Sweet River SCIENCES

Joshua Strange, Ph.D.

Fish Biology, Aquatic Ecology, Restoration Design, Water Planning

Joshua Strange (*Ph.D., Fish Biology*) is the owner and founder of Sweet River Sciences. Sweet River Sciences specializes in understanding complex river and water issues and technical information in order to provide easy to understand summaries, win-win solutions, innovative restoration designs, fundable study plans, sustainable water planning, and reliable expertise with a proven record of excellence and success. Dr. Strange has 15 years of experience in fisheries biology and aquatic ecology, and completed a Ph.D. dissertation on the behavioral adaptations of adult Chinook salmon migrating in diverse environmental conditions in the Klamath River basin. He has conducted applied research on multiple anadromous fish species focused on migration, ecology, and fish pathogens. Dr. Strange has worked on salmonid life-cycle population models, epidemiological models of fish diseases, and PHABSIM and criteria-mapping based instream flow studies for salmonids and has been involved with ESA consultations and hydropower relicensing. He has also assisted with cutting-edge research on green sturgeon migration using biotelemetry, PIT tagging, and dual-frequency sonar technologies. Dr. Strange is versed in the principles and techniques available to effectively enhance anadromous fish habitat (at site-specific design and large-scale planning levels), restore dynamic river processes, and reintroduce salmon. He is knowledgeable on genetic sampling methods and the options available to examine fish genetics, including eDNA. Dr. Strange has authored numerous technical reports and multiple journal publications on fisheries. He is an award winning speaker and effective communicator for technical and diverse general audiences.

AREAS OF EXPERTISE

- Fisheries Biology
- Aquatic Ecology
- Fish Disease Ecology
- Fish Habitat Restoration
- Fish Migrations & Biotelemetry
- Water Infrastructure Planning

EDUCATION

Ph.D., *Fisheries Biology*, University of Washington, 2011

B.S., *Fisheries*, Humboldt State

SELECTED PROJECT EXPERIENCE

Restoration and Ecology of Coho in the Lower Trinity River, CA (*Client: Hoopa Valley Tribe)*: Dr. Strange provides biological and ecological input in addition to conceptual ideas for on-going restoration and ecological research to assist with coho recovery in the lower Trinity River and its tributaries.

Investigation of Green Sturgeon of the Eel River, CA (*Client: Wiyot Tribe; in collaboration with Stillwater Sciences)*: Dr. Strange led a cutting-edge three-year investigation of the status and genetic origin of green sturgeon of the Eel River using a combination biotelemetry tagging and monitoring, genetic analysis, and a mobile DIDSON sonar survey using

University, 1999

SELECTED PUBLICATIONS

Strange, J.S. 2010. **Upper thermal limits to migration in adult Chinook salmon: evidence from the Klamath River basin**. Transactions of the American Fisheries Society 139:1091-1108.

Strange, J.S. 2012. **Migration strategies of adult Chinook salmon runs in response to diverse environmental conditions in the Klamath River basin.** Transactions of the American Fisheries Society 141:1622-1636.

Strange, J.S. 2012. **Factors influencing the behavior and duration of residence of adult Chinook salmon in a stratified estuary.** Environmental Biology of Fishes 96:225-243.

Mosser, C.M., Thompson, L.C., and J.S. Strange. 2013. **Survival of captured and relocated adult spring Chinook salmon *Oncorhynchus tshawytscha* in a Sacramento River tributary after cessation of migration.** Environmental Biology of Fishes 96:405-417.

SELECTED CONFERENCE PRESENTATIONS

2016 Salmon Restoration Federation Annual Conference, Fortuna, CA. *A Conceptual Plan to Remedy Major Fish Pathogens in the Klamath-Trinity Basin.*

2016 Salmon Restoration Federation Annual Conference, Fortuna, CA. *Spring-Run Chinook Salmon Recovery in the Klamath-Trinity Basin.*

2016 Salmon Restoration Federation Annual Conference, Fortuna, CA. *Synergistic Benefits: Coupling Salmon Life-Cycle Monitoring and Population Models in Context*

2016 American Fisheries Society, California-Nevada Chapter Annual Meeting, Reno, NV. *Survive, Thrive, or Die? Adapting Water Infrastructure to*

a custom-built motorized cataraft.

Conceptual Design of Creek and Floodplain Restoration for Tributaries to the Trinity River, CA (*Client: Hoopa Valley Tribe; in collaboration with McBain and Associates)*: Dr. Strange provides biological and fisheries input in addition to conceptual ideas for an on-going design team developing floodplain and creek channel restoration, including berm removal, for tributaries to the lower Trinity River in the Hoopa Valley.

Salmon River Floodplain Restoration (*Client: Salmon River Restoration Council; in collaboration with Stillwater Sciences)*: Dr. Strange is leading the development of prioritized floodplain and mine-tailing restoration conceptual designs for 33 river miles over 13 alluvial reaches in the Salmon River to benefit steelhead, coho, and spring Chinook salmon. This project includes limiting factors analysis, LiDAR based inundation mapping, and geomorphic characterization.

Mid-Klamath River Floodplain Restoration (*Client: Salmon River Restoration Council; in collaboration with Stillwater Sciences and Rocco Fiori)*: Dr. Strange is leading a floodplain and mine-tailing restoration feasibility assessment along with conceptual designs for connecting existing mine-tailing ponds to the river for winter refuge habitat for coho salmon. This project also includes LiDAR based inundation mapping, and geomorphic characterization.

Redwood Creek Flow Enhancement Feasibility, Redway, CA (*Client: Salmonid Restoration Federation; in collaboration with Stillwater Sciences):* Dr. Strange serves as the fish biologist on a multi-disciplinary team evaluating flow needs and flow enhancement feasibility on Redwood Creek, a tributary to the South Fork Eel River.

Field-based Thermal Tolerance of Juvenile Salmonids as a function of Food Rations, CA (*Client: Salmon River Restoration Council; in collaboration with Stillwater Sciences)*: Dr. Strange is leading a field-based study to determine the upper thermal tolerance of juvenile Chinook salmon, coho, and steelhead by assessing fish distribution with snorkel surveys early in the summer prior to the onset of high water temperatures and later in the summer during the peak of annual water temperatures in a river with low food rations (Salmon River) compared to a river with high food rations (Shasta River). The study will address a long-standing area of uncertainty in the literature.

RECENT PROJECT EXPERIENCE

Bull Creek Floodplain Restoration Design, Weott, CA. (*Client: CA State Parks with Stillwater Sciences):* Dr. Strange served at the fish biologist on a multi-disciplinary team developing restoration approaches and designs for aggregated and incised floodplain reaches on Bull Creek. Designs were developed to be robust in the face of channel and bedload instability and to provide benefit to steelhead,

Help Native Fish in the Face of Extreme Climate Change.

2016 American Fisheries Society, California-Nevada Chapter Annual Meeting, Reno, NV. *Green Sturgeon of the Eel River.*

2015 Eel River Symposium, Fortuna, CA. *Moving Towards Resilience in the Eel River Basin in the Midst of Climate Chaos.*

2015 American Fisheries Society, California-Nevada Chapter Annual Meeting, Santa Cruz, CA. *Using targeted flow releases in regulated rivers to improve migration success and decrease disease risk for adult salmonids.*

2015 American Fisheries Society, California-Nevada Chapter Annual Meeting, Santa Cruz, CA. *Factors influencing the behavior and duration of residence of adult Chinook salmon in a stratified estuary.*

2014 Salmon Restoration Federation Annual Conference, Santa Barbara, CA. *A quantitative life-cycle modeling approach for evaluating effective restoration strategies for southern steelhead.*

2014 American Fisheries Society, California-Nevada Chapter Annual Meeting, Sacramento, CA. *Status and Origin of Green Sturgeon of the Eel River: Myth or Mystery?*

2013 Salmon Restoration Federation Annual Conference, Spring-run Chinook Recovery Session, Fortuna, CA. *Perspectives on adult spring-run Chinook salmon migration: challenges and opportunities for persistence and recovery in a dramatically warming climate (in preparation).*

2013 Klamath Fish Health Workshop, Fortuna, CA. *Year-round monitoring of Polychaete Populations in the Hyper-infectious Zone: Densities, Infection Levels and Observations of Life-Cycle Dynamics.*

2012 Klamath Fish Health Conference,

coho, and Chinook salmon.

Tuolumne River Steelhead Assessment, Modesto, CA (*Client: Turlock Irrigation District with Stillwater Sciences):* Dr. Strange provided senior technical support to determine steelhead population level responses for various management scenarios, as well as anadromy versus residency, using population and bioenergetics models, .

Framework for Coho Salmon Habitat Restoration and Enhancement in the Lower Ten Mile River, Fort Bragg, CA (*Client: The Nature Conservancy with Stillwater Sciences):* Dr. Strange helped develop a framework to identify restoration and enhancement approaches and opportunities for to address winter-rearing as a limiting habitat factor for coho salmon in low-gradient floodplain reaches of the Ten Mile River that relied on LiDAR based inundation mapping, hydraulic and geomorphic analysis, habitat evaluation, coho biology, and state-of-the-science design principles. This cost-effective framework can be used to assess coho winter-rearing habitat in a variety of settings.

Conceptual Design of Redwood Creek Estuary Restoration and Levee Reconfiguration, CA (*Client: Humboldt County with Stillwater Sciences)*: Dr. Strange provided senior technical support for the development of conceptual designs for the restoration of the Redwood Creek estuary including partial levee removal and off-channel habitat features and connectivity. He also developed evidence of limiting factors in the estuary ecotone for coho, steelhead, and Chinook salmon and predicted likely biological responses to restoration actions.

Expert Witness (*Client: Yurok Tribe, Hoopa Valley Tribe, and PCFFA with Stillwater Sciences):* Dr. Strange provided expert witness court testimony for litigation involving special fall flow releases from dams on the Trinity River to protect migrating fall-run Chinook salmon in the lower Klamath River from disease outbreaks.

Technical Review, Restoration Project Prioritization (*Client: Mid Klamath Watershed Council with Stillwater Sciences):* Dr. Strange supported a collaborative process of review and prioritization of restoration actions within the Mid-Klamath River basin in floodplain areas and low gradient tributary reaches for off-channel over-wintering habitat for coho salmon and other species.

Limiting Habitat Factors Analysis of Salmonid Populations in Pescadero Creek, CA (*Client: CA State Water Board with Stillwater Sciences):* Dr. Strange provided senior technical support to determine the limiting habitat factors for steelhead and coho using a field-calibrated, state-of-the-science predictive model – RIPPLE. The model is also used to examine population response to restoration scenarios.

EIS for Remanded Biological Opinions on the Coordinated Long-Term Operation of the CVP and SWP, CA (*Client: US Bureau of Reclamation, as*

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Klamath Falls, OR. *Overview of Fish Health Issues (with Drs. Scott Foott and Jerri Bartholomew).*

2012 Salmon Restoration Federation, Spring-run Chinook Symposium, Douglas City, CA. *Perspectives on spring-run Chinook salmon research and management in the Klamath-Trinity basin.*

2011 American Fisheries Society, National 141st Annual Meeting, Seattle, WA. *Upper thermal limits to migration in adult Chinook salmon: evidence from the Klamath River basin.*

2011 Traditional Ecological Knowledge Symposium, Arcata, CA. *The Klamath River Story: Perspectives on Traditional Ecological Knowledge and Modern Resource Management.*

2011 Coho Confab, Smith River, CA. Salmon Restoration Federation: *Perspectives on Effective Restoration and Research on Coho Salmon in the Klamath Basin.*

2011 Klamath Fish Health Conference, Fortuna, CA. *Year-round Polychaete Sampling Methodology and Population Dynamics.*

2010 Klamath Basin Science Conference, Medford, OR. *Ecology and Fishes of the Estuary and Nearshore Marine Environments.*

2010 Klamath Fish Health Conference, Fortuna, CA. *Strategies for Using Dam Releases to Reduce Risk for Adult and Juvenile Salmonids.*

2009 Klamath Fish Health Conference, Fortuna, CA. *Bogus Creek Pilot Study: Effects of Carcass Removal on Myxospore Input.*

2008 Klamath Fish Health Conference, Fortuna, CA. *2007 Adult Fall Chinook Salmon Health Monitoring Results; and, Coho Myxospore Infection Levels.*

2007 American Fisheries Society,

subconsultant to CH2MHill with Stillwater Sciences): Dr. Strange was the lead fisheries analyst, with an emphasis on the Sacramento-San Joaquin delta, contributing to the preparation of the Environmental Impact Statement (EIS) and aquatic resources evaluation of the long-term coordinated operations of the Central Valley Project and State Water Project. The EIS was being prepared in response to the United States District Court for the Eastern District of California November 16, 2009 ruling which mandated that a NEPA review of potential impacts be conducted before Reclamation provisionally accepts and implements Reasonable and Prudent Alternatives recommended in the Biological Opinions issued December 2008 by USFWS, and June 2009 by NMFS.

Ecosystem Services Valuation for Aquatic Species, Mokelumne River, Lodi, CA (*Client: Sustainable Conservation with Stillwater Sciences):* Dr. Strange provided senior technical support for the development of a riparian function and in-stream habitat environmental benefit quantification tool that allows riparian landowners to score the relative amount of crucial ecological services and high-quality habitat attributes their land provides to aquatic species such as fall-run Chinook salmon on a regulated river.

Research, Monitor, and Evaluate Habitat Conditions and Salmonid Populations in the Anchor River Basin, AK (*Client: US Fish and Wildlife Service with Stillwater Sciences):* Dr. Strange provided senior technical support for the development of a field-calibrated, state-of-the-science predictive model – RIPPLE. The model is used to estimate the distribution and quantity of coho and Chinook habitats throughout the basin, identify limiting habitat factors, and to examine population response to anthropogenic changes. Model simulations will be used to generate hypotheses about population dynamics and to guide a comprehensive and resilient protection and restoration strategy for the Anchor River watershed in the face of climate change.

PREVIOUS RELEVANT EXPERIENCE

- **Dr. Strange was a full time Senior Fish Biologist at Stillwater Sciences** for four years (Arcata, CA). He developed, assisted, and managed numerous fish research and river restoration projects throughout California and the Pacific Northwest.

- **Dr. Strange was a full time research fish biologist at the Yurok Tribal Fisheries Program** for ten years (Yurok Tribe, Weitchpec, CA). He was the lead biologist for a small team of fisheries biologists and technicians conducting applied research on anadromous fishes in the Klamath River basin focused on migration, ecology, and fish pathogens. Fish species studied included Chinook and coho salmon, steelhead, Pacific Lamprey, eulachon, and green sturgeon. He has participated in eDNA studies using qPCR amplification techniques and has

National 137th Annual Meeting, San Francisco, CA. Co-organizer of symposium titled: *Addressing ambiguity in the Klamath River Basin through scientific certainty*. Presented: *Adult Chinook salmon migration in the Klamath River basin: lessons learned from five years of research*.

2007 Salmon River Spring Chinook Symposium, Forks of Salmon, CA. *Parasite Dynamics of Adult Chinook Salmon in the Klamath River Basin.*

2007 Trinity River Science Symposium, Weaverville, CA. *Adult Chinook Salmon Migration Behavior: Implications for Flow Management in the Trinity River.*

2004 Lower Klamath Basin Science Conference, Arcata, CA. *Adult Chinook Salmon Migration in the Klamath River Basin Using Radio Telemetry.*

2003 Pacific Ecological Conference, Bamfield, BC, Canada. *Adult Chinook Salmon Migration Behavior and the Klamath River Fish Kill: Lessons to Learn.*

SELECTED WORKSHOPS ATTENDED

2012 Salmon Restoration Federation, Coastal Off-Channel and Tidal Restoration Conference and Workshop, Eureka, CA.

2014 Coho HELP Workshop, Mendocino, CA.

2016 Landmark Forum, San Francisco, CA.

CERTIFICATIONS

Rescue 3 Swiftwater Rescue Technician
American Red Cross 1st Aid/CPR

FILM

Dr. Strange's dissertation research was featured in a series segment of a national PBS documentary, *Journey to Planet Earth*, narrated by Matt Damon.

assisted with genetic stock identification, including SNPs. His duties included securing research grant funding, negotiating annual funding agreements, budgeting and fiscal oversight, employee hiring and supervision, research study design and implementation, fieldwork, data analysis, report writing and dissemination, and coho salmon ESA consultations with NOAA Fisheries and the US Bureau of Reclamation for the Klamath Irrigation Project, including instream flow studies using PHABSIM methods. He provided technical comments, expertise, and scientific oversight on FERC relicensing of the Klamath Hydroelectric Project, and contributed data and expertise to a salmon reintroduction plan for the upper Klamath Basin. He developed and led studies on fish pathogens, including myxozoans, and participated in the Klamath Fish Health Research and Management Team. He was involved in several technical work groups for the Trinity River Restoration Program. Research collaborators include Oregon State University, HSU, US Fish and Wildlife Service Arcata Field Office and the CA/NV Fish Health Center, Karuk Tribe, Hoopa Valley Tribe, University of California Davis, USGS Cook Research Station, and NOAA Fisheries.

- Dr. Strange was a fisheries instructor at Humboldt State University and at the University of Washington. Dr. Strange taught courses at HSU's Department of Fisheries Biology for three years and was solely responsible for lecture and laboratory sections for *Ecology of Freshwater Fishes*, in addition to a *Special Topic Seminar in Fisheries* on the Klamath Hydroelectric Project Relicensing. At the University of Washington, Dr. Strange was a Teaching Assistant in the School of Aquatic and Fishery Sciences for Fisheries 101. He was responsible for leading discussion sections, facilitating service learning projects, presenting full-class lectures and managing the class website.

- Dr. Strange was a professional river guide for over seven seasons on rivers in California, Oregon, Idaho, Arizona, and New Zealand on multi-day and Class V river trips. He led a rafting team that competed in the USA Rafting National Championships.