EFFECTS OF SUCTION DREDGE MINING ON OREGON FISHES AND AQUATIC HABITATS, SUPPLEMENTAL INFORMATION

OREGON CHAPTER AMERICAN FISHERIES SOCIETY
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SUMMARY

Oregon Chapter of the American Fisheries Society (ORAFS) previously authored a 2013 white paper entitled, “Effects of Suction Dredge Mining on Oregon Fishes and Aquatic Habitats” that is available at www.orafs.org. In 2014, in accordance with Senate Bill 838 (passed in 2013), the Governor convened a study group to develop recommendations for a regulatory framework for suction dredge mining in Oregon. In addition to restricting suction dredge mining, SB 838 calls for a five year moratorium on suction dredge mining beginning in January 2016 unless a new regulatory framework is approved. Our intent in providing this supplemental information is to inform policy conversations that have the potential to lead to additional regulations.

This supplemental white paper reinforces the previous white paper’s recommendations and provides additional details from our literature review and professional knowledge about specific effects from suction dredge mining as it relates to mercury, geomorphology, lamprey, and impacts to freshwater mussels and clams (bivalves). Our work on the original white paper and this supplemental paper has led us to make the following overall recommendations:

1. Review and strengthen current best management practices (BMP) (e.g. Oregon DEQ 2010 and Oregon DSL 2011) to substantially reduce or eliminate impacts to lamprey and other fish species, bivalves and aquatic habitat. BMP elements for consideration may include:
    - Monitor tailings from dredging operations to ensure they are not used by fish and bivalves for spawning or during other sensitive life history stages.
    - Update permitted in-stream work periods to protect all seasonal fish species spawn timings and enforce them to adequately protect egg and larval stages of fish and bivalves.
    - Inventory fish species presence in streams currently open to suction dredge mining. Mapping and monitoring locations of lamprey and bivalve presence for inclusion in areas to be avoided by suction dredge mining operations.

2. Prohibit suction dredge mining in areas used for spawning by sensitive fish stocks, particularly in areas of Essential Salmonid Habitat (ESH). These areas would be determined by biologists who would review dredge permits before they are issued.

3. Adequately enforce stipulations in suction dredge mining permits (e.g., removing mercury, leaving boulders and instream large wood in place, fueling away from streams, leaving riparian vegetation intact, etc.), particularly in ESH areas.

4. Reduce the uncertainty of impacts resulting from increased suction dredge mining activity in Oregon waters through monitoring and reporting of activities. Specifically, we recommend including:
    - A risk assessment of Oregon watersheds where suction dredge mining has the potential to mobilize toxic heavy metals already present or deposited by historical mining actions.
    - Annual reporting of stream area/volume disturbed by suction dredge mining in both ESH and non-ESH areas.
    - Developing methodologies for predicting biological impacts from multiple suction dredge mining operations in a single system.
    - Independent monitoring of a random sample of suction dredge mining claims throughout Oregon to evaluate localized impacts to fish and aquatic habitat.
    - Studying efficacy of smoothing suction dredge tailings as an effective mitigation technique for suction dredge mining in areas of spawning fishes.

MERCURY ACCUMULATION IN HABITAT AND IN FISHES

Legacy mercury occurs in many deep streambed sediments as a result of historical gold mining practices in Oregon. Mercury (Hg) and trace metals are remobilized from stream bed sediments during suction dredge mining and high banking practices (USFS 2015). The methylated form of mercury (MeHg) has the greatest potential to negatively impact fish and other aquatic or terrestrial species that eat fish (piscivorous). Methylmercury is passed up the food chain through adsorption by plankton and then by bio-accumulating in the tissues of organisms in higher concentrations at each successive trophic level. Fish metabolic processes are not effective at processing and eliminating methylmercury and at certain tissue concentrations, methylmercury negatively impacts behavior, health and reproductive success (USFS 2015). Bloom (1992) as cited by USEPA (1997) demonstrated that over 95 percent of mercury in fish tissue is in the methylated form and fish obtain greater than 90 percent of the methylmercury in their tissue from food (Sandheinrich and Wiener (2011)).

Rearing juvenile salmonids may be particularly vulnerable to increased methylmercury production as a result of suction dredge mining. Juvenile salmonids are known to utilize habitats such as lakes, sloughs, side channels, estuaries, beaver ponds, low-gradient tributaries to large rivers, and large areas of slack water. Marvin-DiPasquale et al. (2011) suggests that mercury contaminated fine sediments in the clay-silt sediment fraction may travel in the water column far downstream from source locations and settle in slow velocity areas. Such slow velocity areas include wetlands that also provide substrates rich in organic materials that are conducive to methylmercury production. Therefore, suction dredge mining related increases in methylmercury are most likely to be observed in wetlands and estuarine environments that are also known to be important rearing habitats for juvenile salmonids.

To summarize, piscivorous fish in the Rogue River basin already exhibit mercury tissue concentration levels that are known to cause deleterious effects to fish. Increased suction dredge mining will further increase the availability of methylated mercury to bioaccumulate in fish, and juvenile rearing salmonids may be particularly vulnerable because the habitats they utilize are conducive to methylated mercury production. It is likely that there are also negative impacts from mercury contamination to other non-salmonid fishes in the Rogue River, particularly those that are long-lived.

RISKS TO GEOMORPHOLOGY FROM SUCTION DREDGE MINING

Suction dredge mining is disproportionately concentrated in southwest Oregon. About 70 percent of the 748 ODEQ authorizations issued for suction dredge mining in 2014 were in two basins: the Rogue River (48 percent) and Umpqua River (22 percent). The sub-basins with the greatest numbers of authorizations were the Middle Rogue with 179 and the South Umpqua with 156 (E. Brawner, ODEQ, Pers. Comm. 2014 as cited in USFS 2015).

Harvey and Lisle (1998) describe that dredging activities near riffle crests can destabilize spawning areas and adjacent downstream stream reaches and suction dredge activities have the potential to decrease the depth of upstream pools by degrading riffle crests which control upstream water surface elevations (i.e., hydraulic control). Published studies document that effects of dredge tailing piles to channel morphology and bed composition are not long-lasting and are typically not visible the next year as a result of peak flows after the dredging season. However, Harvey et al. (1982), Thomas (1985) and Stern (1988) describe exceptions for sites not near the thalweg and where cobbles and boulders had been piled. Additionally, Thomas (1985) identified that gravel from dredging tailing piles can redistribute downstream from the original location and fill downstream pool habitat within a year. This relates back to how with the removal of substrate and disturbance of the stream bed, spawning areas, rearing, and holding areas are negatively impacted by dredging activities. These disturbances may impact the life history and biology of anadromous and resident fish, and change natural stream function in both short term and long term timeframes.

Dredging impacts also increase as dredging locations expand from single to multiple sites. The accumulation of impacts associated with dredging activities within a stream may result in cumulative effects that are greater than effects associated with a single suction dredge location. A difficulty in addressing this cumulative effects question is that the impact dredging footprint at an individual claim can vary dramatically. Typically a dredger burrows to bedrock and many holes are 3 feet deep, which along with the related tailings pile(s), can affect a large part of the active streambed, particularly in smaller streams. Streambed modifications can significantly modify the amount and quality of spawning and rearing habitat available. Additionally, modification and deposition of fine sediment may affect adjacent and downstream habitats. The length of stream impacted by suspended sediment can vary widely depending on the type of channel bed material at the dredging location. If channel bed material is coarse with few fines, sediment related impacts will be more localized as heavier mobilized sediments settle a short distance from the dredging site. Finer sediments including clay, silt, and sand remain suspended in the water column over long distances and have the potential to impact habitats at considerable distance from the mining site.

Concentrated dredging in specific stream reaches may have cumulative impacts to geomorphology including:

- Armoring of river bottoms from downstream redistribution of stream bed materials and fine sediment re-suspension and redistribution, including frequent and long-lasting unseasonal turbidity plumes. Increased fine sediments can negatively affect early life stage fish by decreasing circulation of oxygenated water through interstitial spaces in gravel, therefore decreasing egg to fry survival.
- Destabilization of stream bed spawning habitat and reduction in adjacent pool depths affects habitat quality, and in turn, is detrimental to spawning, holding, and rearing habitat availability and fish use. Habitat destruction causes the redistribution of juvenile and adult fish to less suitable habitats.
- Seasonal, short-term or long-term changes in stream bed sediment size, composition, and stability which can reduce macroinvertebrate fauna and stream productivity.

POTENTIAL IMPACTS TO LAMPREY AND FRESHWATER BIVALVES

Suction dredge mining has the potential to affect native freshwater bivalves and non-salmonid Oregon State Sensitive species including lamprey. Both lamprey and freshwater bivalves live for a portion of their life cycle in the stream bed and banks. Lamprey spawn in the spring and early summer (Moser et al. 2007, Luzier et al. 2011) in gravel at pool tailouts and riffles, creating nests for embryos. Juvenile (ammocoetes) rearing habitat is typically nearby associated spawning habitat (Moser et al. 2007). Lamprey embryos typically remain in the substrate for 19 days after spawning depending on water temperature. After hatching, ammocoetes burrow into the stream sediment and filter feed for between 2 and 7 years (USFWS 2012).

Freshwater bivalves spend their lives buried in sediment and as they mature the posterior end of the bivalve projects above the sediment surface during warm months, and retreats beneath the surface during colder months. Male bivalves will release gametes into the water column which are then drawn in by females to achieve internal fertilization of their eggs. Females then release larva (glochidia) into the water column, where they attach to fish and stay for days to months. The glochidia later release from the fish and burrow into the sediment. Release of glochidia varies by species and is triggered by environmental conditions and presence of host fish species (Nedeau et al. 2008).

Lamprey (embryos and ammocoetes) and bivalves (adults and glochidia) can be present in the stream bed during all times of the year. These species are at risk of direct mortality by being passed directly through a dredge, nesting destruction, and displacement and degradation of rearing habitats (HWE 2009). Overall impacts of suction dredge mining to rearing lamprey include direct mortality from being passed through a dredge, and indirect effects such as habitat disturbance which could lead to displacement and an increased chance of predation as well altered food availability. Since various lamprey life stages are present in the system for up to 7 years, continued disruption at the same habitat could have long lasting effects over time to generations of fish. Suction dredge mining is considered a threat to lamprey (USFWS 2012) and there is a need to develop guidance on suction dredge operations to protect ammocoetes (Luzier et al. 2011).

LITERATURE CITED

Bloom, N. 1992. On the chemical form of mercury in edible fish and marine invertebrate tissue. Canadian Journal of Fisheries and Aquatic Sciences: 49:1010-1017.

Brawner, E. 2014. Oregon Department of Environmental Quality [ODEQ], Suction Dredge Mining Specialist. Personal communication with Susan Maiyo, Forest Fishery Biologist, Rogue River National Forest.

Harvey, B., K. McCleneghan, J. Linn, and C. Langley. 1982. Some physical and biological effects of suction dredge mining. California Department of Fish and Game Environmental Services Branch Fish and Wildlife Water Pollution Control Laboratory. Laboratory Report No. 82-3. Rancho Cordova, California.

Horizon Water and Environment [HWE]. 2009. Suction Dredge Permitting Program. Literature review on the impacts of suction dredge mining in California. http://www.dfg.ca.gov/suctiondredge/

Luzier, C.W., H.A. Schaller, J.K. Brostrom, C. Cook-Tabor, D.H. Goodman, R.D. Nelle, K. Ostrand and B. Streif. 2011. Pacific lamprey (*Entosphenus tridentatus*) Assessment and Template for Conservation measures. U. S. Fish and Wildlife Service, Portland, OR. 282 pp.

Marvin-DiPasquale, M., J.L. Agee, E. Kakouros, L.H. Kieu, J.A. Fleck, and C.N. Alpers. 2011. The effects of sediment and mercury mobilization in the South Yuba River and Humbug Creek confluence area, Nevada County, California: Concentrations, speciation and environmental fate—Part 2: Laboratory Experiments: U.S. Geological Survey Open-File Report 2010−1325B, 53 p.

Moser, M.L., J.M. Butzerin and D.B. Dey. 2007. Capture and Collection of lampreys: the state of the science. Reviews in Fish Biology and Fisheries 17(1):45-56.

Nedeau, E.J., A.K. Smith, J. Stone and S. Jepsen. 2009. Freshwater Mussels of the Pacific Northwest, second edition. The Xerces Society for Invertebrate Conservation.

Oregon Department of Environmental Quality [DEQ]. 2010. 700 PM permit. http://www.deq.state.or.us/wq/wqpermit/mining.htm

Oregon Department of State Lands [DSL]. 2011. http://www.oregon.gov/DSL/PERMITS/docs/placer_facts.pdf

Sandheinrich M. and J. Wiener. 2011. Methylmercury in freshwater fish: recent advances in assessing toxicity of environmentally relevant exposures. In: Beyer WN, Meador JP (eds) Environmental contaminants in biota: interpreting tissue concentrations, 2nd ed. Chapter 4:169-190.

Stern, G. 1988. Effects of suction dredge mining on anadromous salmonid habitat in Canyon Creek, Trinity County, California. A thesis presented to the faculty of Humboldt State University in partial fulfillment of the requirements for the Degree of Master of Science. 80 p.

Thomas, V. 1985. Experimentally determined impacts of a small, suction gold dredge on a Montana stream. North American Journal of Fisheries Management: 5:480-488.

United States Fish and Wildlife Service [USFWS]. 2012. Pacific Lamprey Fact Sheet.

United States Forest Service, Rogue River-Siskiyou National Forest (USFS). 2015. Suction Dredging and High Banking Operations for Notices of Intent within the Rogue River-Siskiyou National Forest. Biological Assessment.

United States Environmental Protection Agency [US EPA]. 1997. Mercury study report to Congress. Volume III: Fate and transport of mercury in the environment. EPA-452/R-97-005. December 1997.