Effects of Suction Dredging

A Summary of Dredging Publications

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Draft of April 16, 2001

This article is a summary of facts and conclusions found in about two dozen published articles about the effects of suction dredging. The purpose of this study is to present the known facts to the general public. It is expected that only facts and truths can lead to a rational end to the controversies over multiple use of the public lands.

The number of articles directly about effects of dredging are limited. Publications about fish habitat are legion. Most of the articles were garnered from the internet. A few had been around for a long time.

The total of 27 publications contained reports on some 13 separate studies of dredging effects and 7 reviews of accumulated findings and existing regulations. Three older articles discuss effects of sediment from historic mining or sediment in general. One of these, Dr. Wards ODOGAMI Bulletin #10, is also remarkable because the Oregon Dept. of Fish and Wildlife tried to recover and suppress this article some years back. Dr. Ward's conclusions apparently go against some current prevailing doctrines.

No publications were directly ignored, but there are too many related articles in published bibliographies to review them all. The initial deadline for this article was April 23 [2001], the end of the comment period on the local mineral withdrawals. That and the remarkable consistency of the reports permits a public disclosure of findings at this time.

A request to Siskiyou Regional Education Project (SREP) returned no real reference, either for or against. They were specifically asked for photocopies or bibliography of articles about the effects of suction dredging. Their packet contained only local newspaper clippings, some immoderate environmental magazines from Australia promoting "uncivil" acts, and a couple of slick products pushing the Siskiyou National Monument. This is even though they have been known to reference Harvey et al (1995) in public and in court (SREP vs. Rose, 1999).

Reference numbers are keyed to the related bibliography. All studies were by government agencies, universities, and professional organizations. All studies are certainly main-stream and reasonably scientific.

Harvey et al (1995)

Harvey et al (1995) is a review of publications and potential problems, as well as recommendations for future management at the watershed level. This seems to be about the only article quoted by immoderate environmentalists. It does record every possible thing that could be used to suggest there might be significant harm. It doesn't come to any conclusion about whether or not dredging should be allowed.

After the over-environmentalistic excesses at the end of the Clinton administration, Harvey et al (1995) can also be viewed in a different light. The study was requested and funded by the Clinton Forest Service. Immoderate environmentalists, those who are trying to end multiple use, seem to think that this article gives them something that the earlier publications didn't. Therefore, this article appears to be a gift to the extremists whose interests were improperly pushed at the end of the Clinton era.

Summary of Conclusions

All statements from the articles are referenced. Your present reporter's comments are not.

Miner's Efforts

A majority of dredge operations studied did not work long periods or disturb large areas of the stream bed.[9] Of the 200 miners studied, only 57 spent more than 500 hours per season.[16] Thus, it appears that dredgers mostly worked afternoons in the summer, even before the setting of the dredging season between hatching and spawning. That's partly because it takes half a day to drive out there and mornings in the mountains can be cool, even in summer.

Water Quality: Turbidity, Sediment, Temperature

Water quality was impacted only during the actual operation of a suction dredge, which generally was only 2 to 4 hours of actual operation.[9] The primary effect of suction dredging was increased turbidity and total filterable solids downstream from the dredge from 30 to 150 meters.[14, 16] Naturally occurring minerals, such as copper and zinc sulfides, may be stirred up from stream bed sediments.[16] Dredge plumes, although visible, were probably of little direct consequence to fish and invertebrates.[19] Movement rate of suction dredging equals 0.7% of natural rates.[3]

Deposited sediment decreased exponentially downstream with distances from dredging.[20] Suspended sediment returned to ambient levels 30 to 60 meters downstream.[8, 20] In a few cases, sediment went further downstream than found in other studies because of steep stream gradient and fine sediment.[18] Maximum sediment concentrations were only a minute fraction of the great loads needed to impact fish feeding and respiration.[19]

Dredge mining had little, if any, impact on water temperture.[9]

Fish: Eggs, Young, and Adults

Mortality of fish eggs by dredging ranged by species from 29% to 100% and were generally greater than that of hatchery stock of the same age.[5] Presence of silt during nonerosion periods results in bottom deposition which is damaging to fry production.[17] This is why the dredging season was set between hatching and the next spawning.

There's no doubt that too much sediment is bad for fish eggs. However, dredging can improve permeability and velocity of water in gravel.[11] Intergravel permeability at one site increased, although not significantly; no changes in downstream permeability were noted.[20] A five-inch dredge could improve the intergravel environment for both fish eggs and benthos.[11] Weighing all factors, dredging can improve the gravel environment for both fish eggs and aquatic insects, especially if the operator mined uniformly in one direction, as opposed to a pocket and pile method.[11]

The amount of colloidal fines in the Rogue River below (historic) placer mines was too small to adversely effect young fish eggs or fish food.[25] It was found that the thin intermittent layer of gritty sediment (less than 1/8 inch) from (historic) placer mining did not interfere with oxygen supply to fish eggs.[25]

Placer mining debris is typically chemically inert and does not take oxygen from the stream or add toxic agents to the water.[25] Hydraulic placer mining debris was typically just stream sand and gravel that had been left behind as the streams meandered.[25]

The tank tests at Reed College showed that young fish live well up to thirty days in good water mixed with natural soil materials.[25] The tests used sediment loads from two to three times as large as the extreme load contributed to the Rogue River by maximum conditions of hydraulic placer mining.[25]

Of course, dredging should not be conducted while young salmonids reside in the gravel.[2] Because of the short mining season, fry emergence and rearing did not appear to be impacted to a high degree by dredging.[9] Juveniles used dredge holes, and their feeding, growth, and production did not seem to be impacted.[9] In contrast to Sigler et al (1984), young steelhead in Canyon Creek sought out dredge plums to feed on exposed invertebrates.[9, 10, 19]

Dr. Ward reviewed another study, which found young Alaskan salmon suffered no ill effects from heavy sediment loads ten times that found at Agness (from historic mining).[25]

Adult fish are not acutely affected or likely to be sucked into dredges.[7] Dace, suckers, steelhead, juvenile steelhead and salmon fed on exposed invertebrates, rested, and held in dredge holes.[9] Adult salmon have been observed to spend considerable time within yards of active dredgers and to hold in the dredged holes.[19] Feeding, growth, and production did not seem to be impacted at the current level of dredge activity.[9]

Salmonids spawned in the vicinity of the previous season's dredging, but, in one study, salmonids redds were not located in tailing piles.[9] The gravels dispersed by the high stream flows, which included dredge tailings, certainly composed a portion of the suitable spawning gravels each year.[9] Dredge tailings have been observed to provide good salmonid spawning ground due to the loose condition of the sand and gravel.[9] In some places, mining debris may provide the best or only habitat.[9, 10]

At the present level of activity, anadromous salmonids and habitat were only moderately affected.[25] Impacts on fish and habitat were moderate, seasonal, and site specific.[25] With restrictions, even large dredges have minimal impact on moderate to large-sized waterways.[2] The essence of Dr. Ward's findings is that the placing of muddy water from (historic) placer mining operations in the Rogue River drainage is not inimical to fish and fish life.[25] Sediment from dredging is much less than that of historic mining.

Invertebrates

The abundances of several species of aquatic insects and riffle sculpin were adversely affected, but only at and immediately downstream from the dredge site.[8] Due to differences between species… the lack of significant differences between control and dredged stations observed for some taxa is not surprising.[6] The dredging did not significantly reduce the number of invertebrates.(9) Only 7.4% of benthic insects died from going through a dredge.[11] The effects of dredging… were not severe enough to cause differences in mean numbers of invertebrates or in diversity indices.[18]

Effects on the benthic community are highly localized.[6, 8] All settled back to the bottom within 40 feet of the dredge.[11] Impacts on aquatic insect abundance were limited to the area dredged.[20] Most of the recolonization of benthic invertebrates was completed after 38 days.[5]

Impacts of dredging to invertebrates were minimal.[25] Effects of dredging on insects and habitat were minor compared to bed-load movement due to large stream flows during storms and from snowmelt.[18]

Several studies all reported that invertebrates recolonized dredge sites within 30 to 45 days.[5, 14] Substantial recovery of invertebrates occurred rather rapidly, and disturbance occurred only close downstream from the dredge.[16] The 45 day recolonization experiment indicates not only a rapid recovery but also a rapid recovery in the total numberof insects over time.[6] Almost all taxa found on cobble substrates take part in the recolonization of sand and gravel areas.[6] Dredging can improve the gravel environment for aquatic insects, as well as fish eggs.[11]

Stream Channel and Banks

Dredging or highbanking of bank materials should be prohibited as this may create turbidity and stream bank instability, unless there is a holding pond.[2] Stream-side vegetation should not be removed.[2] Only a few dredgers undercut banks, thus channelizing the stream, removing vegetation and accelerating bank erosion.[25] Camping in the riparian zone caused some damage.[12] Survey suggested that mining of the stream banks caused more damage than dredging.(12) Moving of large boulders alters the stream bed.(12) Boulders and logs should be replaced, if removed, for fish habitat.(2) Few miners caused adverse impacts.(12)

Changes to stream bed were major but localized, such as excavation to bedrock in a hole.(18) Disturbed stream reaches were only a few tens of meters.(8, 14) Stream bed alterations are probably more long-lived on streams with controlled flows than on those with flushing flows.(8, 19) Where flushing flows occur, substrate changes are gone in from one month to one to three years.(8, 16, 17) Holes and piles in the center of the stream are usually gone after one winter.(19) Piles along the banks may linger.(19) This is similar to piles left by historic miners.(19) Pool habitat created at the dredge site may compensate for pool loss immediately downstream.(20)

Natural Variation

Fish and invertebrates displayed considerable adaptability to dredging, probably because the stream naturally has substantial seasonal and annual fluctuations.(6) All measurements of dredge effects turned out to be within the natural variation of the local environment.(24) Stream environments are typically dynamic and variable due to floods, natural inputs of sediment from landslides, and other sources, especially dams.(25) Salmon and steelhead runs were established in past climates much rougher at times than today's, even with mining.(25) That is, in the Ice Age precipitation, landslides, and sediment loads were often much greater than today.(25)

The fish runs did not decline during the first and greater episode of mining.(25) Thus, it's likely that the lesser mining of the 1930's is not the reason for the decline in fish runs at that time.(25) The main difference between the two times are the dams, industrial wastes, and agricultural withdrawals of the later period.(25)

In the mid-seventies, Willard Street, local historian and author, told your present reporter that the end of the great fish runs of the Rogue River had coincided with the beginning of the agricultural withdrawals, not with mining. In the early 1990's, agricultural withdrawals are oversubscribed and that inforcement is poor, at best.

Cumulative Effects

Cumulative effects of suction dredging have probably not been fully determined, but there is considerable evidence of only localized and temporary effects from multiple dredges.(6, 7, 9, 12) Studied were the effects of six dredges in a 2 km stretch, (6) 40 dredges on an 11 km stretch,(7) up to 24 dredges on 15 km,(9) and 270 dredges in a part of the Sierra Nevada.(12) Three years of monitoring on the Chugach National Forest found no noticeable impact to water quality from dredges of 6 inches or less.(10)

"If there were a cumulative effect of dredging, an increasing number of taxa should have declined in abundance after June at downstream stations."[8] No such decline appeared in the data.[8] There is a need for additional study of cumulative effects and other items.[9, 16, 26] However, no authors declared that effects were serious enough to warrant a change of law and end of dredging rights.

Conclusions about the Conclusions

Studies to date have not shown any actual effect on the environment by suction dredging, except for those that are short-term and localized in nature.[14, 21] Effects were significant, but localized.[8] The size of the impact zone varies.[8] A six-inch dredge is appropriate where substrate gravel size is large, but a large aperture may be disruptive in a small channel.[11] Suction dredging effects could be short-lived on streams where high seasonal flows occur.[6, 7, 9] The greatest potential for damage is at low flow.[15]

Even though cumulative effects and some other questions have not been thoroughly studied, there has been nothing to date to substantiate closure of the small-scale mining operations.[23] Even with the absence of data, environmental groups were active to close down mining citing unsubstantiated possible discharge violations.[23] The effects of suction dredging would appear to be less than significant and not deleterious to fish.[26]

Regulations and Future Management

Current regulations of size and season appear adequate to protect habitat, with some future adjustments.[18, 25, 27] Suction dredges of larger than 4 inches generally have more than de minimis effects on the aquatic environment and therefore require authorization.[21] The DEI by the State of California stated that, "based on best available data, it is anticipated that the regulations, as amended by the proposed project, will protect fish and other related aquatic dependent resources and will not cause significant effects to the environment or deleterious effects to fish."[26]

Harvey et al (1995), at the request of the Forest Service, reviewed existing studies and recommended analyzing dredging effects by watershed.[27] California, Idaho, Washington, and Oregon manage dredging with the conclusion that, with mitigations, effects are insignificant.[27]

Present Researcher's Conclusions

As in most aspects of life, risk of negative effects cannot be reduced to nothing. However, consistency of the findings indicate that doesn't seem to be necessary. It would seem that existing regulations, monitoring and periodic upgrade of regulations would be enough to prevent significant negative effects. Just in case the price of gold should triple, procedures should be put in place for limiting the number of operations in heavily dredged reaches. This should be based on some scientific study or determination. Of course, numerous operations only occur in the very few areas where there's still some gold to be found.

The Corps of Engineers eloquently summarizes the current situation:

"Four-inch and smaller dredges have inconsequential effects on aquatic resources.[21] This is an official recognition of what suction dredgers have long claimed; that below a certain size, the effects of suction dredging are so small and so short-term as to not warrant the regulations being imposed in many cases."[21]

"The U.S. Environmental Protection Agency (EPA), has ignored this concept, although numerous studies, including the EPA's own 1999 study of suction dredging, repeatedly and consistently support the Corps finding de minimis effects.[21] The reports consistently find no actual impact of consequence on the environment, and so almost always fall back to the position that potential for impact exists."[21]

"The regulatory agencies should be consistently and continually challenged by the dredging community to produce sound, scientific evidence that support their proposed regulations.[21] To regulate against a potential for harm, where none has been shown to exist, is unjustifiable and must be challenged."[21]

References

1. Ames, 1995
2. Badali, 1988
3. Cooley, 1995
4. Gough, 1997
5. Griffith and Andrews, 1981
6. Harvey, 1980
7. Harvey, et al, 1982
8. Harvey, 1986
9. Hassler, et al, 1986
10. Huber and Blanchet, 1992
11. Lewis, 1962
12. McCleneghan and Johnson, 1983
13. Nelson et al, 1991
14. North, 1993
15. Oregon Dept. of Fish and Wildlife, 1980
16. Prussian et al, 1999
17. Shaw and Maga, 1942
18. Somer and Hassler, 1992
19. Stern, 1988
20. Thomas, 1985
21. US Army Corps of Engineers, (1994)
22. US Dept. of Agriculture, (1997)
23. USGS, 1998
24. Wanty et al, 1997
25. Ward, 1938
26. State of California, 1997
27. Harvey et al, 1995

BIBLIOGRAPHY
OF THE
EFFECTS OF SUCTION DREDGING

Draft of April 15, 2001

By: Josiah Cornell

Actual studies of the effects of suction dredging are few. Articles about the general effects of sediment and other disturbances to streams are numerous, and they may be found in the bibliographies of articles included here.

(1.) Author(s): Ames, Frank, compiler, 1995

Title: Excerpts From Suction Dredge Studies

Source: Published by the Washington Alliance of Miners and Prospectors

Purpose: To compile information about dredging effects on entrainment, feed and fish, flushing flows, sediment, effects of silt on fish, effects on spawning, changes in the stream bed, temperature, turbidity, and water quality.

Method(s): Excerpts from published articles

Conclusion(s): Conclusions are recorded under the names of the excerpted authors.

Notes: This is a compilation of excerpts from published articles about effects of dredging.

(2.) Author(s): Badali, P.J., 1988

Title: Effects of Suction Dredging on Fish and Benthic Invertebrates

Source: Western Mining Council and State of Idaho Dept. of Water Resources, Recreational Dredging Seminar

Purpose: To gather together available facts from scientific publications

Method(s): Summary of articles and conclusions

Conclusion(s): Dredging should not be conducted while young salmonids reside in the gravel. Dredging or "highbanking" of bank materials should be prohibited as this may create turbidity and stream bank instability, unless there is a holding pond. Stream side vegetation should not be removed. Boulders and logs should be replaced, if removed, for fish habitat. **With these restrictions, even large dredges have minimal impact on moderate to large-sized waterways.** (emphisis added)

Notes: Summarized articles are included under the authors' names

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(3.) Author(s): Michael F. Cooley, Oct. 16, 1995

Title: A comparison of stream materials moved by mining suction dredge operations to the natural sediment rates

Source: USDA Siskiyou National Forest

Purpose: To compare amount of material moved by dredging versus natural rates

Method(s): Compared rates from several studies

Conclusion(s): **Sediment rates from suction dredging are only a minor fraction of natural rates in mountainous terrain.** (emphisis added)

(4.) Author(s): Gough, L., et al, 1997

Title: Placer Gold Mining in Alaska-Cooperative Studies on the Effect of Suction Dredge Operations on the Forty-mile River.

Source: USGS Fact Sheet 155-97, October 1997

Purpose: To evaluate possible negative effects of dredging, such as increasing the load of toxic metals and turbidity and decreasing the number and diversity of aquatic biota.

Method(s): Sampling of metals in rocks and stream bedloads of the watershed; sampling of turbidity and stream chemistry below dredge operations.

Conclusion(s): Published in Wanty et al, 1997

Notes: A description of the metals study; results were reported in Wanty et al, 1997.

(5.) Author(s): Griffith, J.S., and Andrews, D.A., 1981

Title: Effects of a small suction dredge on the fishes and aquatic invertebrates in Idaho streams.

Source: North American Journal of Fisheries Management 1:21-28

Purpose: To evaluate some of the effects on aquatic organisms from use of small suction dredges.

Method(s): A small dredge was operated on four small Idaho streams and mortality and recolonization was assessed. Dredging was deliberately done during emergence of fry.

Conclusion(s): Mortality of fish eggs ranged by species from 29% to 100% and were generally greater than that of hatchery stock of the same age. Most of the recolonization of benthic vertebrates was completed after 38 days. Survival of entrained vertebrates that settled on the surface was not assessed.

(6.) Author(s): Harvey, B.C., 1980

Title: Effects of Suction Dredge Mining on Fish and Invertebrates in California Foothill Streams

Source: M.S. University of California at Davis

Purpose: to determine the impact of small (8-inch and less) suction dredges on fish and invertebrates in foothill streams

Method(s): field study with in-stream sampling of control areas and dredge sites. The effect of a number of dredges in a limited area of stream was investigated, six dredges in a 2km section of stream.

Conclusion(s): The overall effect of dredging on the benthic community appears highly localized. Due to differences between species… the lack of significant differences between control and dredged stations observed for some taxa is not surprising. Fish and invertebrates displayed considerable adaptability to dredging, probably because the stream naturally has substantial seasonal and annual fluctuations. The 45 day recolonization experiment indicates not only a rapid recovery in the total number of insects over time, but also that almost all taxa found on cobble substrates take part in the recolonization of sand and gravel areas. Flushing winter flows can greatly reduce the long term impact of dredging.

(7.) Author(s): Harvey, B.C., McCleneghan, K., Linn, J.D., Langley, C.L., 1982

Title: Some Physical and Biological Effects of Suction Dredge Mining

Source: California Dept. of Fish and Game Lab Report No. 82-3

Purpose: to examine the effects of dredging on turbidity, settleable solids, and sedimentation rate, aquatic insects, and fish

Method(s): Field surveys

Conclusion(s): Effects were significant, but localized. The abundance of several species of aquatic insects and rifle sculpin were adversely affected, and the size of the impact zone varies. No additive effects were detected on the Yuba River from 40 active dredges on an 11 km stretch. The area most impacted was from the dredge to about 30 meters downstream, for most turbidity and settleable solids. Sedimentation rates fell back to ambient after 60 meters. Stream bed alterations are probably more long-lived on streams with controlled flows than on those with flushing flows. Effects on the benthic community are highly localized. Where flushing flows occur, substrate changes are gone in one year.

(8.) Author(s): Harvey, Bret C., 1986
Title: Effects of suction gold dredging on fish and invertebrates in two California streams
Source: North American Journal of Fisheries Management, 6:401-409, 1986
Purpose:
Method(s):
Conclusion(s): **Adult fish are not acutely affected or likely to be sucked into dredges.** Benthic communities were significantly altered, but alterations were localized and associated with changes in degree of embeddedness of cobbles and boulders. Suction dredging effects could be short-lived on streams where high seasonal flows occur. Six small dredges (<6in.) on a 2 km stretch had no additive effects. ***"If there were a cumulative effect of dredging, an increasing number of taxa should have declined in abundance after June at downstream stations."*** **No such decline appeared in the data.** *"Fish and invertebrates apparently were not highly sensitive to dredging in general, probably because the streams studied naturally have substantial seasonal and annual fluctuations in flow, turbidity, and substrate."* Substrate changes were gone after one year. (emphisis added)
Notes: From the compilations

(9.) Author(s): Hassler, T.J., Somer, W.L., Stern, G.R., 1986
Title: Impacts of Suction Dredge Mining on Anadramous Fish, Invertebrates and Habitat in Canyon Creek, California
Source: California Cooperative Fishery Research Unit, U.S. Fish and Wildlife Service, Humboldt State University, Cooperative Agreement No. 14-16-0009-1547, Work Order No. 2, Final Report
Purpose: To evaluate impacts of suction dredge mining on fish, invertebrates, and habitat.
Method(s): Similar to McCleneghan and Johnson (1983), interviews and subjective site observations.
Conclusion(s): Studied 24 3" to 6" dredges along 15 km stretch. "Dredges on Canyon Creek seemed to be spaced far enough apart, and operated at low enough levels during the study not to result in cumulative effects. Most visible effects were gone after one year. At the
present level of activity, anadromous salmonids and habitat were only moderately affected. Fish congregate and feed where dredging displaces and exposes benthic invertebrates. The dredging did not significantly reduce the number of invertebrates. Steelhead fed opportunistically. Impacts of dredging on invertebrates were minimal. Salmonids spawned in the vicinity of the previous season's dredging, but salmonid redds were not located in the tailing piles. The gravels dispersed by the high stream flows, which included dredge tailings, certainly composed a portion of the suitable spawning gravels each year. Because of the short mining season, fry emergence and rearing did not appear to be impacted to a high degree by dredging. Juveniles used

dredge holes, and their feeding growth, and production did not seem to be impacted. A majority of dredge operations studied did not work long periods or disturb large areas of the streambed. Dace, suckers, and juvenile steelhead and salmon fed, rested, and held in dredge holes. Dredge mining had little, if any, impact on water temperature. Water quality was impacted only during the actual operation of a suction dredge, which was generally only 2 to 4 hours of actual operation. Those few dredgers who undercut banks channelized the stream, removed vegetation and accelerated bank erosion. Impacts on fish and habitat were moderate, seasonal, and site specific. **Current regulations of size and season appear adequate to protect habitat.** Three referenced studies had found that salmonids spawned in tailings. (emphisis added)

(10.) Author(s): Huber, C., and Blanchet, D., 1992

Title: Water quality cummulative effects of placer mining on the Chugach National Forest, Kenai Peninsula, 1988-1990

Source: U.S. Forest Service, Chugach National Forest, Alaska Region

Purpose:

Method(s):

Conclusion(s): Three years of monitoring on the Chugach National Forest found no noticeable impact to water quality from dredges of 6 inches or less.

(11.) Author(s): Lewis, R., 1962

Title: Results of Gold Suction Dredge Investigation, Memorandum of September 17

Source: California Dept. of Fish and Game, Sacramento, Ca.

Purpose: Part of a study of suction dredge effects.

Merthod(s): A rented 5-inch dredge was operated

Conclusion(s): Only 7.4% of benthic insects died from going through a dredge, although it varied by order. All settled back to the bottom within 40 feet of the dredge. Fish appeared and began to feed as soon as dredging started. The turbidity plume was 200 feet long. A five-inch dredge could improve the intergravel environment for both fish eggs and benthos. A six inch dredge is appropriate where substrate gravel size is large, but a large aperture may be disruptive in a small channel. Dredging improved permeability and velocity of water in gravel. **Weighing all factors, dredging can improve the gravel environment for both fish eggs and aquatic insects, especially if the operator mined uniformly in one direction as opposed to a pocket and pile method.** (emphisis added)

(12.) Author(s): McCleneghan, K., and Johnson, R.E., 1983

Title: Suction Dredge Gold Mining in the Mother Lode Region of California, Environmental Services Branch, Administrative Report 83-1

Source: State of California Dept. of Fish and Game

Purpose: To evaluate some effects of suction dredge mining

Method(s): Field surveys included 200 interviews with miners, over 200 sites were assessed, observations at dredge sites, and subjective determinations of damage estimates

Conclusion(s): Study of the impacts of 270 dredges with up to 10 inch intake. Of the 200 miners, only 57 spent more than 500 hours per season, the average was 235 hours per season. Few miners caused adverse impacts. Damage that does occur is of concern because of a high number of dredgers in the state. Some damage was from the few miners camping in the riparian zone. Survey suggested that mining of the stream banks caused more damage than dredging. Moving of large boulders alters the stream bed. Types of damage were not described or quantified. Because of the number of miners in California at the time, there was a need to fully examine the effects of dredging.

(13.) Author(s): Nelson, R.L., McHenry, M.L., and Platts, W.S., 1991
Title: Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats
Source: American Fisheries Society Special Publication 19:425, 1991
Purpose:
Method(s):
Conclusion(s): General, not related to suction dredging. Sediment accrues in streams naturally and is not a normal component of salmonid habitat. Major disruption of the system occurs when placer sediment delivery substantially exceeds the natural level and the amounts of sediment deposited and the turbidity becomes excessive, as from hydraulic mining.

(14.) Author(s): North, Phillip A., 1993
Title: A Review of the Regulations and Literature Regarding the Environmental Impacts of Suction Gold Dredges
Source: U.S. Environmental Protection Agency
Purpose:
Method(s):
Conclusion(s): **Adult fish are not acutely effected or likely to be sucked into suction dredges.** Several studies all reported that invertebrates recolonized dredge sites within 30 to 45 days. Disturbed stream reaches were only a few tens of meters. For four studies reviewed, **impacts are local and of short duration** when certain limitations are placed on dredge activity. Water quality is impacted for a distance downstream range of a few meters to 30 meters. (emphisis added)
Notes: From Ames excerpts

(15.) Author(s): Oregon Dept. of Fish and Wildlife, 1980
Title: Recreational Mining Can Be Compatible with Other Resources
Source: Oregon Dept. of Fish and Wildlife, 1976 and revised 1980
Purpose: To educate dredgers to reduce negative effects
Method(s): A three page summary document, not a study in itself.
Conclusion(s): Very little turbidity results from normal use of smaller suction dredges (4-inch or less) in stream gravels. The majority of heavy suspended solids settles out within a few yards of the sluice box. Severe turbidity and resulting siltation occur when bank materials are washed into the stream. Harassment of adult fish and disturbance of eggs and fry occur when dredging takes place during the critical times of spawning and hatching. The greatest potential for damage is at low flow.

(16.) Author(s): Prussian, A.M., Royer, T.V., and Minshall, G.W., 1999
Title: Impact of suction dredging on water quality, benthic habitat, and biota in the Fortymile River, Ressurrection Creek, and Chatanika River, Alaska
Source: Dept. of Biological Sciences, Idaho State Univ., EPA Pocatello, Idaho
Purpose: To study impacts of dredging on water quality, benthic habitat, and biota
Method(s): Background sampling and sampling at dredge sites

Conclusion(s): The primary effect of suction dredging was increased turbidity, total filterable solids, and copper and zinc concentrations (from stream bed sediments) downstream from the dredge for about 150 meters. **These were larger dredges, 8 and 10 inches.** High flows redistribute dredge tailings after 1 to 3 years. Substantial recovery of invertebrates rather rapidly, and disturbance occurred only close downstream from the dredge. It appears that **impacts of small-scale dredging are primarily contained within the dredged area and immediately downstream and persist about one month after the mining season.** More study is needed to fully quantify dredging effects. (emphisis added)

(17.) Author(s): Shaw, P.A., and Maga, J.A., 1942

Title: The Effect of Mining Silt on Yield of Fry from Salmon Spawning Beds

Source: California Dept. of Fish and Game

Purpose: To show the extent of damage from mine tailings

Method(s): Compared yield of fry from salmon eggs from similar nests in areas with and without mining silt, using hatchery troughs. Silt and mud from mining holding ponds were mixed with water and introduced to some nests

Conclusion(s): Presence of silt during nonerosion periods results in bottom deposition which is damaging to fry production.

Notes: About historic mining, not dredging.

(18.) Author(s): Somer, W.L., and Hassler, T.J., 1992

Title: Effects of Suction-Dredge Gold Mining on Benthic Invertebrates in a Northern California Stream.

Source: Pub. In North American Journal of Fisheries Management 12:244-252; authors are U.S. Fish and Wildlife Service

Purpose: To investigate the effects on benthic invertebrates and habitat of two suction dredges

Method(s): use of artificial substrate samplers and drift samplers above and below dredges

Conclusion(s): **Adult fish are not acutely affected or likely to be sucked into dredges.** Young salmon and steelhead fed on insects dislodged by dredging. Changes to stream bed were major but localized, such as excavation to bedrock in a hole. Effects of dredging on insects varied with taxa and were site-specific. **Effects were not severe enough to cause differences** in mean numbers of invertebrates or in diversity indices. **Habitat changes were minor** compared to bed-load movement due to large stream flows during storms and from snowmelt that removed holes and flushed sediment from study site. **California regulations for dredge aperture size and season appeared adequate to protect fish and habitat at the level of dredging observed.** Cumulative effects of dredging, especially during low flow years, need to be assessed. Sediment went further downstream than other studies because of the steep stream gradient and fine sediment. (emphisis added)

(19.) Author(s): Stern, Gary R., 1988

Title: Effects of suction dredge mining on anadramous salmonid habitat in Canyon Creek, Trinity County, California

Source: M.S. thesis, Humboldt State University

Purpose:

Method(s):

Conclusion(s): Most streams with mobile beds and good annual flushing flows should be able to remove the instream pocket and pile creations of small suction dredges, although some regulated streams with controlled flows may not. Holes and piles in the center of the stream are usually gone after one winter. Piles along the bank may linger. This is similar to piles left by historic miners. In several studies, adult salmon have been observed to spend considerable time within yards of active dredges and to hold in dredged holes. **Dredge plumes, although visible, were probably of little direct consequence to fish and invertebrates. Maximum sediment concentrations were only a minute fraction of the great loads needed to impact fish feeding and respiration.** In contrast to Sigler et al, young steelhead in Canyon Creek sought out dredge plumes to feed on exposed invertebrates. (emphisis added)

Notes: From Ames excerpts

(20.) Author(s): Thomas, V.G., 1985

Title: Experimentally Determined Impacts of a Small Suction Gold Dredge on a Montana Stream

Source: North American Journal of Fisheries Management

Purpose: To determine dredging effects on aquatic insects and bottom habitat.

Method(s): A small suction dredge was operated with before and after observations, not for gold recovery.

Conclusion(s): Suspended sediment returned to ambient levels 30.5 meters downstream. Deposited sediment decreased exponentially downstream with distance from dredging. Impacts on aquatic insect abundance were limited to the area dredged. Pool habitat created at the dredge site may compensate for pool loss immediately downstream. Intergravel permeability at the site increased, although not significantly; no downstream changes in permeability were noted. **This study has found no violations to date to substantiate closure of the small-scale mining operations. Even with the absence of data, environmental groups were active to close down mining on the river citing unsubstantiated possible discharge violations.** (emphisis added)

(21.) Author(s): US Army Corps of Engineers

Title: Special Public Notice 94-10

Source: US Army Corps of Engineers, SPN 9410, Sept. 13, 1994

Purpose: To show the finding of de minimis (inconsequential) effects on aquatic resources for 4-inch and less suction dredges and hand mining.

Method(s): results of field studies and court decisions

Conclusion(s): **Four-inch and smaller dredges have inconsequential effects on aquatic resources.** ***"This is an official recognition of what suction dredgers have long claimed; that below a certain size, the effects of suction dredging are so small and so short-term as to not warrant the regulations being imposed in many cases. The U.S. Environmental Protection Agency (EPA), has ignored this concept, although numerous studies, including the EPA's own 1999 study of suction dredging, repeatedly and consistently support the Corps finding de minimis effects. The reports consistently find no actual impact of consequence on the environment, and so almost always fall back to the position that potential for impact exists. Studies to date have not shown any actual effect on the environment by suction dredging, except for those that are short-term and localized in nature."*** Suction dredges of larger than 4 inches generally have more than de minimis effects on the aquatic environment and therefore requires authorization. (emphisis added)

"The regulatory agencies should be consistently and continually challenged by the dredging community to produce sound, scientific evidence that support their proposed regulations. To regulate against a potential for harm, where none has been shown to exist, is unjustifiable and must be challenged." (emphisis added)

(22.) Author(s): US Dept. of Agriculture, 1997

Title: Suction Dredging in the National Forests

Source: US Dept. of Agriculture, 1997

Purpose: To make sure that dredging is done in a manner consistent with current law and good natural resource management

Method(s): an educational handout to the public

Conclusion(s): **When done properly, legal dredging must be allowed by law and effects are acceptable** (emphisis added)

(23.) Author(s): USGS, 1998

Title: Certain mining operations have not hurt pristine Alaskan River

Source: News Release, U.S. Dept. of the Interior, U.S. Geological Survey, USGS Fact Sheet-0155-97, Oct. 27, 1998

Notes: See Wanty et al, 1997

(24.) Author(s): Wanty, R.B., Wang, B., and Vohden, J., 1997

Title: Studies of suction dredge gold-placer mining operations along the Fortymile River, eastern Alaska

Source: USGS Fact Sheet 154-97

Purpose: To evaluate possible negative effects of dredging, such as increasing the load of toxic metals and turbidity and decreasing the number and diversity of aquatic biota

Method(s): Sampling of metals in rocks and stream bedloads of the watershed; sampling of turbidity and stream chemistry below dredge operations

Conclusion(s): **All measurements of dredge effects on turbidity and geochemistry turned out to be within the natural variation of the local environment.** See Prussian et al (1999) for other results. (emphisis added)

(25.) Author(s): Ward, H.B., 1938

Title: Placer Mining on the Rogue River, Oregon, in its Relation to the Fish and Fishing in that Stream.

Source: Oregon Dept. of Geology and Mineral Industries Bull. 10

Purpose: To determine the true facts as to… the effect of muddy (hydraulic) mine water on fish and fish life.

Method(s): Field observations, measurements of turbidity, etc., and tank studies of fish in turbid water.

Conclusion(s): **The essence of Dr. Ward's findings is that the placing of muddy water from placer operations in the Rogue River drainage is not inimical to fish and fish life.** The amount of colloidal fines in the Rogue River below placer mines is too small to adversely effect young fish eggs or fish food. Hydraulic placer mining debris is just more stream sand and gravel. It is typically chemically inert and does not take oxygen from the stream or add toxic agents to the water.

In Alaska, an exam of salmon in silty water due to mining found no damage to gills. **Young salmon suffered no ill effects from heavy sediment loads ten times that found at Agness from hydraulic mining.**

The tank tests at Reed College showed that **young fish live well up to thirty days in good water mixed with natural soil materials. The tests used sediment loads from two to three times as large as the extreme load contributed to the Rogue River by maximum conditions of hydraulic placer mining. The thin intermittent layer of placer mining gritty sediment (less than 1/8 inch) seen along Rogue River would not interfere with oxygen supply to fish eggs.**

Stream environments are typically dynamic and variable due to floods, natural inputs of sediment from landslides, and other sources, especially dams. Salmon and steelhead runs were established in past climates much rougher at times than today's, even with mining. That is, in the Ice Age precipitation, landslides and sediment loads were often much greater than today.

The fish runs did not decline during the first and greater episode of mining. This, it's likely that the lesser mining of the 1930's is not the reason for the decline in fish runs at that time. The main difference between the two times are the dams, industrial wastes, and agricultural withdrawals of the later period. (emphisis added)

(26.) Author(s): State of California Department of Fish and Game

Title: Draft Environmental Impact Report Adoption of Amended Regulations for Suction Dredge Mining, 1997

Source:

Purpose: To determine whether or not to amend the current state regulations governing suction dredging in California.

Method(s): EIS

Conclusion(s): "Based on best available date, it is anticipated that the regulations, as amended by the proposed project, will protect fish and other related aquatic dependent resources and will not cause significant effects to the environment or deleterious effects to fish." **The effects of suction dredging would appear to be less than significant and not deleterious to fish.** There is a need for additional study of CE and other items. (emphisis added)

(27.) Author(s): Harvey, B.C., Lisle, T.E., Vallier, T., and Fredley, D.C., September 29, 1995

Title: Effects of Suction Dredging on Streams: A Review and Evaluation Strategy

Source: Pursuant to a Charter by USFS, April 18, 1995

Purpose: to review conclusions of existing publications about effects and provide recommendations for future management processes.

Method(s): Review of existing publications

Conclusion(s): More study needs to be done, and management of dredging needs to be approached from a watershed (cumulative effects) level.

July 29, 2002
Josiah H. Cornell, III
P.O. Box 881
Grants Pass, OR
97528

ph: 541-476-5026

To whom it may concern;

This letter is a statement of my qualifications to comment about environmental controversies of the Pacific Northwest.

Education:

B.S. Geology, U. of Kentucky, 1967

M.S. Geology, U. of Oregon, 1971

Employment and Experience:

Engineering Technician, 1969-1973, seasonal,
USDA Forest Service in western Oregon.

Geologist, 1973 to 1994, (Retired, 1994)
USDA Forest Service in western Oregon.

Worked with foresters, engineers, hydrologists, soil scientists, biologists, and others on timber sales, mountain roads, bridge foundation studies, erosion control projects, burned area rehabilitation, and investigations, repair, and rehabilitation of landslides.

Served as geologist on interdisciplinary teams, wrote and helped write parts of environmental (NEPA) documents relating to geology, soils, water, and other environmental subjects. Investigated environmentalist complaints; reported findings of field investigations of environmentalist group complaints.

In retirement: Has continued studies of environmentalist science; has written numerous documents about environmental controversies and environmentalist group science to newspapers, elected officials, and others.

Sincerely,

Josiah Cornell