Patrick Higgins
Consulting Fisheries Biologist
791 Eighth Street, Suite N
Arcata, CA 95521
(707) 822-9428

July 9, 2010

Mike Orcutt, Director
Hoopa Tribal Fisheries Department
PO Box 417
Hoopa, CA 95546

Re: KBRA/KHSA Hoopa Valley Tribe Comment Recommendations for Addition

Dear Mike,

I am providing background information on water quality, fisheries and restoration issues pertinent to the Klamath Basin Restoration Agreement (KBRA) and Klamath Hydropower Settlement Agreement (KHSA) for the Hoopa Tribal Fisheries Department at your request. Specifically this is directed toward the Department of Interior's ("Department") Notice of Intent to Prepare an Environmental Impact Statement/Environmental Impact Report ("EIS") regarding the Klamath Hydroelectric Settlement Agreement ("KHSA") Secretarial Determination (the "Scoping Notice"). I am emphasizing subjects and strategies that are for the most part overlooked in both agreements and that rely on passive restoration techniques, but that would require much more extensive land use changes than envisioned under the KBRA/KHSA.

Linkage of Acute Water Quality Problems in Keno Reservoir to Lost River, Tule Lake and Lower Klamath Lake Conditions

A key issue that the KBRA and KHSA avoid is the acute water quality problem in the Keno Reservoir reach of the Klamath River and its linkage to the Lost River, Tule Lake and Lower Klamath Lake. The Keno Reservoir exhibits anoxic conditions for up to five weeks a year (Deas and Vaughn, 2007). This reach lies immediately below Lake Ewauna, the City of Klamath Falls and the outlet of Upper Klamath Lake. The nitrogen fixing bacteria *Aphanizomenon flos-aquae* took over Upper Klamath Lake after marshes that maintained pH balance were filled following WWII. The resulting nitrogen fixation causes acute nutrient pollution that then feeds the Link River and is also pumped through the A-Canal into the Lost River basin to irrigate the Klamath Project. The acute dissolved oxygen problems in Keno Reservoir are also driven by nutrients from the Lost River and the bed of Lower Klamath Lake.

U.S. Fish and Wildlife Service (USFWS 2001) described the Lost River condition:

> "The Lost River can perhaps be best characterized as an irrigation water conveyance, rather than a river. Flows are completely regulated, it has been channelized in one 6 mile reach, its riparian habitats and adjacent wetlands are

> highly modified, and it receives significant discharges from agricultural drains and sewage effluent. The active floodplain is no longer functioning except in very high water conditions."

Flows into the Lost River from the A-Canal are laden with *A. flos aqua*, which inoculates the lower Lost River and Tule Lake and contributes to nitrogen loading and extremely poor water quality conditions. The Lost River is a closed basin and ends in Tule Lake, which was once 110,000 acres and is now reduced to the Tule Sump that covers 9,000-13,000 acres. The Tule Sump is noted for acute water quality impairment (pH = 10, D.O. < 3mgl). High pH and water temperature also create a substantial conversion of ammonium ions to dissolved ammonia that can be lethal to fish species. Water from Tule Lake is pumped directly through Sheepy Ridge and into the Klamath Straits Drain and the Keno Reservoir in summer.

In addition, water from the Lost River is pumped into the Keno Reservoir directly in winter (Deas and Vaughn, 2007). Although the winter pumping does not create water quality problems in that season, nutrients attached to suspended sediment and flocculent organic matter do have the potential to contribute to subsequent summer water quality problems by contributing to sediment oxygen demand.

Lower Klamath Lake was once a water storage and water purification system for the Klamath River. It swelled with winter overflow through the Straits Drain to create a 95,000 acre water body and then flow went back into the Klamath in late summer and fall (NRC 2004). More than half Lower Klamath Lake was Tule beds and marsh that would strip nutrients, store water and also likely help maintain cold water temperatures (Figure 1). Lower Klamath Lake was diked off from the Klamath River in 1917 and within five years the lake had almost completely evaporated (Amory 1926, as cited in NRC 2004). Today the lake bed is industrially farmed (Figure 2) and drain water is pumped directly into the Straits Drain contributing further to the acute nutrient pollution of the Keno Reservoir.

Notice also in Figure 1 that the entire valley floor on both sides of the Klamath River above Keno was marsh that has now mostly been diked and filled and is now industrially farmed (Figure 3). This creates yet another major nutrient source for the Keno Reservoir. A rational restoration strategy would be to retire farmlands immediately adjacent to the river to restore nutrient filter capacity, to restore pH balance to fight *A. flos aquae*, to reduce water demand and to increase wetland water storage.

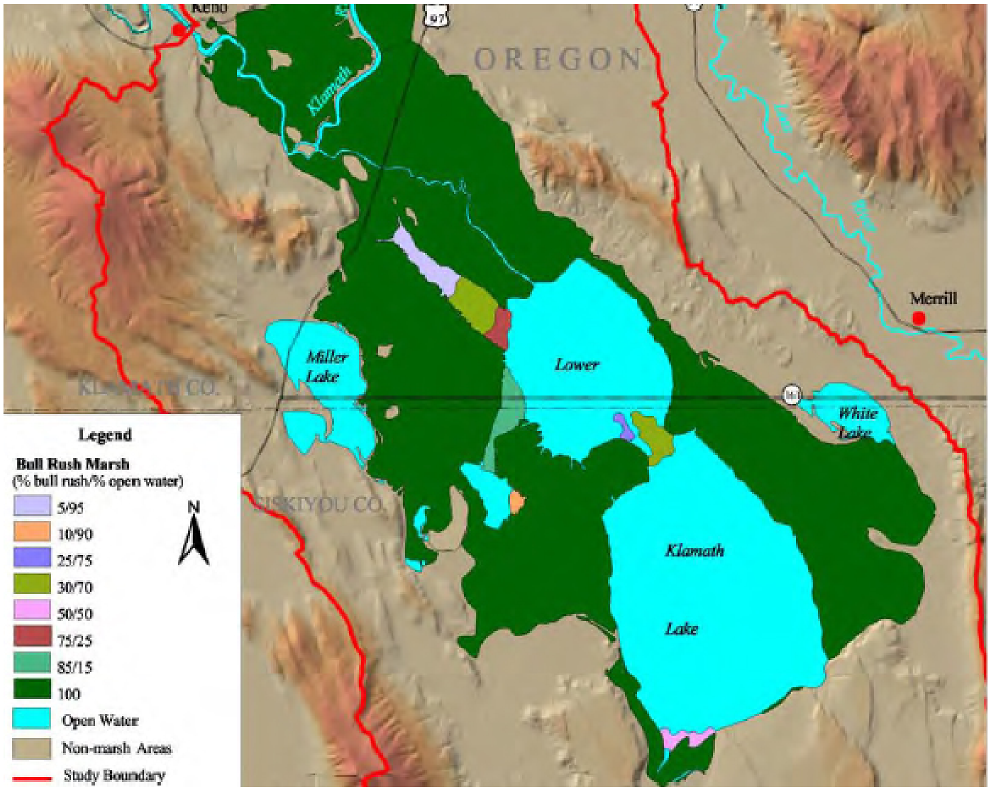

Figure 1. Historic size of Lower Klamath Lake and associated wetlands are shown in the map above, with wetlands broken down by percentage of cover by bulrushes. Map from U.S. BOR (2005).

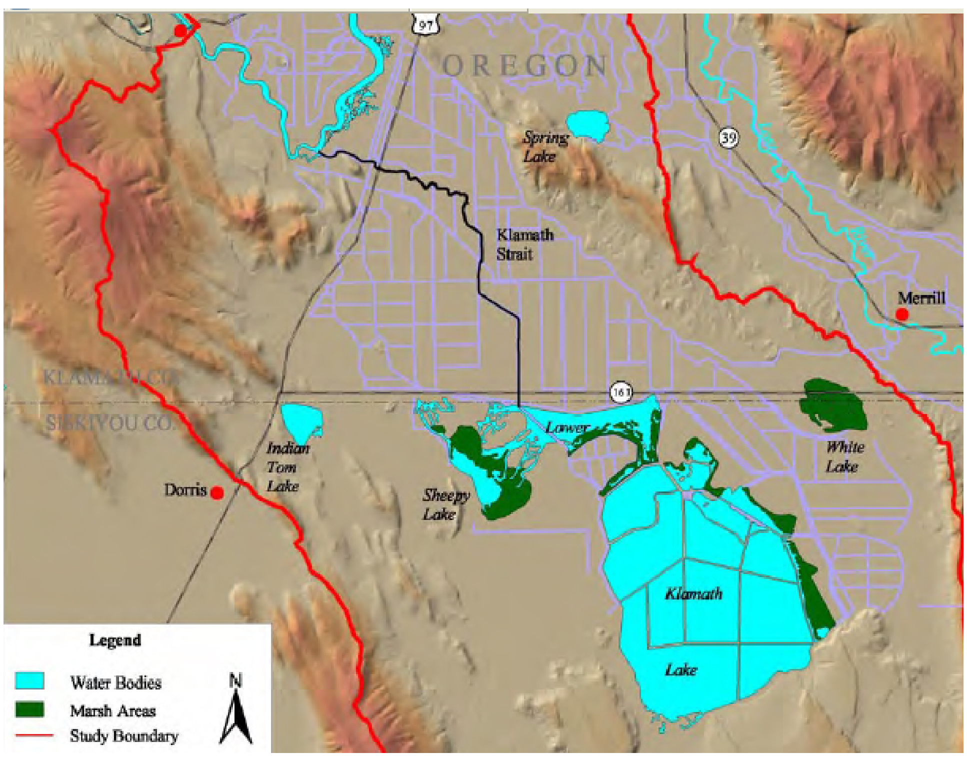

Figure 2. Present size and configuration of Lower Klamath Lake and associated marshes. Map from U.S. BOR (2005).

Figure 3. Keno Reservoir below Klamath Falls is displayed here in a Google Earth image that shows encroachment of farming into the riparian zone above and below the convergence with the Klamath Straits Drain.

Insufficient Action to Clean Up Keno Reservoir Will Confound Lower Klamath River Restoration

Even if the Klamath Hydroelectric Project dams below Keno Dam are removed, acute water quality problems in the Keno Reservoir reach are likely to confound lower Klamath River recovery. The nutrient pollution problems below Iron Gate Dam that create stressful or toxic conditions for Pacific salmon will persist but the location of problems will move. Similarly, the ideal conditions for the deadly fish pathogen *Ceratomyxa shasta* and its polychaete host *Manayunkia speciosa* (Bartholomew 2008, Stocking and Bartholomew In Press) will likely relocate upstream to reaches below Keno Reservoir.

Nutrient spiraling that emanates from below Iron Gate Dam (Kier Associates 2004) will propagate now from below Keno Dam and likely continue to affect the entire lower Klamath River. The build up of filamentous algae beds below Iron Gate trap nutrients for months in spring and early summer and then algae beds shed and decay and a major pulse of nutrients washes downstream. This fosters blooms of periphyton in reaches near Orleans and Weitchpec that elevate the pH (Kier Associates 2004) and occasionally set up acute water quality problems, such as the August 10, 1997 fish kill at Big Bar where Klamath River nocturnal D.O. of 3.5 ppm was measured (Halstead 1997). Unless nutrient pollution in the Keno Reservoir is abated, nutrient spiraling effects that pose a high risk to salmonid recovery will occur at different locations but with similar ill effects for water quality and fish health.

Klamath Health Requires Restoring Lost River, Tule Lake and Lost River

The Keno Reservoir is essentially a waste dump for the Lost River basin and the Klamath Project. In order to restore water quality in the Keno Reservoir, water quality problems must be abated through marsh restoration and by increasing the foot print of Tule Lake and Lower Klamath Lake for water storage and filtration. Because of the inoculation of the Lower Lost River and Tule Lake with *A. flos aquae*, the only way to stop out of control nitrogen production is to restore riparian vegetation and marsh areas that create slightly acidic conditions that prevent algae growth.

The winter water flushed from the Lost River into the Klamath River and the Keno Reservoir should instead be used to refill Lower Klamath Lake. This could serve as a major water supply source. Current practices shunt winter Lost River water into the Klamath River (Deas and Vaughn 2007) when it is not needed and in turn this practice contributes to potential Keno Reservoir pollution. Work on the Lower Klamath Lake Wildlife Refuge by Mayer (2005) found that wetlands have very high nutrient retention capacity, indicating that refilling the lake and restoring surrounding marshes could play a major role in abating Klamath River pollution. Tule Lake nutrient filter and buffer capacity also needs to be restored through expansion of a healthy marsh ecosystem to maintain the necessary pH balance to help prevent *A. flos aquae* blooms. Similar buffers also need to be established along the Lost River and the Keno Reservoir reach of the Klamath River, if water quality problems are to be reversed.

Politics of KHSA/KBRA Prevent Rational Policy in Light of Global Climate Change

Refilling Lower Klamath Lake and expanding Tule Lake were politically "off the table" in Klamath Settlement discussions, which has lead to an agreement that is fundamentally ecologically flawed. Leaving the Klamath Project at 200,000 acres, including allowing lease land farming adjacent to Tule Lake and in the bed of Lower Klamath Lake for the next 50 years, makes little sense in the face of climate change. The extremely low total rainfall in 2001 in the Upper Klamath Basin, which created a water supply crisis, is likely a harbinger of the future. It would seem more logical to shrink the footprint of farming and expand wetlands and riparian zones that can help in the water storage equation. If the number and extent of farming operations were reduced through purchase of easements or buy-outs, water demand would be reduced and come more into balance with available supply. Instead the KBRA calls for purchase of a power plant for the Klamath Project water users for water delivery and to facilitate pumping of Lost River ground water that is already recognized as over-draughted (USGS 2005).

Tule Lake and Lower Klamath Lake are also presently potential bottlenecks on the Pacific Flyway. If these two formerly magnificent water bodies were expanded to improve water supply and water quality, then there would likely be improvement in duck and goose populations and a substantial opportunity to promote ecotourism. This would help diversify and stabilize the economy of the Upper Klamath Basin. Another side benefit would be the restoration of the short-nose and Lost River suckers (see below).

Endangered Sucker Survival Prospects Low Under KBRA/KHSA

The National Research Council (NRC 2004) noted that Lower Klamath Lake had completely lost its ability to support endangered short-nose and Lost River suckers:

> "Lower Klamath Lake has been reduced to a marshy remnant by dewatering. It has occasional connection to the Klamath River through which it appears to receive some recruitment of young suckers, but there is no adult population… Development of an adult population is unlikely unless the depth of water can be increased, which would involve incursion of the boundaries of the lake onto lands that are used for agriculture. If the lake were deepened, water quality might be adequate for support of suckers."

The Lost River has also changed so profoundly that it does not support a viable population of either sucker species, except in Clear Lake Reservoir. The Lost River sucker population in Clear Lake is not necessarily stable because there is a risk that fish could die of anoxia, if the lake were frozen for a protracted period of time. Lower Lost River water quality and flow conditions make sucker reproduction impossible and in fact non-native warm water fish species have displaced suckers (Shively et al. 2000) that used to number in the tens of thousands (NRC 2004). Juvenile suckers are constantly introduced to the Lost River through the A-Canal but these fish cannot successfully reproduce. Instead the population of Lost River suckers resides in the Tule Sump where they swim in circles constantly during summer and stir up mud to reduce photosynthesis and prevent lethal rises in pH and ammonia. This also maintains open water that is dubbed locally as the "donut hole" (Figure 4).

The Lost River and short-nosed suckers have been recognized as in need of protection under the Endangered Species Act since 1988 (USFWS, 1993, Scoppettone et al. 1995), yet according to NRC (2004) "the U.S. Fish and Wildlife Service and the Ecosystem Restoration Office do not appear to have an operational recovery plan for the two sucker species." In order to secure the recovery of endangered populations it is essential that multiple refuge areas are established. If a population resides in only one location it is more likely to be eliminated by stochastic events. Presently the upper Lost River population of Lost River suckers is not secure due to the risk of loss if Clear Lake freezes for an abnormally long period. The Upper Klamath Lake population of this species and short-nose suckers do not show consistent year class productivity and there are periodic large-scale fish kills (Perkins et al. 2000).

Under the KBRA/KHSA little or no action will be taken to restore endangered sucker species in the lower Lost River, Tule Lake or Lower Klamath Lake. Instead farming practices will continue in these basins unchanged for the next 50 years. Consequently, establishment of diverse refugia that would provide insurance against extinction of the Upper Klamath Basin's two endangered sucker species will not take place.

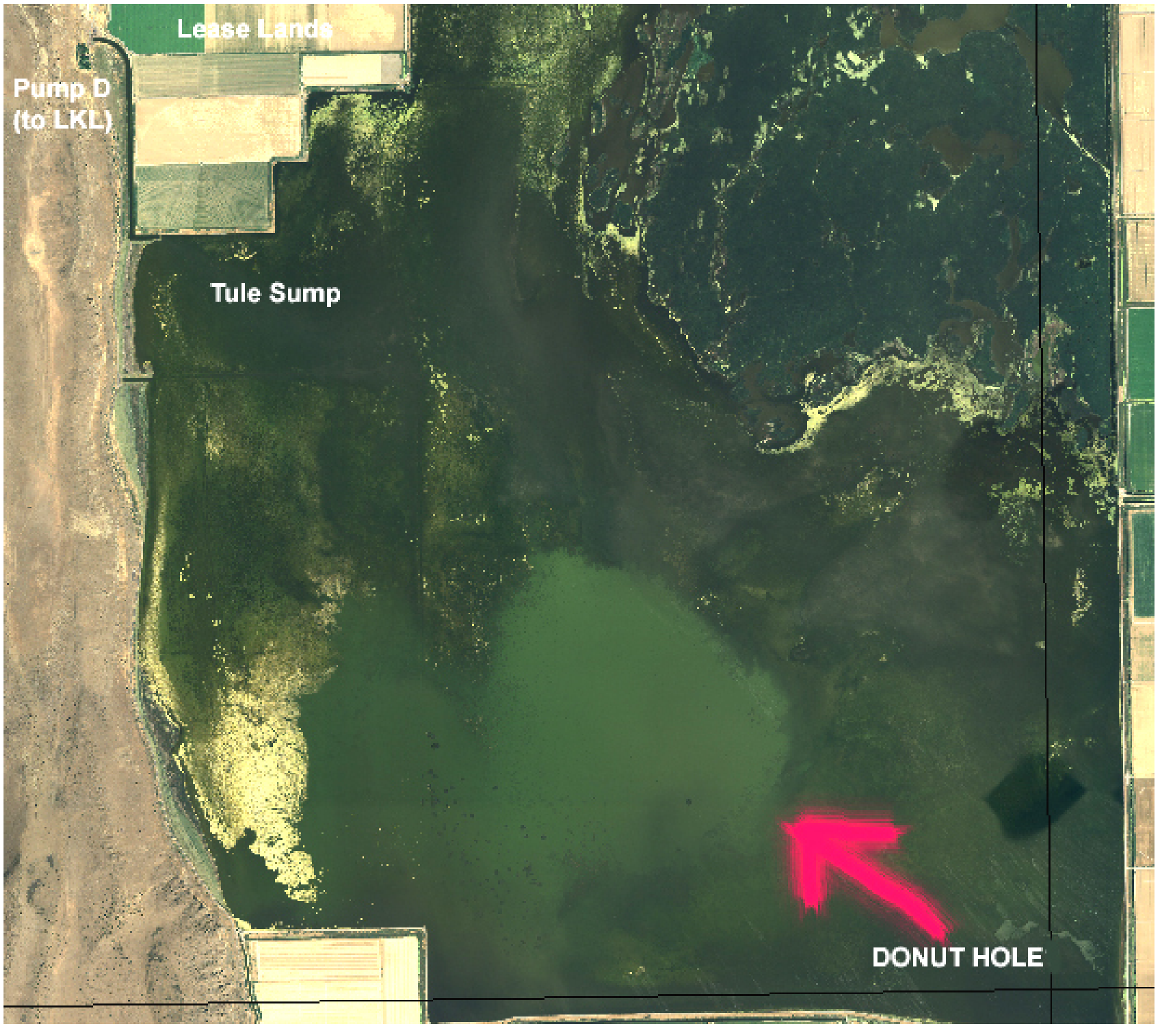

Figure 4. Tule Sump aerial photo image from Google Earth shows circle of turbid open water that is likely the "donut hole" where mature adult Lost River suckers swim in circles to maintain open water and livable water quality conditions.

Hoopa Tribe Should Consider Requesting Specific DEIR Alternatives

The Hoopa Tribe might request that the DEIR consider the alternative recommended above: refilling Lower Klamath Lake using Lost River winter water, somewhat expanding the footprint of Tule Lake and restoring riparian zones along the entire lower Lost River and Keno Reach of the Klamath River.

DEIR Scoping Considerations

Topics above should be parsed into specific points and added to Hoopa Tribe comments under water quality, hydrology and biological resources scoping request sections.

Conclusion

Harmony based cultural wisdom of the Tribes in the Klamath Basin recognized that, if you work in harmony with nature, nature will reward you; but that if you work against nature, nature will play tricks on you. This is akin to the western understanding of ecosystems that recognizes that success in restoration means pushing things back towards their normal range of variability. The Klamath River ecosystem flourished when it was joined to Lower Klamath Lake and refilling that lake bed creates tangible restoration benefits. Creating new water sources, such as Long Lake, are technically infeasible and not likely to succeed because of algae blooms, evapotranspiration and pumping costs. This is a serious flaw in the KBRA since future water allocation scenarios for fish include water from such new sources. Measures within the KBRA/KHSA fail to address water quality problems in the lower Lost River, Tule Lake, Lower Klamath Lake and the Keno Reservoir and these problems can only be cost-effectively remedied through restoring natural hydrologic and biological cycles as described above.

The Hoopa Tribal Environmental Protection Agency is a member of the Klamath Basin Tribal Water Quality Work Group, which is a consortium of the water quality and environmental protection departments of five federally recognized lower Klamath Basin Indian Tribes. Work Group comments on the Lost River and Klamath River Total Maximum Daily Load (TMDL) processes are also part of the public domain having been filed with State and federal agencies. The subjects touched lightly above are all extensively documented in these comments (Yurok Tribe, 2007, Quartz Valley Indian Community 2007, 2009) and yet they have not been considered sufficiently in the KBRA/KHSA process. Therefore, the Hoopa Tribe should consider submitting relevant TMDL comments previously submitted for the record for consideration during preparation of the DEIR.

Sincerely,

Patrick Higgins

References

Abney, R. M. 1964. A Comparative Study of the Past and the Present Condition of Tule Lake. Bureau of Sport Fisheries and Wildlife Tule Lake NWR, Tule Lake, California. Provided historical information on Lost River Slough.

Asarian, E. and J. Kann. 2006. Klamath River Nitrogen Loading and Retention Dynamics, 1996-2004. Kier Associates Final Technical Report to the Yurok Tribe Environmental Program, Klamath, California. 56pp + appendices.

Bartholomew, J. 2008. Ceratomyxa shasta 2007 Study Summary. Prepared for Klamath River Fish Health Symposium. Funded by BOR and OR sea Grant. Department of Microbiology, OSU, Corvallis, OR. 13 p.

Deas, M.L. and J. Vaughn. 2007. Characterization of Organic Matter Fate and Transport in the Klamath River below Link Dam to Assess Treatment/Reduction Potential. Prepared for the U.S. Bureau of Reclamation, Klamath Falls, OR. 167. p.

Dileanis, P. D., S. E. Schwarzback, and J. Bennett. 1996. Detailed study of water quality, bottom sediment, and biota associated with irrigation drainage in the Klamath Basin, California and Oregon, 1990-92. U.S. Geological Survey, Water-Resources Investigations Report 95-4232. Sacramento, CA. 77 pp.

Halstead, B. G. 1997. Memorandum to Bruce Gwynne of the California North Coast Regional Water Quality Control Board concerning water quality in the Klamath River. Unpublished letter of 23 September 1997. US Fish and Wildlife Service. Coastal California Fish and Wildlife Office. Arcata, CA. 14 pp

Hoopa Valley Tribe Environmental Protection Agency (HVTEPA). 2008. Water Quality Control Plan Hoopa Valley Indian Reservation. Approved September 11, 2002, Amendments Approved February 14, 2008. Hoopa Tribal EPA. Hoopa, CA. 285 p.

Kier Associates. 2004. Review comments, Final License Agreement for the Klamath River Hydroelectric Project by PacifiCorp. April 4, 2004. Comments provided for the Klamath Basin Water Quality Work Group from Kier Associates, Sausalito, CA. 33 p.

Mayer, T.D. 2005. Water Quality Impacts of Wetland Management in the Lower Klamath National Wildlife Refuge, Oregon and California, USA. Wetlands 25: 697-712.

National Research Council (NRC). 2004. Endangered and threatened fishes in the Klamath River basin: causes of decline and strategies for recovery. Committee on endangered and threatened fishes in the Klamath River Basin, Board of Environmental Toxicology, Division on Earth and Life Studies, Washington D.C. 424 pp.

Perkins, D., J. Kann, and G.G. Scoppettone. 2000. The role of poor water quality and fish kills in the decline of endangered Lost River and shortnose suckers in Upper Klamath Lake. U.S. Geological Survey, Biological Resources Division Report Submitted to U.S. Bureau of Reclamation, Klamath Falls Project Office, Klamath Falls, OR, 97603 -- Contract 4-AA-29-12160.

Quartz Valley Indian Community. 2007. Comments on Klamath River Nutrient, Dissolved Oxygen, and Temperature TMDL Implementation Plan Workplan Outline for CA (NCRWQCB, 2007). Quartz Valley Indian Community, Fort Jones, CA. 30 pp.

Quartz Valley Indian Community. 2009. Re: Comments on Public Review Draft and Staff Report for the Klamath River Total Maximum Daily Loads (TMDLs) and Action Plan Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in California. Submitted by Crystal Bowman. QVIR, Ft. Jones, CA. 39 p.

Scoppettone, G.G., S. Shea, and M.E. Buettner. 1995. Information on Population Dynamics and Life History of Shortnose Suckers (Chasmistes brevirostris) and Lost River Suckers (Deltistes luxatus) in Tule and Clear Lakes. National Biological Service, Reno Field Station, Reno, NV.

Shively, R.S., A.E. Kohler, B.J. Peck, M.A. Coen, and B.S. Hayes. 2000. Water quality, benthic macroinvertebrate, and fish community monitoring in the Lost River sub-basin, Oregon and California, 1999. Report of sampling activities in the Lost River sub-basin conducted by the U.S. Geological Survey, Biological Resources Division, Klamath Falls, OR. 96 p.

Stocking, R. W. and Bartholomew, J. L. (In Press). Distribution and habitat characteristics of Manayunkia speciosa and infection prevalence with the parasite, Ceratomyxa shasta, in the Klamath River, OR-CA, USA. Submitted for publication in the Journal of Parasitology.

U.S. Fish and Wildlife Service (USFWS). 1993. Lost River (Deltistes luxatus) and Shortnose (Chasmistes brevirostris) Sucker recovery plan. Prepared by Kevin Stubbs and Rolland White. Portland, OR. 80 pp.

U.S. Geologic Survey. 2005. Assessment of the Klamath Project Pilot Water Bank: A Review from a Hydrologic Perspective. Performed under contract to U.S. BOR, Klamath Falls, OR by the USGS, Portland, OR. 98 p.

Yurok Tribe 2007. Yurok Tribe comments on Lost River TMDL. Letter dated July 3, 2007, from Kevin McKernan of Yurok Tribe Environmental Program to Gail Louis of U.S. EPA. Yurok Tribe, Klamath, CA. 34 pp.