approaches to Evaluating Hydropower Effects (*Client: Hydropower Reform Coalition*): Mr. Wooster co-authored a technical report that evaluated approaches to analyzing the effects of hydropower projects on hydrology; channel morphology, sediment supply and transport, and large woody debris.

Saeltzer Dam Removal on Clear Creek, CA (*Client: California Bay-Delta Authority*): As part of his Master's Thesis work, Mr. Wooster investigated sediment transport and channel evolution following dam removal in a flume and at a Saeltzer Dam on Clear Creek. Following the removal of Saeltzer Dam, Mr. Wooster designed and conducted monitoring activities related to sediment transport, channel width and stream gradient adjustments, and bank erosion in the sediment prism stored upstream of the former dam. In conjunction with his field work, he constructed physical models investigating mixed bimodal sediment transport and channel geometry adjustments following dam removal at St. Anthony Falls Laboratory, MN. He used the flume results to evaluate a suite of numerical models developed for dam removal.

Geomorphic Assessment, Big Creek Hydroelectric Project Relicensing, CA (*Client: Southern California Edison*): Mr. Wooster was the field study lead for conducting geomorphic assessments and hydrologic analyses in support of the Big Creek hydroelectric relicensing project in the San Joaquin River watershed in Southern CA. His primary responsibilities were investigating sediment transport relations in the project area using tracer gravel studies, numerical modeling, and monitoring suspended sediment during high flow releases. He also analyzed the changes to the basin's hydrologic regime due to project operations.

Channel Assessments, Kilarc-Cow Hydroelectric Relicensing, CA

(Client: Pacific Gas and Electric): Mr. Wooster conducted channel morphologic assessments in the Cow Creek watershed near Redding, CA in support of the Kilarc-Cow hydroelectric relicensing project. His responsibilities included assessing the potential project effects to channel bank stability, vegetation encroachment, fine sediment deposition in pool habitats, and in-channel sediment storage.

Erosion Monitoring, San Clemente Dam, CA *(California American Water Company)*

Mr. Wooster assisted Cal-Am with their annual reservoir water drawdown by monitoring erosion of the sediment deposit upstream of the dam, turbidity, and discharge downstream of the dam. He also reviewed and summarized the potential biological impacts from grain size adjustments and channel aggradation from previous studies on sediment transport modeling to evaluate the potential impacts of dam removal options.