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# Commentary
# by Dr. William Trush

on Global Warming Considerations regarding the April 2011 2nd Revised Draft Environmental Impact Report for Consideration of Modifications to U.S. Bureau of Reclamation's Water Right Permits 11308 and 11310 (Applications 11331 and 11332) to Protect Public Trust and Downstream Water Rights on the Santa Ynez River – Bradbury Dam (Cachuma Reservoir)

The steelhead landscape in the Santa Ynez watershed changed significantly two ways when the Cachuma Project went online in the early-1950s. Both have heightened the vulnerability of a sustainable steelhead population to environmental changes. With the Santa Ynez River teetering near the southern limit of the steelhead's geographic range, increasing environmental changes attributable to global warming (e.g., an increase in frequency and intensity of wildfires) could have major consequences to the Bureau of Reclamation's proposed actions in the Revised Draft Environmental Impact Report (RDEIR).

First, headwater mainstem and tributary anadromous spawning and productive juvenile rearing habitats were eliminated by Bradbury Dam. This was particularly significant because abundant over-summering juvenile habitat is always at a premium in watersheds near the southern edge of the steelhead's geographic range. Population size always will be greatly limited by this loss of headwater habitat. This loss has shifted the burden of producing enough smolts for a sustainable population onto those tributaries downstream of Bradbury Dam.

The second significant landscape change emanated from the first. Before any large dams, and even after large headwater dams (Gibraltar and Jameson dams) began operating by the 1930s but before the Cachuma Project, the mainstem Santa Ynez River provided at least two vital functions. Spawning adult steelhead relied on the mainstem and the annual hydrograph as their migratory conduit to the tributaries. Just as important, however, was the mainstem's role in growing downstream migrating pre-smolts and smolts.

The mainstem's potential to grow 120 mm juveniles into 175 mm smolts before reaching the Pacific Ocean must have been considerable. Annual hydrographs near Lompoc from WY1908 through WY1918 (USGS Gaging Sta. 11133500 Santa Ynez River near Lompoc) have streamflows commonly exceeding 200 cfs during smolt outmigration. The $ft^2$ of mainstem juvenile rearing and productive benthic macroinvertebrate riffle habitats created by these streamflows 'serviced' many migrating pre-smolts and smolts arriving from the upstream tributaries.

With the Cachuma Project online, the mainstem channel below Bradbury Dam had become the landscape surrogate for the habitat lost upstream. It still retains the responsibility of transporting migrating adults and growing downstream migrating pre-smolts originating from tributaries below Bradbury Dam, e.g., from Salsipuedes Creek. However a short segment of mainstem channel now must spawn and rear steelhead.

Flood years and extended drought years made the Santa Ynez River an ongoing challenge to a highly adaptable fish, even prior to the Cachuma Project. However, steelhead were resilient because there were so many options at the population level, to survive and even flourish, that some would be available any given year. For example, a watershed with many tributaries offering spawning and rearing habitat (i.e., a spatially complex landscape) and variable annual streamflows can keep a population resilient, even when encountering as major a disturbance as wildfire, which can cause major increases in turbidity. High turbidity reduces the ability of juvenile steelhead to seize prey (juvenile steelhead are sight predators) and reduces light penetration which reduces primary production. These high levels of turbidity greatly impair a tributary or mainstem's potential for adequately growing downstream migrating juvenile steelhead. Historically, wildfire must have been significant in the Santa Ynez River. But when one swath of the tributary watersheds was burned, and the highly turbid water then flowed into the mainstem making the mainstem streamflows turbid as well, other tributary watersheds escaping the burn could still contribute some larger pre-smolts to the annual smolt run.

Global warming is a widespread disturbance giving rise to many local disturbances. Although no one can say definitively what the future holds, future extremes of the present environment are expected. This will include bigger, more intensive floods and droughts, more intense and frequent wildfires, and warmer spring through early-fall water temperatures. Actions prescribed today may not be sufficient to maintain and recover future steelhead population resiliency as the environment changes.

Present analyses, including the RDEIR, do not quantitatively evaluate how, or to what extent, proposed actions can/will maintain and recover steelhead population resiliency needed today within the new steelhead landscape. Without at least some directed analyses, no objective forecast can be offered on likely impacts due to global warming.

A steelhead population sustained solely from a tailrace fishery (only the mainstem channel extending 3 miles below Bradbury Dam), *if even possible*, would be small, fragile, and highly susceptible to disturbances. Overall, this population would have extremely low resiliency. Juvenile steelhead rearing in the mainstem Santa Ynez River and in the tributaries could be severely compromised by global warming impacts, compounding the burden of producing enough pre-smolt and smolt steelhead (for a minimally self-supporting population) from the tributary channels. I could find no reported analyses distinguishing projected smolt production between the tributaries and the mainstem Santa Ynez River channel. In part this distinction is artificial in that tributary steelhead will rely heavily on mainstem habitat for continued, or even accelerated, growth during their mainstem journey to the estuary. However, if the mainstem channel was highly impacted by turbidity (and therefore not capable of significantly growing juvenile fish), then the 'fate' of future returning runs would be determined by larger smolts (> 175 mm) originating from the tributaries and migrating to the Pacific Ocean without appreciable added growth.

Proposed actions must show that mainstem flow releases will provide sufficient spawning success in tributary watersheds below Bradbury Dam and protect/grow outmigrating pre-smolts/smolts once they leave the tributaries and head down the mainstem channel. These tributary watersheds that escape direct wildfire impacts will become disproportionately important to annual steelhead run success. I could find no applicable analyses. For example, summaries such as Table 4-7 (DEIR, August 2003 and in Stetson Engineers (2006) Hydrologic Modeling Technical Memoranda Nos. 5–7 Appendix F) characterize operations, but not from a steelhead or river ecosystem perspective. Steelhead experience day-to-day streamflows of the annual hydrographs, not hydrologic conditions expressed as averaged ac-ft compressed over many years (WY1918 to WY1993) into exceedence probability curves. Simply stating that there are 14 days of streamflows greater than 25 cfs of fish passage from the analyses provided is not an analysis, but simply a statement.

Assessment and guidance, with respect to managing for global warming, are briefly addressed in the RDEIR (p.4.12-22):

*Aquatic Ecosystem Changes*

*The DWR technical memorandum revealed that increased air temperatures as the result of climate change will likely cause increases in water temperatures at California's lakes and waterways. Increased water temperatures might affect the aquatic ecosystem, especially for aquatic species that are sensitive to changes in water temperature. Increases in water temperature might also cause a decrease in dissolved oxygen demand concentrations, which would likely increase production of algae and some aquatic weeds.*

*Increased Risk of Wildfires*

*Scientists at the UC Merced and Pardee RAND Graduate School, as outlined in the CAT report, performed a novel analysis of wildfire risk in California. They estimated that wildfire risk due to impacts of climate change would increase throughout the end of the century.*

*The influence of global climate change on future environmental condition of Cachuma Lake cannot be predicted with any accuracy. The potential effects listed above may occur, but it is not possible at this time to estimate when they might occur or to what extent. It is therefore not possible to assess whether any changes in future environmental conditions would influence the implementation of the proposed project. To address this uncertainty, the local managing partner will update the Fish Management Plan and Biological Opinion to periodically manage the potential effects of climate change if and when they occur.*

The RDEIR has no provision or plan for evaluating present recommendations regarding future global warming effects. As explained above, a steelhead population sustained solely from a mainstem channel tailrace fishery (extending 3 miles below Bradbury Dam), *if even possible*, would be small, fragile, highly susceptible to disturbances, and would have extremely low resiliency in the event of more frequent and more intense wildfires, as well as other global warming effects. Waiting to manage such effects until they occur is inadequate and runs the risk of eliminating the population. Instead, resiliency can be quantitatively assessed now to evaluate how, or to what extent, the proposed actions will restore steelhead population resiliency.

For example, a fish passage analysis by individual water years -- from the estuary up to a desirable spawning destination in Salsipuedes Creek – would establish how many continuous days of fish passage flows would really be needed in individual water years (not assessable from exceedence curve). Similarly, another analysis could be done for outmigrating pre-smolts and smolts. Would mainstem streamflows improve the survival and growth of

Salsipuedes Creek outmigrants in individual water years spanning Dry to Wet?

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## BACKGROUND

William Trush has been senior ecologist for McBain & Trush, Inc., an environmental consulting firm in Arcata since 1995. As an adjunct professor to the Humboldt State University Fisheries Department, he has taught courses in stream ecology, river restoration, and coastal stream management since 1990. Bill earned his Ph. D. from the University of California Berkeley in the Department of Forestry and Resource Management, an M.S. (in Stream Ecology) from Virginia Tech, and a B.S. (Zoology) from Penn State. He specializes in integrating fluvial and ecological processes in river ecosystems: particularly floodplain/riparian dynamics, anadromous salmonid population dynamics, aquatic vertebrate and invertebrate life history requirements, the snowmelt hydrograph, and channelbed dynamics. McBain & Trush helped develop maintenance flow recommendations for the Trinity River and has formulated guidelines prescribing annual flow releases in regulated rivers for the USFS. Bill was on the Scientific Review Team (1999) for NMFS and the CA Resources Agency evaluating current California Forest Practice Rules with respect to anadromous salmonids in Northern California, and has testified for the North Coast Regional Water Quality Control Board on establishing water quality standards related to cumulative watershed impacts. He is one of two scientists directing a stream restoration plan approved by SWRCB for Los Angeles Department of Water and Power on two tributaries to Mono Lake. This plan has focused on recovering shallow groundwater processes in floodplains and side-channels to restore cottonwood forests along Rush Creek. Bill is working on a steelhead restoration plan for Alameda Creek and developing instream flows for the Shasta River that will restore salmon habitat and facilitate red willow re-colonization. He has co-instructed with Dr. Luna Leopold and Scott McBain a 3-day course on river channels at the Teton Science School in Wyoming from 1990 up to Luna's death in 2006. Bill recently completed a geomorphic and ecological study funded by the SWRCB on the role of the snowmelt hydrograph in maintaining healthy river ecosystems in steep bedrock dominated rivers of the Sierra Nevada. He also has served on the VFDD Fish Passage Panel on the Santa Clara River for United Water Conservation District in 2009 and 2010.

## EDUCATION

- **Doctor of Philosophy (1991), Wildland Resource Science**
  **Department of Forestry and Natural Resources, University of California, Berkeley**
  Dissertation Title: *The Influence of Channel Morphology on Spawning Steelhead Trout in South Fork Eel River Tributaries*.

- **Master of Science (1979), Zoology,**
  **Center for Environmental Studies, Virginia Polytechnic Institute and State University, Blacksburg, VA**
  Thesis Title: *The Effects of Area and Surface Complexity on the Structure and Formation of Stream Benthic Communities*.

- **Bachelor of Science (1974), Zoology**
  **Pennsylvania State University, University Park, PA**

## EXPERIENCE

- **Senior Ecologist and CEO (1995-present), McBain and Trush, Inc.**
  - Mono Lake Restoration, Los Angeles Department of Water and Power (1993-present). Served as a court-appointed member to the Mono Lake Restoration Technical Committee to advise restoration strategies and biological sampling programs for several tributaries entering Mono Lake (1993-1995). Presently serving as a senior scientist for Los Angeles Department of Water and Power directing the stream restoration and monitoring with another senior scientist.

  - Mad River Gravel Mining Assessment, Humboldt County (1992-present). Conducted geomorphic and anadromous fish habitat evaluation of instream gravel mining on the Mad River, Humboldt County. Presently serving on the Scientific Design and Restoration Committee.

  - Trinity River Maintenance Flow Study, Hoopa Valley Tribe (1991-1997). Developed flow and sediment management recommendations downstream of Trinity and Lewiston dams to rehabilitate channel morphology and reverse negative impacts caused by the dams. Applies the approach of restoring a scaled-down dynamic alluvial river as a foundation for salmon recovery to be used as the long-term solution for dams coexisting with healthy salmon populations.

  - Trinity River Scientific Framework Process, Trinity River Restoration Program (2001-present). After signing of the ROD and prior to staffing the new Restoration Program, assisted the Program during the interim period to continue improving the scientific components of the program. Organized and led two workshops. First workshop (June 2001) gathered agency, tribal, and stakeholder technical participants to refine scientific uncertainties in order to prioritize FY 2002 funding for the Restoration Program. Then assembled the results of the workshop, developed the draft FY 2002 budget ($11 million), and presented budget to the agency and tribal managers for review and approval. Second workshop (February 2002) gathered outside and internal scientists to review primary uncertainties and begin developing an overall Sampling and Monitoring Strategy for the Restoration Program. Currently participating as a member of the planning team for conducting the Scientific Framework Process, which will result in completing the Sampling and Monitoring Strategy.

  - Klamath River Expert Testimony for Klamath River Settlement, Northcoast Environmental Center (2007-present). Participated as part of the Klamath Independent Review Process to conduct analysis of models and assumptions used to develop management scenarios in the Klamath River Settlement to determine how well Klamath River flows anticipated under both interim and long-term conditions are likely to support restoration of sustainable fisheries for Chinook salmon and other native fishes. Analyses include hydrograph analysis, future flow predictions, physical habitat availability, fluvial geomorphology and channel condition, water temperature and other water quality parameters, and impacts of fish diseases on current and future Chinook populations.

  - Clackamas River FERC Relicensing Project, Portland General Electric (2001-2006). Conducted fluvial geomorphology, hydrology, and fish habitat evaluations to help develop instream flow and coarse sediment management strategies as part of the FERC relicensing process on the Clackamas River and Oak Grove Fork of the Clackamas River. Collected and analyzed field data, integrated for applicability in management strategies, and assisted collaborative relicensing group (agencies, NGO's, stakeholders) with technical components of relicensing effort.

- Member of Science Panel for recommending changes to the California Forest Practice Rules as part of a Memorandum of Understanding between California Resources Agency and NMFS (1998-1999).

- **Director (1991-1995), Humboldt State University Institute for River Ecosystems**
  The Institute mission is to further our understanding, preservation, and management of river ecosystems. My duties include fiscal management, proposal development, and research. The River Institute managed the following projects:
  1) Development of a new assessment procedure and handbook for designing culvert systems on logging roads.
  2) Evaluation of geomorphic indices for detecting cumulative impacts to northern California streams.
  3) Maintenance flow recommendation procedures for a Sierra Nevada river.
  4) Facilitate review of a proposed USFS maintenance flow methodology.
  5) Effects of suspended sediment on stream ecology.

  Research projects (with Dr. Terry Roelofs as co-principal investigator) with the Fisheries Department of Humboldt State University included:
  1) Assessment of Benbow Dam effects on anadromous fish populations in the South Fork Eel River.
  2) Limnological and fisheries investigation of Stone Lagoon, CA.
  3) Cutthroat trout restoration program for McDonald Creek, Humboldt County, CA (for the Department of Parks and Recreation).
  4) Salmon fisheries investigation for the lower Smith River, CA.

## TEACHING EXPERIENCE

- **Adjunct Professor (1989-present), Fisheries Dept., Humboldt State University, Arcata, CA**
  Instructor for the following courses: Coastal Stream Management, Technical Writing for Fisheries, Restoration of Aquatic Ecosystems, Watershed Dynamics and Restoration, Conflict Resolution in Natural Resources Management, Marsh Ecology, Stream Ecology, Graduate Fisheries Seminar, and Fisheries Techniques.

- **Instructor (1990-2005), Teton Science School, Kelly, WY**
  Co-instructor for a three day workshop on fluvial processes and stream restoration with Dr. Luna Leopold.

- **Instructor (1987-1988), Landscape Architecture Dept., University of California Berkeley**
  Instructor for: Hydrology for Environmental Planners and Ecological Analysis.

## REFERENCES

- **Dr. Terry Roelofs, HSU Fisheries Department**
- **Dr. Andre Lehre, HSU Geology Department**
- **Dr. Robert Gearheart, HSU Department of Environmental Resources Engineering**

## PUBLICATIONS

McBain and Trush, Inc. 2007. *Pulse Flow Guidelines: Managing the Annual Snowmelt Hydrograph and Winter Floods in Regulated Boulder-Bedrock Sierra Nevada Rivers.* California Energy Commission, PEIR Energy-Related Environmental Research.

McBain and Trush, Inc. 2007. *Draft Tuolumne River Flow Evaluation from O'Shaughnessy Dam to Early Intake. Proposed Study Plan and Methods.* Prepared for San Francisco Public Utilities Commission, USFWS, and Yosemite National Park. July 12, 2007. 15 p.

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Ridenhour, R.L., Hunter, C., and W.J. Trush. 1995. *Mono Basin Stream Restoration Work Plan*. Prepared for Los Angeles Department of Water and Power, October 4, 1995. 228 p.

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*a Symposium held in Eureka, California, 23-24 March 1994*, California Cooperative Fishery Research Unit, 237 p.

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