COMPILATION OF IMPORTANT SCIENTIFIC DOCUMENTS, BIBLIOGRAPHIES AND SUPPORTING DOCUMENTATION PERTAINING TO SMALL SCALE PROSPECTING AND MINING PRACTICES FOR

WDFW COMMISSION, INVOLVED STAKEHOLDERS, AND THE SMALL SCALE MINING COMMUNITY FOR THE RE-WRITE OF GOLD AND FISH PAMPHLET.

MAY 2007, MINERS COUNCIL.

Objective

"To create mineral prospecting and placer mining regulations which allow miners their full rights to use and access their entire mining claim in accordance with the 1872 mining laws, while incorporating reasonable and necessary precautions to protect fish and fish habitat."

Washington Miners Council

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17. LETTER, TO PAUL SCHLANGER, ANCHOR ENVIRONMENTAL, September 6, 2006. "MATERIALS FROM THE SMALL SCALE MINING COMMUNITY, HCP/GOLD AND FISH PAMPHLET RELATED." **180-181**

Bruce Beatty Washington Miner's Council May 18, 2007.

Small Scale Mineral Prospecting and Placer Mining

Power Point Presentation to EPA

Scientific Documentation

EPA Website Removal and Documentation

June 2006

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Thesis: Presented to Humbolt State University, California.
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Scour of Chinook Salmon Redds on Suction Dredge Tailings.
U.S. Forest Service, Pacific Southwest Research Station.
Where natural substrate is in short supply, a large proportion of redds may be located on dredge tailings.

How Suspended Organic Sediment Affects Turbidity and Fish Feeding Behavior.
USGS, Coastal Science and Research News.
Efficiency of fish feeding is affected by turbidity but that limited feeding goes on even at moderate turbidities.

Excerpts From Suction Dredge Studies.
AMDA, Alaska Mining & Supply.
The quotes listed in this document were taken word for word out of the documents written by the scholars named above each quote.

RE: EPA Website: "Aquatic Biodiversity – Placer Mining".
Waldo Mining District, Oregon.
EPA Web Page made materially false, fraudulent and biased statements that misrepresented the suction dredge type of placer mining currently occurring in streams and rivers.

Small-Scale Suction Dredging and the Environment.
Power Point Presentation to EPA, 2006.
Suction dredging is de minimus and impacts from these dredges are less than significant.

Experimentally Determined Impacts of a Small, Suction Gold Dredge on a Montana Stream.
Department of Zoology, University of Montana.
Gold dredging did not have any impact on the quantity of benthic insects in the downstream area in this study.

Effects of Suction Gold Dredging on Fish and Invertebrates in Two California Streams.
Department of Wildlife and Fisheries Biology, University of California, Davis.
Numerical recovery of insects at dredged sites was rapid.

Effects of Angler Wading on Survival of Trout Eggs and Pre-emergent Fry.
U.S. Fish and Wildlife Service, Montana State University.
A single wading just before hatching killed up to 43% and twice daily up to 96% of eggs and pre-emergent fry.

Effects of Suction-Dredge Gold Mining on Benthic Invertebrates in a Northern California Stream.
U.S. Fish and Wildlife Service, Humbolt State University, California.
The effects of dredging on insects and habitat were minor compared with those of bed-load movement due to large streamflows during storms and from snowmelt.

A Review of the Regulations and Literature Regarding the Environmental impacts of Suction Gold Dredges.
U.S. Environmental Protection Agency, Region 10, Alaska Operations Office.
Water quality was typically temporarily and spatially restricted to the time and immediate vicinity of the dredge.

Sediment in Streams; Sources, Biological Effects and Control.
Department of Fisheries and Wildlife, University of Minnesota.
Reductions in fry density were linearly related to the degree of cobble embeddedness.

Studies of Suction Dredge Gold-Placer Mining Operations Along the Fortymile River, Eastern Alaska.
U.S. Department of Interior, USGS.
There is no appreciable difference in the distribution of turbidity values between mined and unmined areas. (8"-10" dredge turbidity study).

Effects of Suction Dredging on Streams: a Review and an Evaluation Strategy.
U.S. forest Service, Pacific Southwest Research Station,
Dredging may loosen and locally flush fine sediment from static streambeds, with little danger of redds being disturbed during egg incubation.

AMDA, Alaska Mining and Diving Supply
Excerpts from suction dredge studies. Some of these studies were done on 50+ cubic yard placer mining operations.

Waldo Mining District
A response by WMD to EPA website correctness challenge. Wayne S. Davis, Office of Environmental Information, Analysis and Access, Environmental Analysis Division, Environmental Science Center, Maryland, USA. Asked for documentation. This entry has extensive reviews of scientific studies involving small-scale suction dredging. "Reasonable Science Does Not Support EPA".

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Small-scale Suction Dredging and the Environment

Presented by Joseph C. Green, Research Biologist and Retired EPA Employee to EPA March 9, 2006, Salem Oregon.

"To regulate against a potential for harm, where none has been shown to exist, is unjustifiable and must be challenged." (U.S. Army Corps of Engineers.)

Scour of Chinook Salmon Redds on Suction Dredge Tailings.

Bret C. Harvey and Thomas E. Lisle, U.S. Forest Service, Pacific Southwest Research Station, 1999.

"If natural spawning sites were relatively abundant, tailings were not strongly selected, a small fraction of redds would be located. However, where natural spawning substrate is in short supply a large proportion of redds may be located on dredge tailings."
"Mackay (1992) and Boulton (1991), Stevenson (1991), Stevenson and Peterson (1991) noted that small patches of new or disturbed substrate in streams were re-colonized."
"Minshall (1983) said that even after large-scale disturbances, invertebrates could recover even in areas of widespread dredging."
"Harvey and Thomas and Lisle (1998), Deep scour may intersect sub-surface flow and create pockets of cool water during summer. Nielsen (1994) increased water depth can provide refuge from predatory
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Harvey and Stewart (1986) a single dredge operation cannot mobilize significant volume of fine sediment compared to the

Harvey and Lisle, 1999, contd.

volume mobilized during high seasonal discharges when erosional sources deliver fine sediment from the watershed and wide spread areas of the streambed are entrained."

Studies of Suction Dredge Gold-Placer Mining Operations Along the Fortymile River, Eastern Alaska.

USGS, Coastal Science & Research News.

8"-10" dredges failed to reach turbidity levels of more than 5 NTUs at 500 feet behind the dredge, therefore, complied with Alaska State Regulations.

"Therefore, suction dredging appears to have no measurable effect on the chemistry of the Fortymile River within this study area."

RE: EPA Website: "Aquatic Biodiversity—Placer Mining."

Tom Kitchar, President, Waldo Mining District, Cave Junction, Oregon, April 3, 2006.

Letter to Wayne S. Davis, Office of Environmental Information, EPA, Ft Meade, Maryland. And, an E-mail from Mr. Davis asking, "If the EPA Website is incorrect, please provide documentation to support your point. Thank you for taking time to Contact me." Following the E-mail from Mr. Davis is a copy of the EPA Website content of 'Placer Mining'.
The following pages, 1-10, by Tom Kitchar is the supporting documentation sent to Mr. Davis. Many of the compiled research studies encountered in this notebook are referred to by Mr. Kitchar of the Waldo Mining District.
NOTE: THE PETITION AND DOCUMENTATION WAS RECEIVED BY MR. DAVIS AND WITHIN 24 HOURS THE WEBSITE WAS DELETED. MANY U.S. CONGRESSIONAL

COMMITTIES HAVING OVERSIGHT OF THE EPA ALSO RECEIVED THE PETITION AND DOCUMENTATION, AND, BECAUSE THIS IS SUCH A RECENT ACTION, CONGRESSIONAL RE-ACTION IS STILL PENDING.

How Suspended Organic Sediment Affects Turbidity And Fish Feeding.

Mary Ann Madej, USGS, Coastal Science and Research News, November 2004.

"Although the efficiency of prey capture decreased at higher turbidities, limited fish feeding activity was still observed at the highest turbidity (45 NTU) in which underwater observations were made. These observations are important because many previous studies have assumed that 30 NTU is a turbidity threshold above which fish cannot feed."

"Our field studies show that the efficiency of fish feeding is affected but that limited feeding goes on even at the moderate turbidities."

Studies of Suction Dredge Gold-Placer Mining Operations Along the Fortymile River, Eastern Alaska.

USGS, Coastal Science & Research News.

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Experimentally Determined Impacts of a Small, Suction Gold Dredge on a Montana Stream.

Virginia G. Thomas, Department of Zoology
University of Montana, 1985.

"Substrate moved per hour is about 2% of manufactured maximum rating.'
" Re-colonization of invertebrates substantially re-colonized in 38 days."
"Small and larger brook trout survived entrainment."
"Hardened eyed cutthroat trout and rainbow trout eggs survived passage through the dredge."
"Eyed and chinook salmon were even more resistant, and there was complete survival of free swimming fry."

Excerpts from Suction Dredge Studies.

AMDS, Alaska Mining and Diving Supply. Published by the Washington Alliance of Miners and Prospectors, with Additions by Steve Herschbach of Alaska Mining and Diving Supply.

"This compilation of suction dredge studies exerpts, includes a biography of Henry Baldwin Ward reprinted from 'The Dictionary of American Biography'. Henry Ward was a zoologist and parasitologis prior to the turn of the twentieth century and worked and held multipl positions and was a recipient of many honors until 1945. He was deep concerned with national problems of wildlife conservation and the pollution of streams"

Effects of Suction Gold Dredging on Fish And Invertebrates in Two California Streams.

Bret C. Harvey, Department of Wildlife and Fisheries Biology, University of California, Davis. 1986.

"Turbidity associated with dredging in mid day, which is not a peak feeding period for Sierra foothill fishes."
"Three out of six fish moved to a downstream riffle when dredging added sand that reduced volume of a pool by 25%, after sand was flushed out by a temporary high flow, two of the three fish returned to the pool. In contrast, during low flows, in the summer all eight fish returned to the dredged pool."
"Insect re-colonization took place in sand and gravel by day 45 (September). Insects in the re-colonized area was not significantly different from the pooled average of the control stations for October."

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Effects of Suction Dredging On Streams: a Review and an Evaluation Strategy.

Bret C. Harvey and Thomas E. Lisle, U.S. Forest Service, Pacific Southwest Research Station, 1998.

"Juvenile Chinook salmon spend more time foraging in water of "moderate turbidity (20-25 NTUs) than in clear water because of decreased risk to predation. Same with Brook trout and juvenile estuarine fishes. Also, Coho Salmon do not avoid turbidities as high as 70 NTUs. Lethal concentrations of suspended sediment are probably rarely produced by a suction dredge."

Effects of Suction Dredge Mining on Anadromous Salmonid Habitat in Canyon Creek, Trinity County, California.

Gary R. Stern, A Thesis presented to the Faculty of Humboldt State University. 1988.

"NTU values at 50m below the dredge were 2-3 Xs the control values, while values 100m below the dredge were equal to the control value."

"Young steelhead in Canyon Creek sought out dredge turbidity plumes to feed upon dislodged invertebrates even though clear water was available nearby."

"Dredge plumes were probably of little direct consequence to fish and invertebrates."

"A stream flow of 24cms effectively obliterated in-stream mining disturbances from previous year."

"High winter flows fill in dredge holes, disperse tailing piles, moved silts and sediments for channel maintenance and also forming and reforming bars and riffles and obliterating most dredge holes and tailing piles."

Stern, 1988, contd.

"Wild flow streams vs controlled stream flows—regulated streams with controlled flows may not remove the in-stream pocket and pile creations of small-scale dredges."

"New pools hold fish, not only in abandoned but in active dredge holes."

"Lewis (1962) (first study) Aquatic habitat of fish and benthic invertebrates was improved by dredging for both fish eggs and benthos."

"Only 8% of 29 holes remained visible following the dredge season."

"On the Trinity River, Chinook Salmon spawned into dredge tailing piles. Idaho streams held steelhead in gravels recently disturbed by human activities. American River (Prokopovich and Nitzberg, 1982) held present channel gravels and salmon gravels mostly originated from old placer (large scale) mining operations."

"Fish are not disturbed by dredging. No relation between holding areas of summer-run fish and suction dredge mining operations."

"Lewis (1962) and Thomas (1985) reported increased intergravel permeability of dredged areas. Thomas also found no significant change below dredge areas."

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

William L. Somer and Thomas J. Hassler, U.S. Fish and Wildlife Service, California Cooperative Research Unit, Humboldt State University, 1992.

"Same amount of invertebrates in the dredged and un-dredged areas after one month."

"Invertebrates re-colonize within one month, only 1% mortality when entrained."

"Holes and tailings are not visible the following summer, also Prokovich and Netzberg (1982) gravels from dredging provided good spawning habitat in American River, California, Thomas (1985)."

"Harvey (1986), At or above 50 NTUs caused by suction dredging-observed NO deleterious effects on Salmonid feeding and Brunson an Rose reported no effect of suspended sediments on feeding torrent sculpins."

Effects of Angler Wading on Survival of Trout Eggs and Pre-emergent Fry.

Bruce C. Roberts and Robert G. White, U.S. Fish and Wildlife Service, Montana Cooperative Fishery Research Unit, Montana State University, 1992.

"Twice daily wading.....killed 83% of eggs of cutthroat and 89% of brown trout, and 96% of rainbow trout."
"Before water hardening, most vulnerable to mortality by wading.
"After" hardening – few eggs are crushed by human wading."

Scour of Chinook Salmon Redds on Suction Dredge Tailings.

Bret C. Harvey and Thomas E. Lisle, U.S. Forest Service, Pacific Southwest Research Station, 1999.

"If natural spawning sites were relatively abundant, tailings were not strongly selected, a small fraction of redds would be located. However, where natural spawning substrate is in short supply a large proportion of redds may be located on dredge tailings."
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Harvey and Lisle, 1999, contd.

volume mobilized during high seasonal discharges when erosional sources deliver fine sediment from the watershed and wide spread areas of the streambed are entrained."

Sediment in Streams; Sources, Biological, and Control.

Thomas F. Waters, Department of Fisheries and Wildlife, University of Minnesota, 1995.

"Burner (1951) noted that fish avoid gravels that were tightly cemented with silt and clay—all successful redds had less that 10% mud, silt and sand."

"Juvenile fish need roughness elements for winter protection against predators, for foraging territories and water depth as this constitutes rearing habitat."

"Bjorn (1971) said reductions in fry density were linearly related to th degree of cobble embeddedness."

"Bustard and Narver (1975) Cutthroat trout preferred clean rubble. Sedimented substrates reduced winter survival of juvenile cutthroat. Experimental additions of clean rubble resulted in fivefold increases o winter density of fry."

Waters, 1995, contd.

"Waters (1995) {Wallen 1951} 16 species of fish were found to be litt affected by turbidity concentrations below 100,000 PPM, fish death occurred around 200,000 PPM."
Waters (1995) Clear Water River, Washington, Cederholm and Reid (1981) juvenile fish (coho) preferentially avoid high suspended sediment concentrations in silty streams, seems fish have evolved behavioral and physiological adaptations to survive short term elevate conditions by natural spates and floods."

Small Scale Mineral Prospecting and Placer Mining

Scientific Documentation

Federal and State Regulatory Agency Statements

Permitting Requirements

June, 2006

Scientific Evidence from Greg's Desk:

Gold Miners Called to Rescue Precious Salmon
March 12, 2004
Eric Robinson, Columbian Staff Writer
Local Gold Prospectors save salmon nests by removing sand. Near Portland.

DIER Suction Dredge Activities, Siskiyou National Forest
December 2001
Socioeconomic: contributions dredgers make to local economies.
$20 million

California EPA, Mercury Collection with Recreational Miners net over 200 lbs of mercury. (Note: I have not been able to find this on line. Still looking)

Letter of appreciation from Mark Peterschmidt (DOE) to the NW Miners Rally
Sept. 1, 2005
Collecting 31 lbs of mercury.

Effects of Small-Scale Gold Dredging on the Similkameen River
WA. State Dept. of Ecology (DOE)
March 2005
http://www.icmj2.com/RecentNews/WADredgeStudy.pdf
Determination the Small-scale dredging does not have a significant impact on the river.

Summary of Rules and Regulations for Mineral Prospecting in Washington State
By Tracy Lloyd
Nov. 12, 2003, 1-20-04 and 3-15-04
WDFW Employee's suggestions to recommendations by miners.

Washington State Mercury Chemical Action Plan
Wa. State Dept. of Ecology, Wa. State Dept. of Healty
August 2002
Participation of the Small-scale mining community in mercury education and collection.

Corps of Engineers propose restoration of Nashawannuck Pond in Easthampton
Nov. 6, 2003
Release No. MA. 2003-124 Tim Dugan Concord, Massachussets
Restoration of aquatic habitat by using a hydraulic dredge to pump dredged material 1 1/8 miles from the pond.

Stream Sweeper could be future of stream restoration.
West Michigan Trout Unlimited Sept 11, 1999
Bob Gwizdz
Baldwin, Michigan
Using a suction dredge to remove sand to upland sites, allowing the water to drain back into the river.

A bibliography, which I hope Bruce has, that lists over 600 studies on aquatic activities.

8 Pages in an e-mail from Bruce that list supplemental bibliography supporting basic science in regards to small-scale mining.

Draft response of fish to cumulative effects of suction dredge and hydraulic mining in the Illinois subbasin, Siskiyou National Forest, Oregon. Peter B. Bailey, Dept. of Fish and Wildlife, Oregon State University.
Dredging Impact is less than significant.
(Unknown year)

Konopack Project No. 064-0
Prepared by Konopacky Environmental, Meridian, Idaho
July 9, 1996
No published or unpublished documentation of any mortality of trout embryos or pre-emergent fry in natural stream systems from the REGULATED use of a suction dredge.
NOTE: A very comprehensive report that could stand alone in defense of the small-scale mining community!

Suction Dredging EIS - Clearwater National Forest, Idaho.
USDA
April 4, 2003 (Volume 68, Number 65)
Full report on 29 dredging operations. (Good and bad)

Effects of Suctin Dredging on Streams: A review and an Evaluation Strategy
Bret C. Harvey and Thomas E. Lisle
Fisheries Habitat Volume 23, No. 8 August 1998.
Includes (at least) 75 bibliographies/references on fish habitat.
Poses more questions than answers. Generally takes a cautious approach to regulation and associated dredging activities.

10 pages of bibliographies of the effects of suction dredging. Some listed above, some new. By Josiah Cornell
April 15, 2001
One of the best compilations for our usage.

Effects of Suction Dredging, A summary of Dredging Publications
Joe Cornell
April 16, 2001
One of the best compilations for our usage.

Summary of Conclusions
Joe Cornell
April 16, 2001
One of the best compilations for our usage.

Page of Joe Cornell's qualifications.....

Charactistics of Pools Used by Adult Summer Steelhead Oversummering in the New River, CA.
Rodney J. Nakamoto Summer, 1991
Unknown usefulness.

5 pages of references on placer mining/suction dredging on fish, aquatic invertebrates and habitat. (75 different reports) For the Red River District.

EPA Suction Dredge Study - 1999
US EPA Region 10
Impact of suction dredging on water quality, benthic habitatm and biota in the fortymile river, resurrection creek and chatanika river, Alaska.
Impacts from suction dredge activities are localized and temporary.

USDA Forest Service
Comparison of stream materials moved by mining suction dredge operations to the natural sediment yield rates.
October 16, 1995
331,000 cubic yards of material move each year from natural causes compared to 2413 cubic yards that was moved by suction dredge mining operations in 1995 on the Siskiyou.

Section 404 of the Clean Water Act.
Army Corps of Engineering
September 13, 1994
Special Public Notice 94-10
Finding that the effects on aquatic resources for cuction dredges with nozzel openings of 4" or less is de minimus (inconsequential).

Washington Law:
RCW 77.85.150
Statewide salmon recovery strategy — Prospective application.

Bibliography

United States District Court, District of Columbia, AMERICAN MINING CONGRESS, et al., Plaintiffs, v. UNITED STATES ARMY CORPS OF ENGINEERS, et al., Defendants, and National Wildlife Federation, et al., Defendant-Intervenors, Civil Action No. 93-1754 SSH, Jan. 23, 1997.

US vs. Lex and Waggener, US District Court, E.D. California, No. CR S-01-559 LKK, May 14, 2003.

US vs. McClure, US District Court, E.D. California, Case No. F2092617, February 2, 2005

USC §440.140; Applicability; description of the gold placer mine subcategory.(a) The provisions of this subpart M are applicable to discharges from --(1) Mines and dredges that produce gold or gold bearing ores from placer deposits; and(2) The beneficiation processes which use gravity separation methods for recovering gold from placer deposits.(b) The provisions of this subpart M are not applicable to any mines or beneficiation processes which process less than 1500 cubic yards (cu yd) of ore per year, or to dredges which process less than 50,000 cu yd of ore per year, or to dredges located in open waters (i.e., open bays, marine waters, or major rivers)

30 U.S.C. § 22. The Supreme Court has stated that the Congressional intent underlying this section is to reward and encourage the discovery of economically valuable minerals located on public lands. United States v. Coleman, 390 U.S. 599, 602, 88 S.Ct. 1327, 20 L.Ed.2d 170 (1968). Congress has further provided that the "locators" of mineral deposits on federal lands under § 22 shall have the exclusive right to extract those minerals if they comply with federal law and state and local laws that do not conflict with federal law. See 30 U.S.C. § 26. The Mining Act establishes a system whereby a prospector can "go out into the public domain, search for minerals and upon discovery establish a claim to the lands upon which the discovery was made." United States v. Curtis Nevada Mines, Inc., 611 F.2d 1277, 1281 (9th Cir.1980).

Thus, as shown in the text and structure of the statute, Congress has set out several purposes and objectives in the Mining Act. These include the encouragement of exploration for and mining of valuable minerals located on federal lands, providing federal regulation of mining to protect the physical environment while allowing the efficient and economical extraction and use of minerals, and allowing state and local regulation of mining so long as such regulation is consistent with federal mining law.

1. Incidental Fallback Is Not the "Addition of a Pollutant"

This understanding of "discharge" excludes the small-volume incidental discharge that accompanies excavation and landclearing activities. Senator Muskie explained that "the bill tries to free from the threat of regulation those kinds of manmade activities which are sufficiently de minimis as to merit general attention at the State and local level and little or no attention at the

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This understanding of "discharge" excludes the small-volume incidental discharge that accompanies excavation and landclearing activities. Senator Muskie explained that "the bill tries to free from the threat of regulation those kinds of manmade activities which are sufficiently de minimis as to merit general attention at the State and local level and little or no attention at the

State and local level and little or no attention at the national level." Senate Report on S. 1952, 95th Cong., reprinted in 1977 Legis.Hist. at 645.

In United States v. Lambert, 18 Env't Rep.Cas. (BNA) 1294, 1981 WL 14886 (M.D.Fla.1981), aff'd, 695 F.2d 536 (11th Cir.1983), the court stated that back-spill from excavation "does not ... constitute the discharge of a pollutant [under the Act], when the dredged spoil simply falls back into the area from which it has just been taken. Such an event cannot reasonably be considered to be the addition of a pollutant." [FN16]

Statements made during the debates confirm that Congress intended for the agencies to regulate discharges, but not the dredging per se. See, e.g., Senate Debate on S. 2770, 92d Cong., reprinted in 1972 Leg.Hist. at 1388 (statement of Senator Muskie).

The legislative history suggests that Congress did not intend to leave much discretion to the agencies. In Senate debate on the conference report, Senator Randolph stated:
Congress has become very specific on the steps it wants taken with regard to environmental protection. We have written into law precise standards and definite guidelines on how the environment should be protected. We have done more than just provide broad directives for administrators to follow.

'Effects of Recreational Suction Dredge Operations on Fish and Fish Habitat: A literature Review in Association with a Petition of the Idaho Gold Prospectors Association to the Idaho land Board.'
Final Report – 1996 Konopacky Project No. 064-0 Konopacky Environmental
Meridian, Idaho 83642-6238

1999 EPA Study - Impact of suction dredging on water quality, benthic habitat, and biota in the Fortymile River, Resurrection Creek, and Chatanika River, Alaska

1998 USGS Press Release on Suction Dredging on the Fortymile River, Alaska

1997 USGS Studies of Suction Dredge Gold-Placer Mining Operations Along the Fortymile River, Eastern Alaska

1995 Siskiyou National Forest Estimate of Yardage Moved by Suction Dredging

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A comparison of stream materials moved by mining suction dredge operations to the natural sediment yield rates.
USDA Forest Service
Estimated 331,000 cubic yards from natural causes vs. 2413 yards from suction dredging.

Certain mining operations have not hurt pristine Alaskan river.
US Dept. of the Interior
The 'Fortymile River' has not been adversely impacted by gold placer mining operations according to an integrated study underway by the USGS and Alaska Dept. of Natural Resources.

Impact of Suction Dredging on Water Quality, Benthic Habitat, and Biota in the Fortymile River, Ressurection Creek, and the Chatanika River, Alaska
US EPA

Socioeconomics of suction dredging
Draft Environmental Impact Statement on Suction Dredging Activities
USDS, Siskiyou National Forest
December 2001
California suction dredge activities contribute to local economies, particularly in small towns located in popular suction dredging areas. A survey indicated that more than 20 million dollars may be spent on living expenses.

Alaska Department of Natural Resources
Considers a suction dredge operation recreational if the dredge has an intake diameter of six (6) inches or less, powered by an 18 horsepower or less engine.

Army Corps of Engineering.
SPN 9410
Application to the 'excavation rule' for recreational placer mining activities.
Recreational placer mining using suction dredges and hand mining (pick and shovel, panning, etc.) activities in light of the new "excavation rule" and has determined that recreational suction dredge mining using an intake nozzle size equal to or less than 4 inches and hand mining in waters of the United States would have de minimus effects on the aquatic environment.

Effects of Recreational Suction Dredge Operations on Fish and Fish Habitat.

Konopacky Environmental

Final Report - 1996

Project No. 064-0

"The effects of REGULATED suction dredge mining are insignificant"

Summary of Dredging Publications
Effects of Suction Dredging
Summary of Conclusions

Josiah H. Cornell, III
P.O. Box 881
Grants Pass, OR.

"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"

Small Scale Mineral Prospecting and Placer Mining in Washington State

Washington Miners Council

S Y N O P S I S

of

Washington State Department of Ecology; "EFFECTS OF SMALL-SCALE DREDGING ON ARSENIC, COPPER, LEAD AND ZINC CONCENTARTIONS IN THE SIMILKAMEEN RIVER, OROVILLE, WASHINGTON".

March 2005.

Publication No. 05-03-007

A B S T R A C T:
A field study was conducted to determine if arsenic, lead, copper, or zinc within dredge effluents (analyzed from 14 sites on the river) and discharge plumes. Data were also obtained on ambient metals concentrations, total suspended solids, and turbidity. Results showed that the metals concentrations discharged from small-scale gold dredges are not a significant toxicity concern for aquatic life in the Similkameen River. Although this activity will exacerbate exceedances of arsenic human health criteria, it would take very large numbers of dredges to effect a 10% change in the river's arsenic levels, even at low –flow conditions.

P R O J E C T D E S C R I P T I O N:

Samples for the gold dredge study were collected on June 30 – July 1, August 18 – 19, and September 21 -22, 2004. Monthly average river flow during this period ranges from 3,029 cfs (July) to 616 cfs (September). The second set was collected during a Resources Coalition dredge rally held in Oroville, Wa. on August 18 – 22, an event designed to generate interest and improve understanding of small-scale gold dredging.
A single sample was collected from each dredge (14) at the point the discharge left the sluice box. Three samples from three dredges were collected at 10, 50, and 200 feet below the dredge, staggered over approximately a 30 minute period. The furthest downstream sample was based upon the Gold and Fish pamphlet (WDFW) requirement that dredges be separated by 200.

D R E D G E P L U M E S:

Turbidity plumes were sampled, one each at sites #1, #10, #12. See table 8.

C O M P A R I S O N W I T H W A T E R Q U A L I T Y C R I T E R I A:

Based upon analyzing14 effluents and 27 plume samples, it appears that small-scale gold dredges have little or no potential to cause exceedances of aquatic life criteria in the Similkameen River. Arsenic and zinc concentration in dredge related samples were one to two orders of magnitude lower than criteria. Copper and lead concentrations were at or below criteria, except for one or two effluent samples that slightly exceeded (sites #4, #5, and #7).

EFFECT OF MULTIPLE DREDGES:

During average September flows, it is estimated that somewhere between 17 and 57 dredges operating continuously would be required to increase dissolved zinc, lead, and copper concentrations in the Similkameen River by 10%. It would take between approximately 20 to 500 dredges to have the same effect on total recoverable and dissolved arsenic, respectively. In order for zinc, lead, or copper concentrations to be doubled in the river, any where from 170 to 570 dredges would need to be operating. Arsenic concentrations in the dredge effluents are too low to cause an increase of that magnitude regardless of river flow.

At the 7-day, 10-year low flow in the Similkameen, relatively few dredges could effect a 10% change in copper, lead, and zinc concentrations. It would take 50 or more continuously operating dredges to double concentrations of these metals.

As demonstrated elsewhere in this report, a 100% increase in the ambient arsenic, copper, lead, or zinc concentrations in the Similkameen River would not result in exceedances of aquatic life criteria.

CONCLUSIONS:

RESULTS OF THIS STUDY SHOW THAT THE CONCENTRATIONS OF ARSENIC, COPPER, LEAD AND ZINC DISCHARGED FROM SMALL-SCALE GOLD DREDGES OPERATING IN THE SIMILKAMEEN RIVER ARE NOT A SIGNIFICANT TOXICITY CONCERN FOR AQUATIC LIFE. ALTHOUGH THIS ACTIVITY WILL EXACCERBATE THE EXCEEDANCES OF THE ARSENIC HUMAN HEALTH CRITERIA 'THAT ALREADY OCCUR', IT WOULD TAKE LARGE NUMBERS OF DREDGES TO EFFECT A 10% CHANGE IN THE RIVER'S ARSENIC LEVELS, EVEN AT LOW-FLOW CONDITIONS.

I certify that the above synopsis is an accurate extraction of the information contained in the study. It is not a complete and exact quote but the figures that are represented above are true and accurate from the study itself.

Bruce Beatty
4602 Alameda Ave. West, University Place, Wa. 98466
253-564-0954, Fax 253-564-1674.

See attached map, Table 8, Table 11, and Appendix C.

Response of fish to cumulative effects of suction dredge and hydraulic mining in the Illinois subbasin, Siskiyou National Forest, Oregon*

Peter B. Bayley

Dept. Fisheries & Wildlife,
Oregon State University
104 Nash Hall, Corvallis OR 97330
peter.bayley@orst.edu

April, 2003

* Final report from a study, Cumulative effects of mining activities on the Siskiyou National Forest, based on a Cost-Reimbursable agreement between the USDA Forest Service, Siskiyou National Forest and Oregon State University under the provisions of the National Agricultural Research, Extension and Teaching Policy Act of 1977 (Pub.L. 95-113), as amended by the Food Security Act of 1985 (7 U.S.C., 3319a Pub. L. 99-198).

Contents

"Truth, like gold, is to be obtained not by its growth, but by washing away from it all that is not gold."

- Leo Tolstoy

Abstract:

Potential cumulative effects of suction dredge mining (SDM) was assessed in combination with early hydraulic mining and other independent variables reflecting land-uses on fish in the Illinois subbasin. Fish response data were from 59 reaches sampled by summer snorkeling under the SMART program. Responses utilized were pool densities of salmonids over one year old, of young-of-the-year salmonids, and a stream habitat measure, width-to-depth ratio. Intensity of suction dredge mining was estimated from a directed survey that censused the quantity of sediment proposed to be moved per unit stream length in each 640-acre Section. The potential cumulative effect for each explanatory variable was estimated by summing the inverse distance of each corresponding pixel in each drainage defined by the location of each fish sample. Cumulative SDM was found to be non-significant (tested at P=0.05, with significance of coefficient always >0.5) for each of the three response variables tested in a general linear model. However, early hydraulic mining was found to have a significant negative effect (P=0.03) on observed density of salmonids over one year old.

1. Introduction

The activities of suction dredge mining (SDM) in streams of the Siskiyou National Forest have attracted the attention of environmental organizations, many of whom oppose such activity in the Forest, particularly in the Kalmiopsis Wilderness. This opposition has been met with similarly well-organized miners who wish to retain their claims. The U.S. Forest Service has responded with a set of guidelines for miners to minimize environment effects of their activities, and an EIS has been prepared.

The ingredient that is lacking in this process is scientific information and analysis that accounts for suction dredge mining and other potential confounding effects on stream biota, including early hydraulic mining (HM). This report describes a first analysis of existing, recent data which accounts for cumulative effects of suction dredge mining, early hydraulic mining, and other activities as reflected by land-use on measures of fish populations and habitat in the Illinois subbasin (Fig. 1).

1.1 Acknowledgements

The following colleagues are thanked for their help during this project: John Bolte, Randall Frick, Steve Jacobs, Kevin Johnson, John Nolan, Tom Atzet, Bonnie Howell, Karen Honeycutt, Edmund Hall, Margaret McHugh, Dan Delany, Roger Mendenhall.

1.2 Background

Suction dredge mining (SDM) involves pumping streambed material via a pipe, passing it over a sluice box to sort out any gold, and discarding the tailings downstream (Fig. 1).

There have been several studies on local effects on stream biota of SDM that have been reviewed from scientific (Harvey and Lisle 1998) and policy (Bernell et al. 2003) points of view. Rather than repeat the details of these excellent reviews, I summarize here the key issues as they may pertain to the area of study.

There have been several localized effects of SDM documented depending on where and at what time of the year it is carried out. These have included entrainment and subsequent mortality of fish larvae, fish eggs, or invertebrates and the use of unstable tailings for spawning by some salmonids (Harvey and Lisle 1998). There are potential effects due to a plume of suspended fine sediment downstream that does not normally occur during summer flows, due to the physical disturbance of riparian habitat or stream banks, effects due to site access by vehicles, and to the inevitable spills of fuel or oil. Harvey and Lisle (1998) opine that "effects of dredging commonly appear to be minor and local", but stress that cumulative effects of several operations at larger scales have not been investigated. This is one reason this study has been undertaken.

In a comprehensive policy review of recreational placer mining in Oregon Scenic Waterways, Bernell et al. (2003) deduce from the literature, stakeholders, and government agencies that the most effective control to prevent potential effects of poor mining practice is self-control, which requires more investment in education and compliance.

Because most SDM activity (e.g., Fig. 1) in the Rogue basin and the Siskiyou National Forest was concentrated in the Illinois River drainage, the study described here was limited to the drainage of that subbasin (Fig. 2).

2. Approach

Designing and executing a study specifically for this purpose would not only require fish sampling during several years, but also a parallel labor-intensive process of tracking and measuring current mining activities in an extensive and challenging landscape. Existing mining claims provide an unreliable measure of potential impact because most claims are not active during any one season, and those that are vary considerably in mining intensity. Therefore, a study based on a new sampling design was beyond the resources available and would not be timely for required management decisions.

Fortunately, two factors coincided to make this study possible. First, a survey of SDM was completed in 1999 (Kevin L. Johnson, Area Mining Geologist, USFS, Grants Pass, OR) that included a measure of the intensity of mining as quantity of sediment moved. Secondly, independent fish survey data were available from the SMART program of USFS (USFS 2001), and ODFW salmon spawning survey data (provided by Steven Jacobs, ODFW Hwy 34 lab., Corvallis, pers. comm.) described in www.streamnet.org.

However, merely combining fish and suction dredge mining data sets alone would not provide sufficient information for a valid analysis, because the study was observational rather than a fully controlled experiment (Diamond 1986). In order to account for any significant influence of other differences among riverscapes and avoid potential confounding with any SDM effects, other 'nuisance' variables were required to represent those potential effects.

Rationales for determining the response and potential effects for the derivation of explanatory variables are described below.

3. Methods: Response variables

For the purposes of this study, a response variable representing fish or fish habitat in a stream needs to (1) be sensitive to habitat change that includes potential effects of SDM, (2) have a sufficient range of values, (3) not be dominated by zero values to prove statistically intractable, (4) be measurable with consistent bias among sample sites, (5) be from a survey with independent and random - or at least representative - samples of consistent protocol, and (6) be from samples that are independent.

A fish habitat variable was used that satisfied the relevant conditions. Regarding fish responses and (4), all fish sampling methods are biased, but the important issue here is that the protocol and sampling conditions beyond the protocol do not produce a variable bias that may be related to the potential causal effects being tested. Two existing surveys satisfied the foregoing conditions:

3.1 ODFW Spawning anadromous salmonid surveys:

In a given stream and year, replicate counts of visible spawning or spawned anadromous salmonids are made by trained personnel during the spawning season, producing "Adult Return-Peak" and "Adult Return-Estimates of Spawning Population" estimates by species, stream reach and year. The "Adult Return-Estimates of Spawning Population" estimates are made by an integration of all counts during the season ('area-under-the-curve' method, English et al. 1992)) over a defined length of stream. These spawning population totals, estimated by ODFW, were expressed as number of adults on a per-stream-kilometer basis for coho salmon, chinook salmon, and all anadromous species combined (that also includes some steelhead).

Data from 1995 through 2000 were obtained from 53 sites (stream reaches) that had been randomly selected in the Illinois subbasin (Fig. 3), in which a subset of those sites had been sampled each year.

3.2 Summer snorkeling counts by SMART program

USFS's SMART (Stream Management, Analysis, Reporting, and Tracking database) has included sampling of reaches in the system during two phases: 1989-1995 and 1996 to the present. Data from the second phase, in which training and recording were more rigorous, were utilized from 1996-1999. Ranger District biologists were required to sample all fish bearing streams within 10 years, and the design protocol required that each stream was to be randomly selected for sampling in a given year.

Summer, daytime snorkel counts by species, with breakdowns for salmonids into size or age groups, were made in a reach from successive pools and riffles progressing upstream. Considerably fewer fish were observed in riffles than in pools. Riffle counts were not included because in summer it is difficult to obtain representative snorkel counts in many riffles due to shallow, turbulent water and coarse substrates.

Sixty-one samples were taken from reaches during the second phase which began in 1996. Of these, two samples were taken from one reach in different years. One of these was eliminated by coin toss. A second reach was eliminated because only one riffle was sampled for fish. Therefore 59 independent reaches were retained for the analysis (Fig. 4). These reaches averaged 3.3 km (range 0.8 - 9.4) long. A mean of 10 pools per reach (range 1-23) was sampled for fish.

Physical measurements of pools and riffles were taken directly every 10th pool (minimum of 10 pool-riffles measured when available).

Mean pool width varied between 5.6 ft (1.7 m) and 37.4 ft (11.4 m), and averaged 17.7 ft (5.4 m). Measurements of remaining habitat units were estimated by identified crew members, estimates that were calibrated with measurements every 10th pool (Appendix 1). Basin drainage areas corresponding to each sample (downstream end of reach) varied from 584 to 51,500 acres (236 to 20,840 Ha).

Only fish data from pool observations were included because it is difficult to maintain consistency when attempting quantitative observations in riffle and other habitat types during low summer conditions. The species breakdown of fish taxa observed in pools in shown in Fig. 5, along with the frequency of presence in all pools and reaches sampled. A total of 610 pools were sampled among the 59 reaches. All reaches contained fish, and a zero fish count was only record for one pool. Sampled pool frequencies (every 10th pool) varied from 1 to 27 pools per reach. Total reach lengths varied from 0.6 to 6.3 miles. Young-of-the-Year (YOY or O+) salmonids were observed in 502 pools and 58 reaches, while older salmonids were observed in 434 pools and 58 reaches.

Only Rainbow trout (which may have included juvenile steelhead which are the same species), occurred consistently throughout the reaches. Statistical analysis would be difficult for other species because of large numbers of zero observations. Because all salmonids are sensitive to higher temperature and restricted habitats during summer and low flows, it was decided to represent all native salmonid species in response variables. However, because of different behaviors and habitat preferences among YOY and older salmonids, these were analyzed as two separate responses. It is easy for trained snorkelers to distinguish between YOY and older salmonids because of their size difference.

The response variable was expressed in density form as the number of a defined fish group (young-of-year or older salmonids) observed per 1000 m^2 of pool area. The number of fish are summed over all pools snorkeled:

Fish Response = S(# fish observed in pool, i)/S(surface area of pool, i)

Methods and results of corrected estimates of pool dimensions, based on SMART calibration data, used to estimate pool area are described in Appendix 1.

3.3 Fish habitat

One of the most useful measures of fish habitat is the dimensionless variable, width-to-depth ratio, based on wetted stream habitat dimensions. Streams that are deep for their width (i.e., low width-to-depth ratio) tend to provide more habitat for fish, especially salmonids during summer (Scarnecchia and Bergersen 1987; Kozel and Hubert 1989). Natural differences in the ratio do exist due to differences in sediment type, transport, and deposition, and also whether the reach channel is constrained geomorphically. However, degradation of streams through riparian forest removal, changes in hydrology, and transport of sediment generally tends to widen streams at the cost of mean depth, a process that is consistent with reduction of overhanging bank habitat and bankside vegetation. Maximum depth of pool or riffle was measured for all sampled habitats, therefore this depth measure was used instead of the strongly correlated mean depth that was estimated for less than half of sampled habitats. The mean ratio for a reach was estimated by calculating the mean of all pool and riffle width-to-depth ratios.

Width-to-depth ratio averaged 9.2, and ranged from 5.4 to 15.5 for the same 59 reaches sampled in the SMART program that contributed to the fish response data (Fig. 4).

All response variables were checked for quality and internal consistency, but were not compared to explanatory variables until an independent set had been derived from the latter as described in Sections 4, 5.1, and 5.2.

4. Methods: Potential effects on fish populations

The primary potential effect represents the object of this study, suction dredge mining (SDM). The 1999 survey of SDM included (1) a census of the proposed amount of sediment that miners were anticipating that they would transfer downstream during the summer season, and (2) an extensive field sample of the mining activity in which the actual amount of sediment moved was measured. Notwithstanding some individual differences in between expected and actual quantities moved, there was a good correlation from 48 samples ($r = 0.600$, $P<0.00001$, Fig. 6). Because it was essential to have a measure of cumulative effects from all SDM operations, the measure of the estimated (proposed) amount to be moved was adopted, because this resulted from a census during the 1999 season. This was also considered to be more appropriate because fish responses were measured over a 5-year period, and proposed SDM that did not occur during 1999 could have occurred during other years.

The proposed measure adopted was expressed as the quantity of sediment moved per unit length of stream in segments that were contained in 640-acre (close to 1-mile square) Sections. Derivation of potential cumulative effect of several processes in a given drainage is described below under Cumulative Effects.

Any effect on the fish response from causes other than SDM could potentially confound interpretation. These 'nuisance' variables include early hydraulic mining (HM) and several land-use effects.

HM mostly occurred in 1860-1910 (Fig. 7), but was included because it had a long-lasting visible effect on the surface geology, soils, and vegetation of riparian zones (e.g., Fig. 8). HM peaked in the early 1900's but continued to occur sporadically until as recently as a single operation on Althouse Creek in the mid 1980's (John R. Nolan, USFS, Pers. comm.).

Also land use varied, with forest type, degree of deforestation, urban, and agriculture uses differing among drainage areas sampled for fish. For quantifying the relative effect of these land uses, the best available source covering the whole basin was the Western Oregon Digital Imagery Project (WODIP: Nighbert et al. 2000). That project classified the region into 25-by-25-m pixels representing 49 land-use types, largely on the basis of satellite imagery and ground truth information. Their very detailed forest classification included estimates of mixed or single stands of hardwoods and conifers, four tree size classes, and canopy cover down to 10% intervals. These distinctions were far too fine to indicate differences among basins statistically in this study, so a reduced set of forest and other land-use components was derived that did not involve the elimination of pixels (Fig. 9). In addition a road cover image was obtained through U.S. Forest Service, Grants Pass, which was merged with the simplified WODIP land-use cover .

Water-use effects on hydrology from dams is negligible in the basin, and water abstraction effects would be related to the potential agricultural and urban influence already being measured. The foregoing data sources were analyzed as follows.

5. Analysis and results:

Before performing a definitive statistical analysis (5.3), an appropriate method for encoding potential influence to derive explanatory variables is described (5.1), followed by the process to derive an independent set of those explanatory variables (5.2).

5.1 Rating potential influence of explanatory variables

The fish sampled at a given location are mostly influenced by habitats in their home range, which is roughly of the same order as the reach lengths sampled. However, these habitats are primarily influenced by natural and anthropomorphic activities upstream. What is the most rational way of measuring potential influence stream and land-use types?

The traditional approach is simply to sum the number of pixels corresponding to each classification, with each sum being the explanatory variable representing the potential influence of each classification (Fig. 10 A). This process provided equal weights to each pixel, so a land-use at the periphery of the drainage basin would be deemed equally influential as one of similar area adjacent to the sample point. This scoring procedure was unrealistic for assessing effects on a stream reach. Given the importance of riparian zones on streams, a stream buffer zone approach (Fig. 10B) became popular, but the distance from the stream (buffer width) beyond which land-use effects were rated at zero has become a controversial issue. Moreover, a land or stream use in the buffer zone was still considered to have the same effect whether it was close or distant from the sampled reach.

A solution to the foregoing problems is to weight each land-use (including mining use) according to some inverse function of its distance, as the water flows, to the sample location ('pour point'). A rationale for utilizing an inverse-distance weighting method is derived (Appendix 2) and illustrated (Fig. 11). This process produces an explanatory variable datum that represents a cumulative measure of the potential impact on each sampled reach from all sources of each candidate effect in the drainage associated with that sample.

Explanatory variables for all land-use types, including SDM and hydraulic mining (HM) activities along the stream corridor, were converted where necessary to raster (25-m pixel) images. A recent 10-m resolution DEM was used to develop a 25-m raster image indicating flow path directions over the entire landscape, a process that also defines the drainages basins corresponding to each fish sample. The process, developed by John Bolte (Department of Bioresources, Oregon State University), utilizes a program (ZOI) that interfaces with the flow direction cover map to derive sums of inverse-distance weighted values for each classification in each drainage basin ARC-INFO GIS software (Bayley et al. 2001; Kehmeier et al. in submission).

The two mining activities were coded as follows. The proposed cubic yards of sediment to be moved (see above) by Suction dredge mining (SDM) in 1999 was expressed on a per unit stream length (cu. yds/1000 ft of stream) in each Section where this mining was involved. This measure of intensity of mining was converted to classes and assigned to pixels in a rasterized GIS image (Figs. 2,3). The process outlined above weighted each pixel by the measure of mining intensity in addition to its inverse distance from the sampled reach.

The stream reaches where early hydraulic mining (HM) occurred was mapped by John Nolan and Roger Mendenhall (USFS, Grants Pass, OR). They assigned one of four ranks to each reach to describe the visual effects (e.g. see Fig. 8) that reflected the intensity of this mining activity independently of other activities. These rankings were assigned intensities of 1 through 4 that were applied to classes in a similar manner as SDM. Different units for different mining effects do not matter in a linear statistical analysis; what is important is to reflect the relative intensity and cumulative effect of each mining activity in each drainage.

Figure 12 provides an example of a combined image with drainage basins corresponding to three SMART fish samples, with corresponding calculations of inverse distance weights of aggregated land-uses (see next section). This process does not eliminate any land or water use in the drainage, but weights each pixel of each classification according to the inverse of its distance to the fish response measured.

5.2 Deriving a set of independent explanatory variables

Any statistical analysis that investigates the significance and magnitude of a potential influence requires that the explanatory variable representing that influence is independent of potentially confounding variables. A fair assessment of whether correlations are insufficiently correlated among a set of candidate variables must account for the multiple testing effect. Consequently Bonferroni adjustments were made to the overall alpha value of 0.05 used as a rejection criterion.

Because the response variables involved two surveys with separate sets of drainages that required separate statistical modeling, a multiple correlation test was performed on the explanatory variables of each data set. Fig. 13 shows the Pearson correlation matrix for all cumulative-effect, explanatory variables for the 53 drainages corresponding to the ODFW salmon spawning samples. Even though Bonferroni corrections (at $P=0.05$) were used, there is a serious problem because of the highly significant correlation between the SDM and HM cumulative effects (Fig. 14). Because subsets of the sites were sampled during different years, the explanatory variables of those subsets were separately analyzed. However, the significant correlation among the mining types persisted. Although there is some overlap between the types, this persistence was partly attributed to lack of proximity to upstream mining of a large proportion of the sites (Fig. 3).

Therefore, an analysis of the salmon spawning response could not proceed, because it would not be possible to distinguish between the mining activities any effects that may be indicated statistically. Impasses such as this are not uncommon when trying to impose a sampling design on existing data, and do not reflect the quality of the information in the data set.

The Pearson correlation matrix for all explanatory, cumulative-effect variables for the 59 SMART drainages is shown in Fig. 15. Here, fortunately, there were no significant (again, Bonferroni at P=0.05) correlations between SDM and any other explanatory variables. While it is not incorrect to proceed with analyses relating this set to the fish response, there are redundancies among several of the remaining 'nuisance' variables that will unnecessarily consume degrees of freedom. Also, some cover types were sparse and did not vary much among drainages (Fig. 16). There were three clusters of strongly interrelated variables that generally represented decreasing degrees of vegetation cover and, to a large extent, human disturbance: (1) agriculture, urbanization, and roads, (2) forest with less than 50% canopy, non-forest vegetation, and barren, and (3) forest with greater than 50% canopy.

The cumulative-effect variables representing these three land-use cover types, and those for the two mining activities, produced a much cleaner correlation matrix (Fig. 17). Because no land-use types from WODIP have been eliminated, and all their areas add to 100% in each drainage, there will clearly not be independence in any set. In this case, a strong negative correlation exists between set (2) and (3) (Fig. 18), indicating that one cumulative variable should be dropped. In this case, a weak correlation was indicated between variable (2) and (1), so variable (2) was eliminated, leaving a set of four variables (Urban-Ag-Roads (1), Forest >50% (3), HM (4), and SDM (5)) that were uncorrelated at the Bonferroni-corrected 5% level. This set of explanatory variables was used in the statistical analyses described below.

5.3 Linear statistical analyses

The response variable is a count of fish in a given sampled area. The fish may or may not be randomly distributed in that area. Expressing the error distribution according to the negative binomial model (White and Bennetts 1996), accounts for any additional variance, μ^2/θ , (μ = mean, θ = constant) to that corresponding to a random error as in a Poisson distribution.

The linear statistical model fit to the SMART data set was:

(1) $$Y = exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_3 x_3 + \beta_{12} x_1 x_2 + \beta_{13} x_1 x_3 \;\ldots\ldots\; + \beta_{34} x_3 x_4)$$

where Y = number of fish per 1000 m^2 of total pool area sampled in the reach (juvenile + adult native salmonids greater than 1 year old or YOY salmonids),

β_0 = fitted constant,

β = fitted coefficients with non-zero subscripts corresponding to the following variables:
x_1 = 'Urban-Ag-Roads' cumulative effect,
x_2 = 'Forest >50%' cumulative effect,
x_3 = Hydraulic mining (HM) cumulative effect,
x_4 = Suction dredge mining (SDM) cumulative effect,
$x_i x_j$ = all first order interaction terms between *i*th and *j*th variables ($i \neq j$),

with the error corresponding to the variance function of the negative binomial distribution:

(2) $var\ (Y) = \mu + \mu^2/\theta$

where μ = mean of count, Y

μ^2/θ = variance additional to Poisson (random) variance

θ = fitted constant

An S-Plus routine that fits the θ constant in the negative binomial model jointly with the model coefficients with an iterative procedure (Venables and Ripley 1999) was used to compute the general linear models. In the case of the stream width-to-depth ratio response, a simple Normal linear statistical model (regression) was applied.

In this study the principal interest is in whether the coefficient, β_4, that estimates the magnitude and sign of any effect of Suction dredge mining (SDM), is significantly different from zero, providing that the SDM variable, x_4, is not part of a significant interaction with another explanatory variable. Other explanatory variables need to be included because interactions with them may confound our interpretation. If the model does not indicate significant interactions, those terms are removed and the reduced model is refitted. The modelling process was repeated after dropping non-significant ($P > 0.05$) interactions. Non-significant main effects (β_i) were not dropped if they were part of a significant interaction.

5.4 Results

With the models on native salmonids greater than one year old, no significant first order interactions remained after the elimination procedure. Fig 19A illustrates a later model run with an interaction term between the two mining activities, Fig. 19B show a run with only main effects, and Fig. 19C shows a model with the least significant ($P > 0.5$) effect, suction dredge mining, removed. Only the cumulative effect of hydraulic mining (HM) indicated a modest significance (at

P = 0.03) among the main effects. It's sign was negative, indicating that the greater the severity of this activity had been, the greater the reduction in salmonids over 1 year old.

Model diagnostics are critical to assess the appropriateness of the statistical procedure and assumptions. Theoretically, deviance residuals are expected to be approximately normal (Pierce and Schafer 1986), so models producing large departures should be viewed with suspicion. A normal probability plot of the deviance residuals suggested reasonable conformity (Fig. 20). A second issue is the independence of the data used. Although the inverse distance weighting effect gave more emphasis to land-uses occurring closer to the sample site, drainage areas of several sample points overlapped to varying degrees. Also the longitudinal movement of fish populations among adjacent sites sampled in the same year may be sufficient to render the samples non-independent statistically. Therefore, spatial autocorrelation among samples could occur to a degree that the key assumption of independence of samples would be questioned. To this end, the SMART samples were ordered according to proximity 'as the fish swims' and the corresponding deviance residuals from the model (Fig. 19C) tested for spatial autocorrelation. The mean correlation among the consecutively placed samples was 0.14 with a standard error of 0.13, so autocorrelation was not close to being significant.

As a matter of interest, Fig. 21 indicates through examples the predicted increase in salmonid density in summer pools that would be expected to occur if the prevailing negative effects on habitat of hydraulic mining did not exist.

Testing the Salmonid young-of-the year (YOY) response with similar models did not produce any significant coefficients of explanatory variables or their interactions. Similarly the stream width-to-depth ratio response using simple linear models produced no significant effects. In both cases SDM coefficients were in fact positive but not remotely significant at $P>0.5$.

6. Discussion and Conclusions

Analyses of observational field data sets can never be expected to produce strong results compared with laboratory or field experiments (Diamond 1986; Rose 2000). This is particularly true when the sampling study has not been designed to test the specific variable of interest. However, there are not realistic alternatives because this variable, suction dredge mining, cannot be controlled or easily measured over a sufficiently larger number of drainages to provide a design robust enough to account for confounding factors and provide enough statistical power.

The statistical analyses did not indicate that suction dredge mining has no effect on the three responses measured, but rather any effect that may exist could not be detected at the commonly used Type I error rate of 0.05. The fact that the analysis was able to detect a negative effect of another mining process, HM, on native salmonids, is an indication of the long-lasting effect that hydraulic mining has had on the environment, particularly on riparian zones and floodplain sections in geomorphically unconstrained reaches (Fig. 8).

The reader is reminded of the effect of scale. Localized, short-term effects of suction dredge mining have been documented in a qualitative sense. However, on the scales occupied by fish populations such local disturbances would need a strong cumulative intensity of many operations to have a measurable effect. Local information reveals that most suction dredge miners more or less adhere to guidelines that have recently been formalized by the Forest Service (Kevin L. Johnson and John Nolan, pers. comm.) and generally in the Oregon (Bernell et al. 2003), but there are individual cases where egregious mismanagement of the immediate environment has occurred, particularly with respect to damaging river banks in various ways. This analysis cannot account for individual transgressions, and a study to do so at an appropriate scale would be very expensive if feasible.

Given that this analysis could not detect an effect averaged over good and bad miners and that a more powerful study would be very expensive, it would seem that public money would be better spent on encouraging compliance with current guidelines than on further study.

7. References

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Appendix 1. Estimation of pool dimensions from SMART calibrations.

Each set below is a regression result for habitat length and width from a specific MasterKey (stream) and observer combination. The linear regression models are:
Ln(HAB_LEN) = LHAB_LEN = CONSTANT + LEST_LEN*(Ln(EST_LEN))
Ln(HAB_WID) = LHAB_WID = CONSTANT + LEST_WID*(Ln(EST_WID))
where HAB_LEN = measured habitat length at water surface,
EST_LEN = independent visual estimate of habitat length at water surface,
CONSTANT, LEST_LEN, LEST_WID = fitted coefficients
HAB_WID = measured mean habitat width at water surface,
EST_WID = independent visual estimate of mean habitat width at water surface.

Therefore, Pool area = HAB_LEN*HAB_WID.

"Observer ID_Masterkey"

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
"B16110300055"						

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DEP VAR:LHAB_LEN	N:	39 MULTIPLE R:	0.985	SQUARED MULTIPLE R:		0.971
CONSTANT	0.160	0.132	0.000	.	1.213	0.233
LEST_LEN	0.986	0.028	0.985	1.000	35.269	0.000
DEP VAR:LHAB_WID	N:	39 MULTIPLE R:	0.931	SQUARED MULTIPLE R:		0.867
CONSTANT	0.437	0.193	0.000	.	2.266	0.029
LEST_WID	0.886	0.057	0.931	1.000	15.523	0.000
"C13110300057"						
DEP VAR:LHAB_LEN	N:	20 MULTIPLE R:	0.991	SQUARED MULTIPLE R:		0.982
CONSTANT	0.043	0.141	0.000	.	0.307	0.763
LEST_LEN	1.011	0.032	0.991	1.000	31.201	0.000
DEP VAR:LHAB_WID	N:	20 MULTIPLE R:	0.753	SQUARED MULTIPLE R:		0.566
CONSTANT	0.924	0.419	0.000	.	2.205	0.041
LEST_WID	0.704	0.145	0.753	1.000	4.850	0.000
"C13110300058"						
DEP VAR:LHAB_LEN	N:	20 MULTIPLE R:	0.991	SQUARED MULTIPLE R:		0.982
CONSTANT	0.043	0.141	0.000	.	0.307	0.763
LEST_LEN	1.011	0.032	0.991	1.000	31.201	0.000
DEP VAR:LHAB_WID	N:	20 MULTIPLE R:	0.753	SQUARED MULTIPLE R:		0.566
CONSTANT	0.924	0.419	0.000	.	2.205	0.041
LEST_WID	0.704	0.145	0.753	1.000	4.850	0.000
"C13110300059"						
DEP VAR:LHAB_LEN	N:	20 MULTIPLE R:	0.991	SQUARED MULTIPLE R:		0.982
CONSTANT	0.043	0.141	0.000	.	0.307	0.763
LEST_LEN	1.011	0.032	0.991	1.000	31.201	0.000
DEP VAR:LHAB_WID	N:	20 MULTIPLE R:	0.753	SQUARED MULTIPLE R:		0.566
CONSTANT	0.924	0.419	0.000	.	2.205	0.041
LEST_WID	0.704	0.145	0.753	1.000	4.850	0.000
"D05110500019"						
DEP VAR:LHAB_LEN	N:	44 MULTIPLE R:	0.995	SQUARED MULTIPLE R:		0.989
CONSTANT	-0.100	0.066	0.000	.	-1.515	0.137
LEST_LEN	1.037	0.017	0.995	1.000	62.325	0.000
DEP VAR:LHAB_WID	N:	44 MULTIPLE R:	0.970	SQUARED MULTIPLE R:		0.941
CONSTANT	-0.082	0.113	0.000	.	-0.722	0.474
LEST_WID	1.028	0.040	0.970	1.000	25.768	0.000
"D06110500022"						
DEP VAR:LHAB_LEN	N:	18 MULTIPLE R:	0.995	SQUARED MULTIPLE R:		0.991
CONSTANT	-0.011	0.100	0.000	.	-0.107	0.917
LEST_LEN	1.001	0.024	0.995	1.000	41.996	0.000
DEP VAR:LHAB_WID	N:	18 MULTIPLE R:	0.983	SQUARED MULTIPLE R:		0.966
CONSTANT	0.175	0.108	0.000	.	1.626	0.123
LEST_WID	0.939	0.044	0.983	1.000	21.381	0.000
"D06110500023"						
DEP VAR:LHAB_LEN	N:	47 MULTIPLE R:	0.991	SQUARED MULTIPLE R:		0.981
CONSTANT	0.103	0.091	0.000	.	1.135	0.262
LEST_LEN	0.979	0.020	0.991	1.000	48.780	0.000
DEP VAR:LHAB_WID	N:	47 MULTIPLE R:	0.981	SQUARED MULTIPLE R:		0.963
CONSTANT	-0.028	0.092	0.000	.	-0.308	0.760

LEST_WID	1.013	0.030	0.981	1.000	34.104	0.000
"B16110500024"						
DEP VAR:LHAB_LEN	N:	411 MULTIPLE R:	0.994	SQUARED MULTIPLE R:		0.987
CONSTANT	0.053	0.024	0.000	.	2.239	0.026
LEST_LEN	0.996	0.006	0.994	1.000	177.376	0.000
DEP VAR:LHAB_WID	N:	411 MULTIPLE R:	0.974	SQUARED MULTIPLE R:		0.948
CONSTANT	0.050	0.031	0.000	.	1.608	0.109
LEST_WID	0.984	0.011	0.974	1.000	86.759	0.000
"B16110500025"						
DEP VAR:LHAB_LEN	N:	411 MULTIPLE R:	0.994	SQUARED MULTIPLE R:		0.987
CONSTANT	0.053	0.024	0.000	.	2.239	0.026
LEST_LEN	0.996	0.006	0.994	1.000	177.376	0.000
DEP VAR:LHAB_WID	N:	411 MULTIPLE R:	0.974	SQUARED MULTIPLE R:		0.948
CONSTANT	0.050	0.031	0.000	.	1.608	0.109
LEST_WID	0.984	0.011	0.974	1.000	86.759	0.000
"B16110500026"						
DEP VAR:LHAB_LEN	N:	411 MULTIPLE R:	0.994	SQUARED MULTIPLE R:		0.987
CONSTANT	0.053	0.024	0.000	.	2.239	0.026
LEST_LEN	0.996	0.006	0.994	1.000	177.376	0.000
DEP VAR:LHAB_WID	N:	20 MULTIPLE R:	0.999	SQUARED MULTIPLE R:		0.999
CONSTANT	0.021	0.021	0.000	.	0.998	0.331
LEST_WID	0.991	0.008	0.999	1.000	119.981	0.000
"B16110500027"						
DEP VAR:LHAB_LEN	N:	411 MULTIPLE R:	0.994	SQUARED MULTIPLE R:		0.987
CONSTANT	0.053	0.024	0.000	.	2.239	0.026
LEST_LEN	0.996	0.006	0.994	1.000	177.376	0.000
DEP VAR:LHAB_WID	N:	411 MULTIPLE R:	0.974	SQUARED MULTIPLE R:		0.948
CONSTANT	0.050	0.031	0.000	.	1.608	0.109
LEST_WID	0.984	0.011	0.974	1.000	86.759	0.000
"B16110500043"						
DEP VAR:LHAB_LEN	N:	411 MULTIPLE R:	0.994	SQUARED MULTIPLE R:		0.987
CONSTANT	0.053	0.024	0.000	.	2.239	0.026
LEST_LEN	0.996	0.006	0.994	1.000	177.376	0.000
DEP VAR:LHAB_WID	N:	35 MULTIPLE R:	0.943	SQUARED MULTIPLE R:		0.889
CONSTANT	0.231	0.203	0.000	.	1.143	0.261
LEST_WID	0.945	0.058	0.943	1.000	16.285	0.000
"B17110500030"						
DEP VAR:LHAB_LEN	N:	411 MULTIPLE R:	0.994	SQUARED MULTIPLE R:		0.987
CONSTANT	0.053	0.024	0.000	.	2.239	0.026
LEST_LEN	0.996	0.006	0.994	1.000	177.376	0.000
DEP VAR:LHAB_WID	N:	411 MULTIPLE R:	0.974	SQUARED MULTIPLE R:		0.948
CONSTANT	0.050	0.031	0.000	.	1.608	0.109
LEST_WID	0.984	0.011	0.974	1.000	86.759	0.000
"B17110500033"						
DEP VAR:LHAB_LEN	N:	411 MULTIPLE R:	0.994	SQUARED MULTIPLE R:		0.987
CONSTANT	0.053	0.024	0.000	.	2.239	0.026

LEST_LEN	0.996	0.006	0.994	1.000	177.376	0.000
DEP VAR:LHAB_WID	N:	411 MULTIPLE R:	0.974	SQUARED MULTIPLE R:		0.948
CONSTANT	0.050	0.031	0.000	.	1.608	0.109
LEST_WID	0.984	0.011	0.974	1.000	86.759	0.000
"B17110500034"						
DEP VAR:LHAB_LEN	N:	411 MULTIPLE R:	0.994	SQUARED MULTIPLE R:		0.987
CONSTANT	0.053	0.024	0.000	.	2.239	0.026
LEST_LEN	0.996	0.006	0.994	1.000	177.376	0.000
DEP VAR:LHAB_WID	N:	411 MULTIPLE R:	0.974	SQUARED MULTIPLE R:		0.948
CONSTANT	0.050	0.031	0.000	.	1.608	0.109
LEST_WID	0.984	0.011	0.974	1.000	86.759	0.000
"B17110500055"						
DEP VAR:LHAB_LEN	N:	411 MULTIPLE R:	0.994	SQUARED MULTIPLE R:		0.987
CONSTANT	0.053	0.024	0.000	.	2.239	0.026
LEST_LEN	0.996	0.006	0.994	1.000	177.376	0.000
DEP VAR:LHAB_WID	N:	411 MULTIPLE R:	0.974	SQUARED MULTIPLE R:		0.948
CONSTANT	0.050	0.031	0.000	.	1.608	0.109
LEST_WID	0.984	0.011	0.974	1.000	86.759	0.000
"B18110500043"						
DEP VAR:LHAB_LEN	N:	21 MULTIPLE R:	0.995	SQUARED MULTIPLE R:		0.990
CONSTANT	0.065	0.102	0.000	.	0.644	0.527
LEST_LEN	1.002	0.023	0.995	1.000	43.145	0.000
DEP VAR:LHAB_WID	N:	21 MULTIPLE R:	0.897	SQUARED MULTIPLE R:		0.804
CONSTANT	0.043	0.340	0.000	.	0.127	0.900
LEST_WID	0.979	0.111	0.897	1.000	8.822	0.000
"B19110500046"						
DEP VAR:LHAB_LEN	N:	411 MULTIPLE R:	0.994	SQUARED MULTIPLE R:		0.987
CONSTANT	0.053	0.024	0.000	.	2.239	0.026
LEST_LEN	0.996	0.006	0.994	1.000	177.376	0.000
DEP VAR:LHAB_WID	N:	411 MULTIPLE R:	0.974	SQUARED MULTIPLE R:		0.948
CONSTANT	0.050	0.031	0.000	.	1.608	0.109
LEST_WID	0.984	0.011	0.974	1.000	86.759	0.000
"D05110500028"						
DEP VAR:LHAB_LEN	N:	21 MULTIPLE R:	0.990	SQUARED MULTIPLE R:		0.981
CONSTANT	-0.175	0.115	0.000	.	-1.526	0.143
LEST_LEN	1.063	0.034	0.990	1.000	31.362	0.000
DEP VAR:LHAB_WID	N:	21 MULTIPLE R:	0.940	SQUARED MULTIPLE R:		0.883
CONSTANT	0.380	0.140	0.000	.	2.718	0.014
LEST_WID	0.811	0.068	0.940	1.000	11.981	0.000
"D06110500029"						
DEP VAR:LHAB_LEN	N:	24 MULTIPLE R:	0.997	SQUARED MULTIPLE R:		0.994
CONSTANT	-0.060	0.073	0.000	.	-0.824	0.419
LEST_LEN	1.019	0.018	0.997	1.000	58.080	0.000
DEP VAR:LHAB_WID	N:	24 MULTIPLE R:	0.945	SQUARED MULTIPLE R:		0.892
CONSTANT	-0.370	0.242	0.000	.	-1.527	0.141
LEST_WID	1.106	0.082	0.945	1.000	13.502	0.000

"D06110500031"

DEP VAR:LHAB_LEN	N:	23	MULTIPLE R:	0.997	SQUARED MULTIPLE R:	0.994
CONSTANT	0.040	0.066	0.000	.	0.597	0.557
LEST_LEN	1.001	0.016	0.997	1.000	61.503	0.000
DEP VAR:LHAB_WID	N:	23	MULTIPLE R:	0.968	SQUARED MULTIPLE R:	0.938
CONSTANT	0.038	0.143	0.000	.	0.268	0.791
LEST_WID	0.989	0.056	0.968	1.000	17.793	0.000

"D06110500032"

DEP VAR:LHAB_LEN	N:	20	MULTIPLE R:	0.998	SQUARED MULTIPLE R:	0.996
CONSTANT	-0.026	0.058	0.000	.	-0.444	0.663
LEST_LEN	1.008	0.014	0.998	1.000	71.231	0.000
DEP VAR:LHAB_WID	N:	20	MULTIPLE R:	0.954	SQUARED MULTIPLE R:	0.910
CONSTANT	-0.117	0.198	0.000	.	-0.594	0.560
LEST_WID	1.044	0.077	0.954	1.000	13.503	0.000

"D06110500060"

DEP VAR:LHAB_LEN	N:	22	MULTIPLE R:	0.982	SQUARED MULTIPLE R:	0.965
CONSTANT	0.028	0.170	0.000	.	0.164	0.871
LEST_LEN	1.002	0.043	0.982	1.000	23.580	0.000
DEP VAR:LHAB_WID	N:	22	MULTIPLE R:	0.922	SQUARED MULTIPLE R:	0.851
CONSTANT	0.277	0.218	0.000	.	1.269	0.219
LEST_WID	0.891	0.083	0.922	1.000	10.673	0.000

"D06110500061"

DEP VAR:LHAB_LEN	N:	22	MULTIPLE R:	0.997	SQUARED MULTIPLE R:	0.995
CONSTANT	0.024	0.063	0.000	.	0.378	0.710
LEST_LEN	0.998	0.016	0.997	1.000	61.761	0.000
DEP VAR:LHAB_WID	N:	22	MULTIPLE R:	0.971	SQUARED MULTIPLE R:	0.944
CONSTANT	0.077	0.129	0.000	.	0.595	0.558
LEST_WID	0.968	0.053	0.971	1.000	18.297	0.000

"D06110500062"

DEP VAR:LHAB_LEN	N:	22	MULTIPLE R:	0.986	SQUARED MULTIPLE R:	0.972
CONSTANT	0.162	0.141	0.000	.	1.147	0.265
LEST_LEN	0.973	0.037	0.986	1.000	26.459	0.000
DEP VAR:LHAB_WID	N:	22	MULTIPLE R:	0.986	SQUARED MULTIPLE R:	0.972
CONSTANT	-0.013	0.094	0.000	.	-0.143	0.888
LEST_WID	1.006	0.038	0.986	1.000	26.320	0.000

"D06110500063"

DEP VAR:LHAB_LEN	N:	20	MULTIPLE R:	0.980	SQUARED MULTIPLE R:	0.961
CONSTANT	0.243	0.168	0.000	.	1.447	0.165
LEST_LEN	0.952	0.045	0.980	1.000	21.088	0.000
DEP VAR:LHAB_WID	N:	19	MULTIPLE R:	0.897	SQUARED MULTIPLE R:	0.804
CONSTANT	0.370	0.221	0.000	.	1.670	0.113
LEST_WID	0.820	0.098	0.897	1.000	8.350	0.000

"D06110500064"

DEP VAR:LHAB_LEN	N:	26	MULTIPLE R:	0.997	SQUARED MULTIPLE R:	0.994
CONSTANT	0.017	0.062	0.000	.	0.278	0.783
LEST_LEN	1.002	0.016	0.997	1.000	62.348	0.000
DEP VAR:LHAB_WID	N:	26	MULTIPLE R:	0.911	SQUARED MULTIPLE R:	0.830

```
CONSTANT              0.017        0.188       0.000       .        0.090     0.929
LEST_WID              0.986        0.091       0.911     1.000     10.820     0.000

"D06110500065"
DEP VAR:LHAB_LEN      N:        28  MULTIPLE R: 0.992  SQUARED MULTIPLE R: 0.985
CONSTANT              0.094        0.092       0.000       .        1.029     0.313
LEST_LEN              0.991        0.024       0.992     1.000     41.150     0.000
DEP VAR:LHAB_WID      N:        28  MULTIPLE R: 0.962  SQUARED MULTIPLE R: 0.926CONSTANT
0.024        0.144        0.000       .         0.170     0.866
LEST_WID              0.998        0.055       0.962     1.000     18.048     0.000

"D07110500056"
DEP VAR:LHAB_LEN      N:       411  MULTIPLE R: 0.994  SQUARED MULTIPLE R: 0.987
CONSTANT              0.053        0.024       0.000       .        2.239     0.026
LEST_LEN              0.996        0.006       0.994     1.000    177.376     0.000
DEP VAR:LHAB_WID      N:       411  MULTIPLE R: 0.974  SQUARED MULTIPLE R: 0.948
CONSTANT              0.050        0.031       0.000       .        1.608     0.109
LEST_WID              0.984        0.011       0.974     1.000     86.759     0.000

"D08110500066"
DEP VAR:LHAB_LEN      N:        39  MULTIPLE R: 0.998  SQUARED MULTIPLE R: 0.996
CONSTANT             -0.019        0.049       0.000       .       -0.393     0.696
LEST_LEN              1.000        0.010       0.998     1.000     97.917     0.000
DEP VAR:LHAB_WID      N:        39  MULTIPLE R: 0.969  SQUARED MULTIPLE R: 0.939
CONSTANT              0.469        0.108       0.000       .        4.355     0.000
LEST_WID              0.853        0.036       0.969     1.000     23.924     0.000

"D10110500085"
DEP VAR:LHAB_LEN      N:       411  MULTIPLE R: 0.994  SQUARED MULTIPLE R: 0.987
CONSTANT              0.053        0.024       0.000       .        2.239     0.026
LEST_LEN              0.996        0.006       0.994     1.000    177.376     0.000
DEP VAR:LHAB_WID      N:       411  MULTIPLE R: 0.974  SQUARED MULTIPLE R: 0.948
CONSTANT              0.050        0.031       0.000       .        1.608     0.109
LEST_WID              0.984        0.011       0.974     1.000     86.759     0.000

"D10110500086"
DEP VAR:LHAB_LEN      N:       411  MULTIPLE R: 0.994  SQUARED MULTIPLE R: 0.987
CONSTANT              0.053        0.024       0.000       .        2.239     0.026
LEST_LEN              0.996        0.006       0.994     1.000    177.376     0.000
DEP VAR:LHAB_WID      N:        38  MULTIPLE R: 0.995  SQUARED MULTIPLE R: 0.990
CONSTANT              0.028        0.041       0.000       .        0.685     0.498
LEST_WID              0.987        0.016       0.995     1.000     60.364     0.000
```

The following bias corrections, based on observers who had consistently valid calibrations across streams, were used in reaches where unsatisfactory calibration data sets were encountered. Those were deemed unsatisfactory because they had identical values for estimates and measurements of pool length and depth, and comprised 42% of all data.

```
DEP VAR:LHAB_LEN      N:       411  MULTIPLE R: 0.994  SQUARED MULTIPLE R: 0.987
CONSTANT              0.053        0.024       0.000       .        2.239     0.026
LEST_LEN              0.996        0.006       0.994     1.000    177.376     0.000
```

DEP VAR:LHAB_WID	N:	411 MULTIPLE R: 0.974		SQUARED MULTIPLE R: 0.948		
CONSTANT	0.050	0.031	0.000	.	1.608	0.109
LEST_WID	0.984	0.011	0.974	1.000	86.759	0.000

Appendix 2. Rationale for representing the effect of a land-use on a stream reach.

It is intuitive that the greater the distance a land-use is from the location of a measured response, the lesser will be its potential impact. An analogy is provided by the simple inverse square distance law of light intensity: The intensity from a point source of light is inversely related to the distance from the source. The intensity, I_1, at distance r_1 changes to I_2 at greater distance r_2 according to the increasing surface area of a sphere of radius r with the light source at the center:

$$I_1 4\pi r_1{}^2 = I_2 4\pi r_2{}^2$$

If the inner sphere 1 is unit distance (say one pixel from the source), then the intensity I_2 at distance r_2 is reduced relative to I_1 thus:

$I_2 / I_1 = 1/r_2{}^2$; hence the inverse square law.

However, this represents a decay in energy intensity in three dimensions. While at that extreme one could envisage loss in the effect of intensity of a land-use in three dimensions (e.g., a pollution effect dissipating outwards and downwards into the water table), one can also envisage some effects (e.g. the distribution of large wood, which decays very slowly, down a stream from a riparian source) as being one-dimensional. Between these extremes, the predominantly two-dimensional nature of landscapes at the scale of drainages containing 2nd to 4th order streams probably mediates the decay of most processes over distance, even when considering the relatively shallow layers of groundwater or hyporheic zones. Therefore, the decay of intensity in two dimensions would be equivalent to that of a light source in a circle of perimeter $2\pi r$:

$$I_1 2\pi r_1 = I_2 2\pi r_2$$

or $$I_2 / I_1 = 1/r_2$$

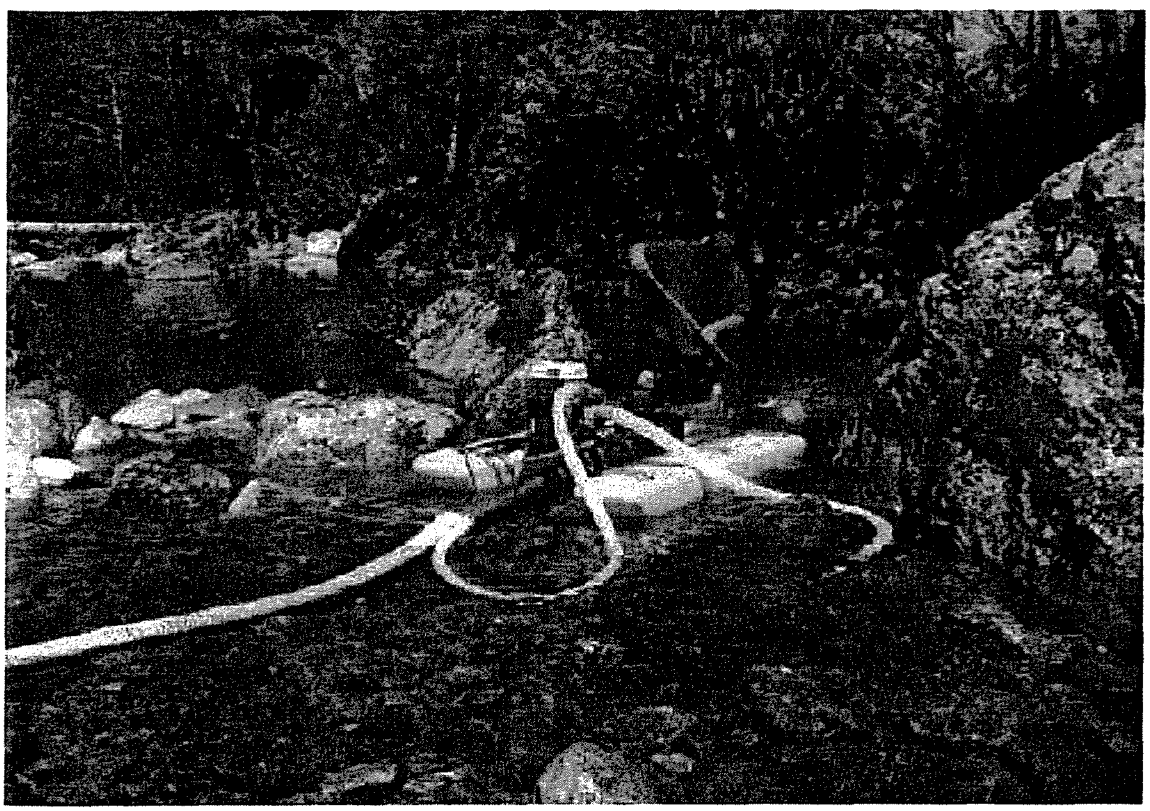
Hence the inverse rule that has been adopted in this analysis (Fig. 11).

The software, ZOI, produces inverse and inverse square measures. It also produces separate measures for instream and out-of-stream distance components from each pixel. While theoretical arguments can be made for combinations of these alternatives there are statistical limitations.

First, splitting the distance into instream and out-of-stream components doubles the number of coefficients that need to be fitted in the statistical analysis. This reduces degrees of freedom, and therefore power, and also increases the probability of lack of independence among variables or significant interactions between them. To attempt to resolve these issues a designed, stratified study covering many more drainages than in this study would be necessary.

Second, while it is tempting to repeat the statistical analysis using alternative derivations of effects (such as inverse and inverse squared variables), this compromises the meaning of the adopted error rate (e.g., the conventional 5% alpha level). In other words, unless one takes the required penalty of lowering the effective significance level to account for multiple testing, one can be accused of undertaking a 'fishing expedition' with the data set.

Fig. 1. Typical suction dredge mining activities.
(photographs by Kevin L. Johnson)



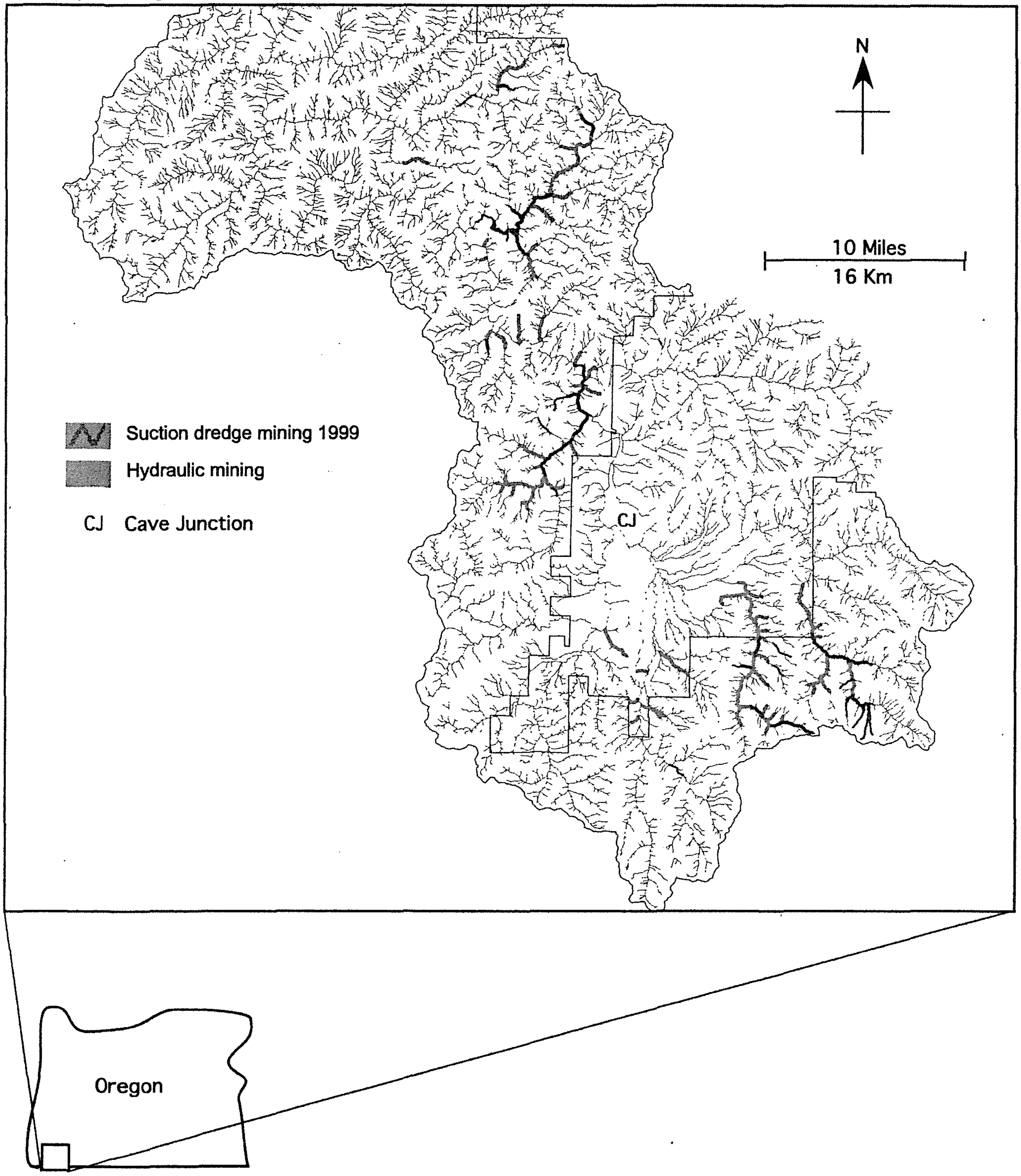


Fig. 2. Illinois river subbasin and location, showing reaches where suction dredge mining activities and early hydraulic mining occurred. Black line shows boundary of the Siskiyou National Forest.

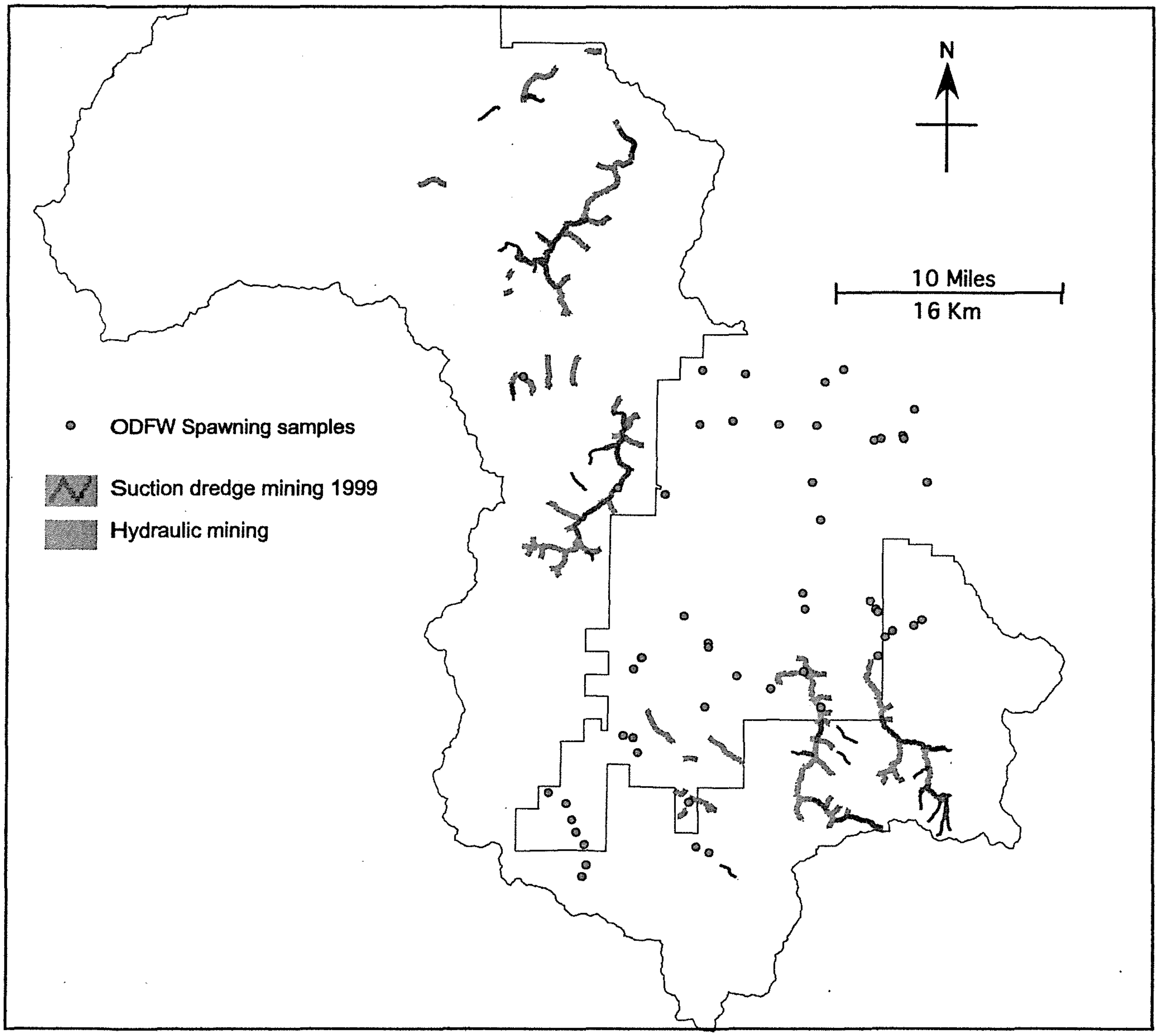


Fig. 3. Locations of ODFW Salmonid spawning stations from 1995-2000 (downstream starting points of reaches sampled) in Illinois subbasin, and reaches where suction dredge mining activities and early hydraulic mining occurred. Black line shows boundary of the Siskiyou National Forest.

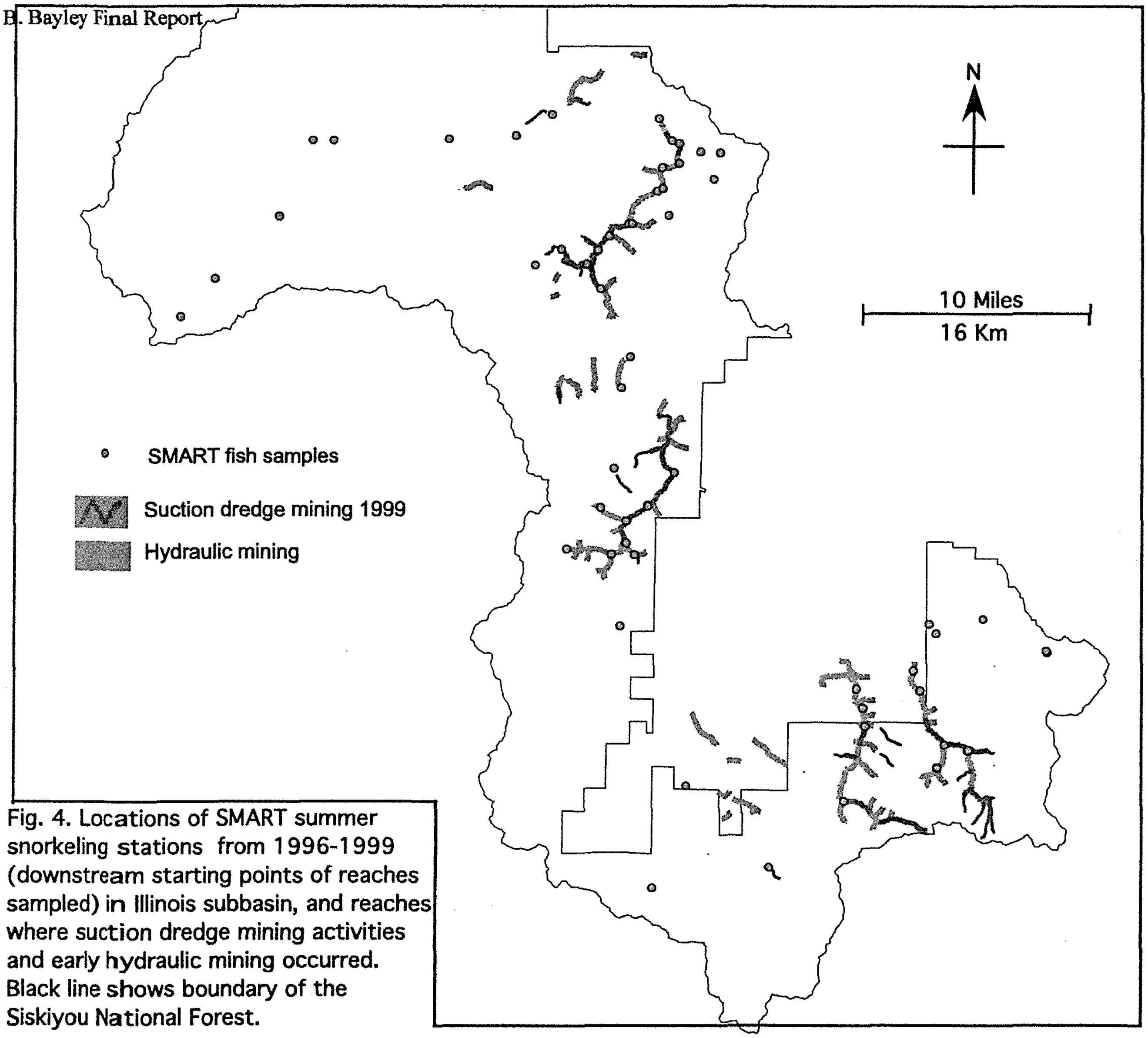


Fig. 4. Locations of SMART summer snorkeling stations from 1996-1999 (downstream starting points of reaches sampled) in Illinois subbasin, and reaches where suction dredge mining activities and early hydraulic mining occurred. Black line shows boundary of the Siskiyou National Forest.

Common name	Scientific name	Total No. individuals observed	No. Pools species was observed	No. reaches species was observed
Rainbow trout*	Oncorhynchus mykiss	5368	531	55
Coastal cutthroat trout	Oncorhynchus clarki	335	127	34
Coho salmon	Oncorhynchus kisutch	21	9	4
Brook trout*	Salvelinus fontinalis	5	5	1
sculpins**	Cottus spp.	257	33	16
Redside shiner	Richardsonius balteatus	93	4	2
Northern pikeminnow	Ptychocheilus oregonensis	84	8	3
	Aggregate values	6163	610	59
	Total number of units sampled		611	59

* introduced species **enumerated in about half of pools sampled

Fig. 5. Numbers of fish observed by species, and numbers of pools and reaches in which separate species and all taxa were observed from 59 SMART summer snorkeling reaches visited from 1996-1999. Fish observed in non-pool habitats were excluded here and from the analysis.

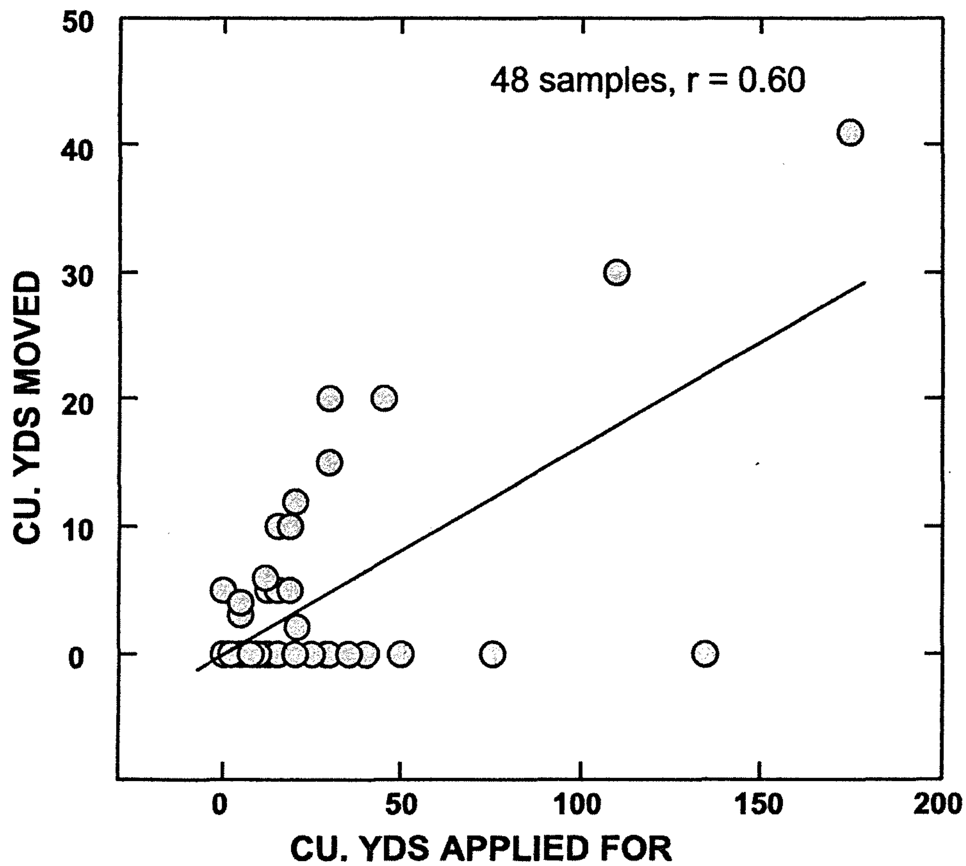
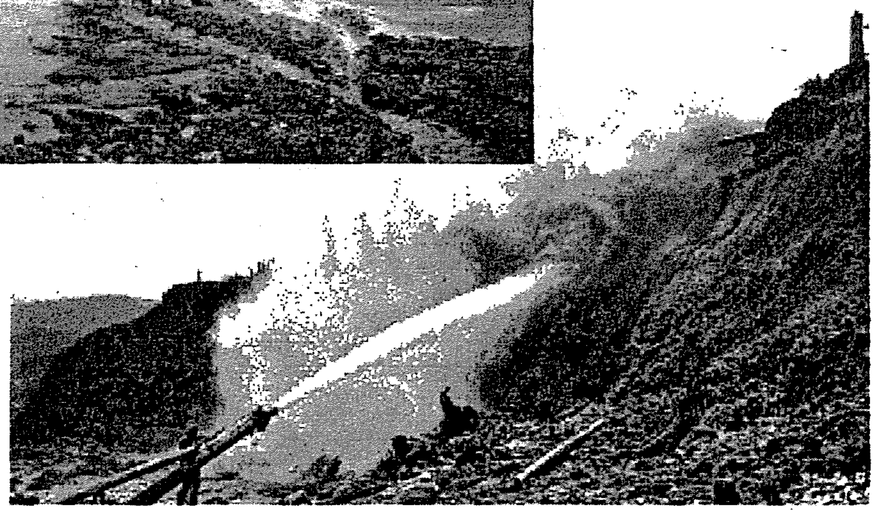


Fig. 6. Sediment moved by independent suction dredge mining operations in 1999. [x-axis = amount estimated prior to season; y-axis = amount moved downstream during season. Least squares regression line shown]
(source: Kevin Johnson, USFS, Grants Pass, OR)

Fig. 7. Examples of late 19th Century hydraulic mining (photograph at left by Nome 1900)



P. B. Bayley

Fig. 8. Sucker Creek floodplain in 2001 that was subject to 19th Century hydraulic mining.

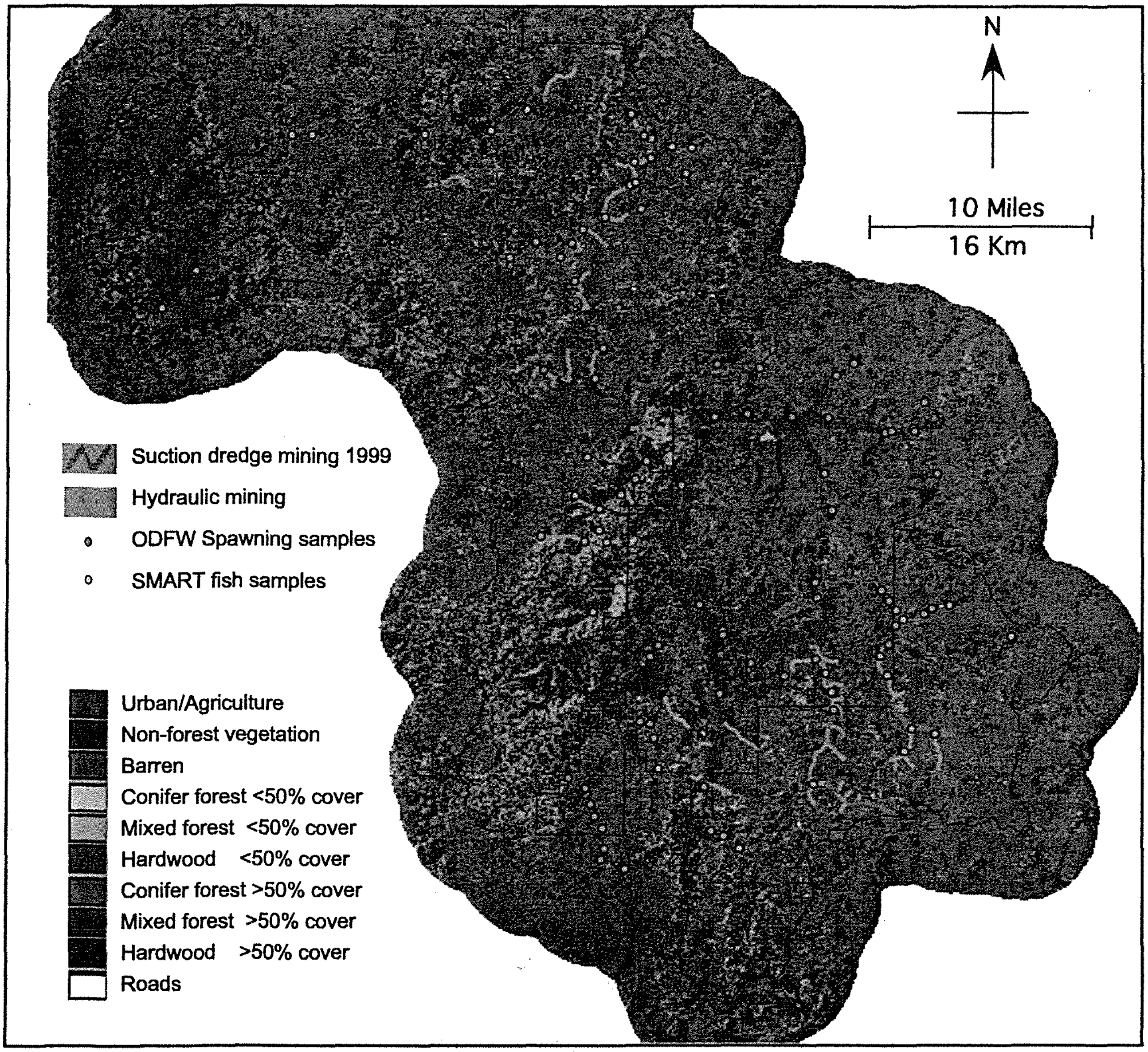


Fig. 9. WODIP classification of land-cover types in the Illinois subbasin, fish sample locations, and reaches where suction dredge mining activities and early hydraulic mining occurred. (Roads are are too fine to be observable at this scale.) Black line shows boundary of the Siskiyou National Forest.

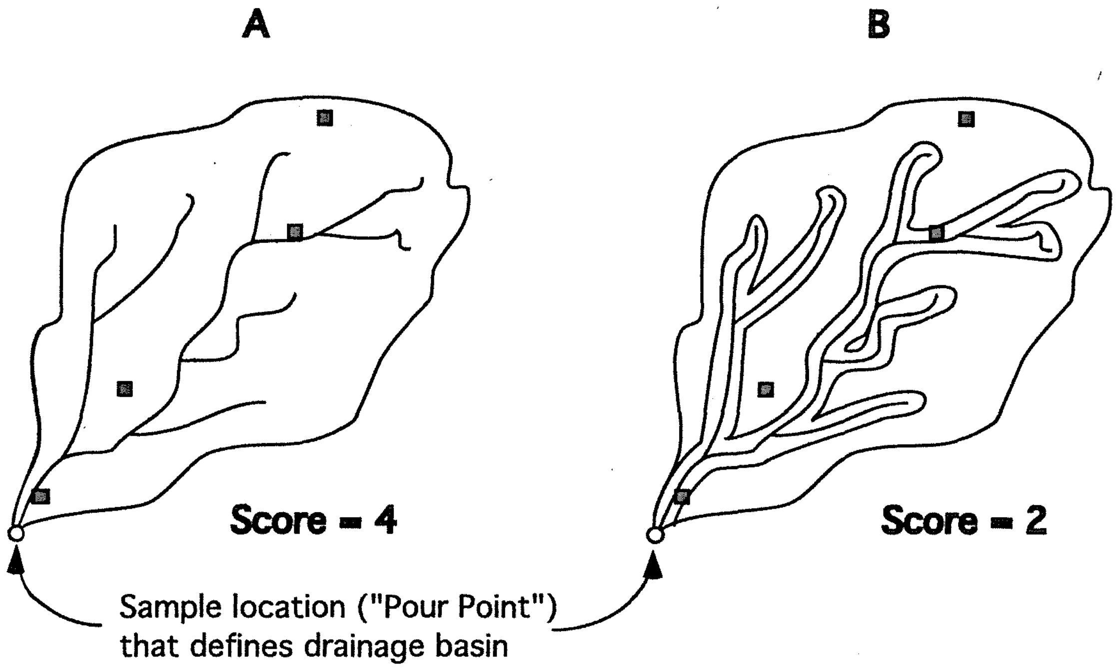
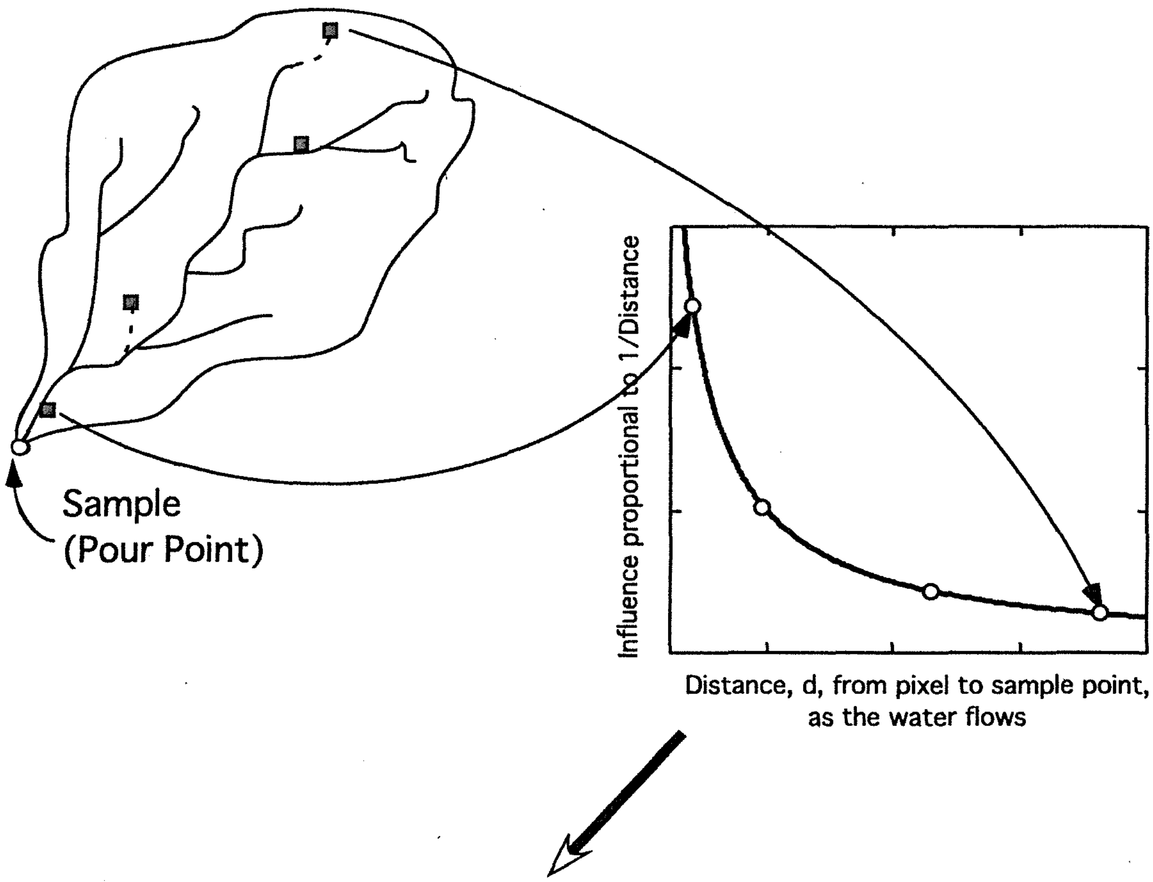
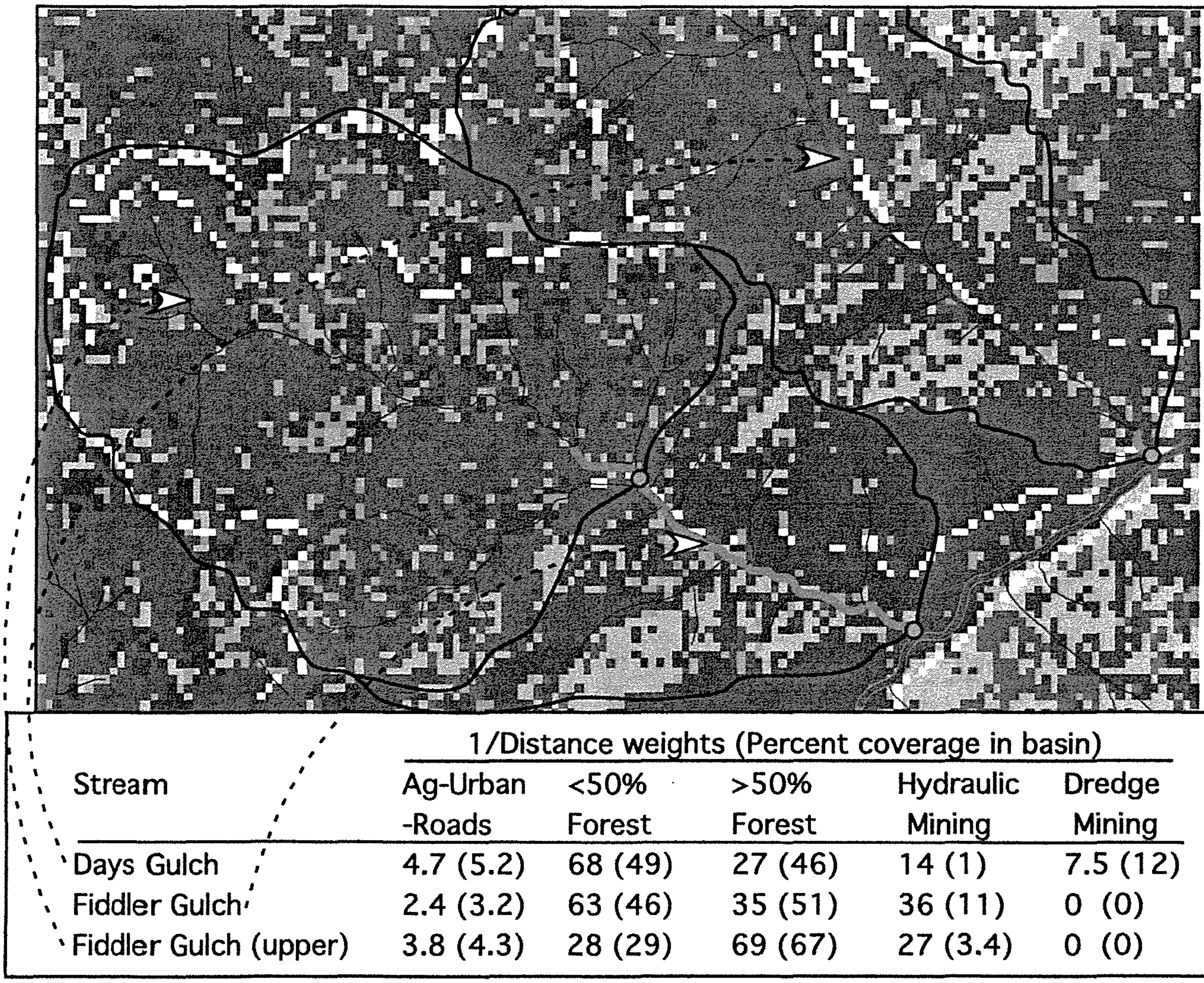


Fig. 10. Examples of scoring land-use classifications for potential influence on a stream sample (A) All pixels for a given classification in the drainage basin summed, (B) Only pixels falling within a defined buffer zone arounf permanent stream are summed.



$$\text{Total potential influence score} = \frac{1}{d_1} + \frac{1}{d_2} + \frac{1}{d_3} + \frac{1}{d_4}$$

Fig. 11. Example of scoring land-use classifications for potential influence on a stream sample in which all pixels for a given classification are weighted by their inverse distance to the sample location and summed (dotted lines show flow paths overland from off-channel pixels determined by a flow map derived from a 10-m DEM (Digital Elevation Map)).



Stream	1/Distance weights (Percent coverage in basin) Ag-Urban -Roads	<50% Forest	>50% Forest	Hydraulic Mining	Dredge Mining
Days Gulch	4.7 (5.2)	68 (49)	27 (46)	14 (1)	7.5 (12)
Fiddler Gulch	2.4 (3.2)	63 (46)	35 (51)	36 (11)	0 (0)
Fiddler Gulch (upper)	3.8 (4.3)	28 (29)	69 (67)	27 (3.4)	0 (0)

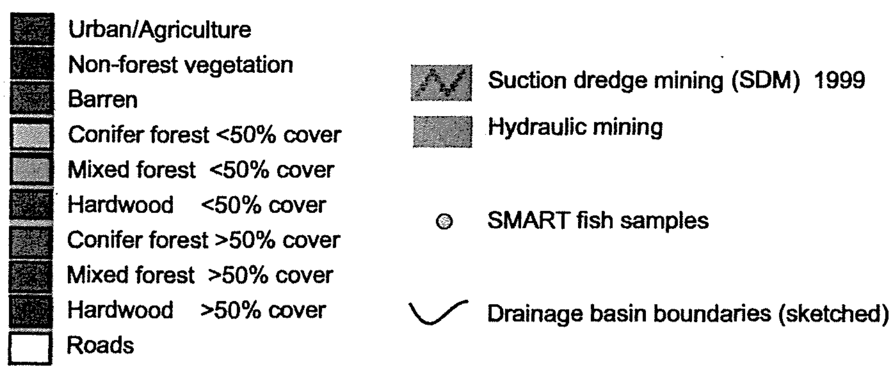
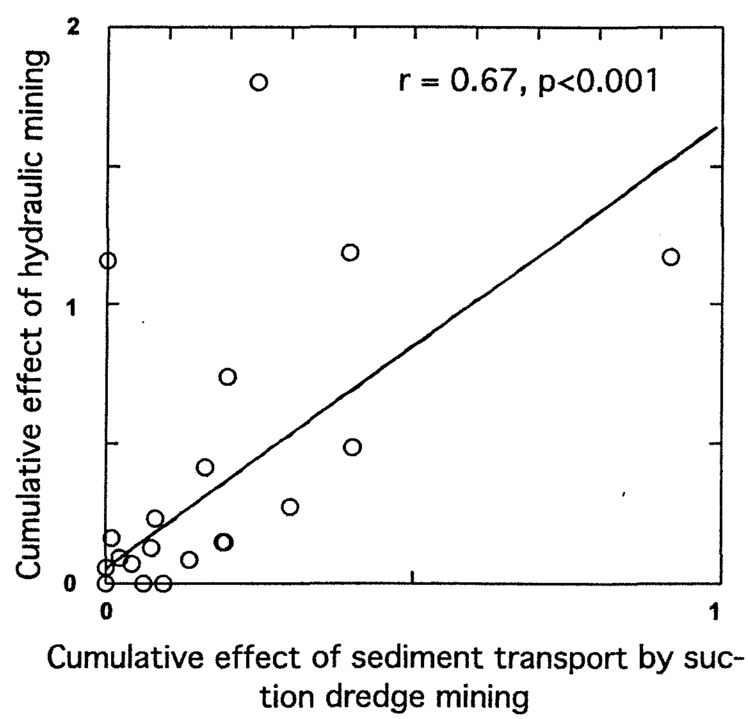


Fig. 12. Example of distribution of original land-use and mining classifications (25-by-25-m pixels), showing three SMART fish sampling locations in Josephine Creek basin, and explanatory variable results. Table shows inverse distance weighting measures for aggregated land-use and mining classifications, which were the explanatory variable values used, in the three drainages. (Percent coverage values based on sums of pixels are shown in parentheses for comparison)

	Urban -Ag	Non-For _Veg	Barren	Forest <50% canopy Conifer	Forest <50% canopy Mixed	Forest <50% canopy Hwood	Forest >50% canopy Conifer	Forest >50% canopy Mixed	Forest >50% canopy Hwood	Roads	Hydraul Mining	Suction Dredge Mining
Urban-Ag	1.000											
Non-For_Veg	0.12	1.000										
Barren	0.152	0.770***	1.000									
Con_For<50%	0.019	0.710***	0.667***	1.000								
Mix_For<50%	0.282	0.405	0.399	0.422	1.000							
Hwd_For<50%	-0.510**	-0.519**	-0.443	-0.504**	-0.757***	1.000						
Con_For>50%	-0.469*	-0.893***	-0.758***	-0.759***	-0.527**	0.659***	1.000					
Mix_For>50%	-0.464*	-0.790***	-0.770***	-0.572**	-0.353	0.569**	0.824***	1.000				
Hwd_For>50%	-0.333	-0.577***	-0.501**	-0.585***	-0.444	0.743***	0.595***	0.632***	1.000			
Roads	-0.300	0.015	-0.157	0.076	-0.399	0.179	0.051	-0.019	-0.100	1.000		
HM	-0.210	0.055	0.257	0.298	0.019	-0.189	-0.043	-0.099	-0.280	0.334	1.000	
SDM	-0.203	0.133	0.406	0.366	-0.121	-0.045	-0.142	-0.179	-0.225	0.442	0.670***	1.00

Fig. 13. PEARSON CORRELATION MATRIX of cumulative effects of drainages defined by 53 ODFW salmon spawning samples. Bonferroni-corrected probabilities: * P<0.05, ** P<0.01, **P<0.001.
(Urban-Ag = Urban and agriculture areas combined; Non-For_Veg = Non-forest vegetation; HM = Hydraulic mining; SDM = Suction Dredge Mining)

Fig. 14. CORRELATION between cumulative effects of Hydraulic mining and Suction Dredge Mining from drainages defined by 53 ODFW salmon spawning samples.



	Urban -Ag	Non-For _Veg	Barren	Forest <50% canopy Conifer	Forest <50% canopy Mixed	Forest <50% canopy Hwood	Forest >50% canopy Conifer	Forest >50% canopy Mixed	Forest >50% canopy Hwood	Roads	Hydraul Mining	Suction Dredge Mining
Urban-Ag	1.000											
Non-For_Veg	-0.022	1.000										
Barren	-0.070	0.825**	1.000									
Con_For<50%	0.025	0.835**	0.890**	1.000								
Mix_For<50%	-0.178	0.530**	0.442*	0.509**	1.000							
Hwd_For<50%	-0.081	0.157	0.072	0.155	0.078	1.000						
Con_For>50%	0.009	-0.947**	-0.875**	-0.927**	-0.634**	-0.217	1.000					
Mix_For>50%	0.060	-0.647**	-0.759**	-0.640**	-0.098	0.239	0.575**	1.000				
Hwd_For>50%	0.017	-0.427*	-0.482**	-0.497**	-0.115	0.377	0.364	0.473*	1.000			
Roads	-0.063	-0.303	-0.352	-0.433*	-0.340	-0.448*	0.333	0.015	0.080	1.000		
HM	-0.117	-0.111	0.022	-0.017	-0.066	-0.309	0.118	-0.079	-0.343	0.039	1.000	
SDM	-0.045	-0.049	0.034	-0.011	-0.112	-0.145	0.078	-0.106	-0.113	-0.057	0.255	1.00

Fig. 15. Pearson correlation matrix of cumulative effects of drainages defined by 59 SMART samples. Bonferroni-corrected probabilities: * P<0.05, ** P<0.01, **P<0.001.
(Urban-Ag = Urban and agriculture areas combined; Non-For_Veg = Non-forest vegetation; HM = Hydraulic mining; SDM = Suction Dredge Mining)

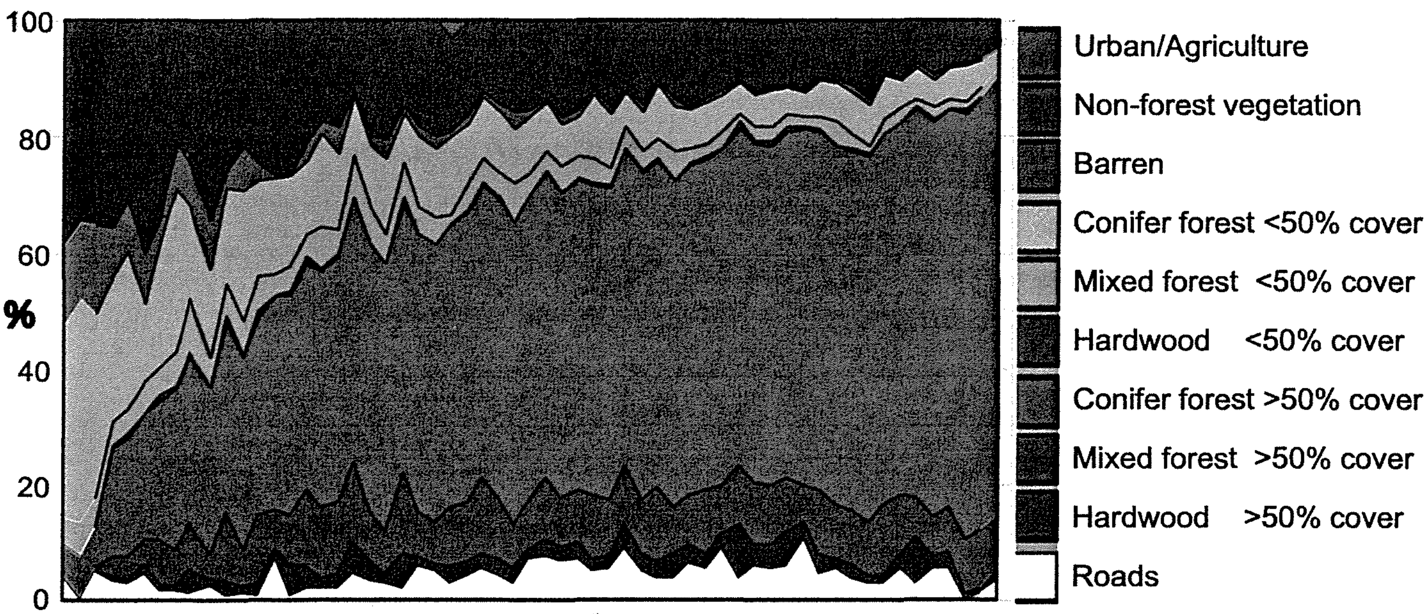


Fig. 16. Proportions of WODIP-based explanatory variables, by area of drainage occupied, from drainages defined by 59 SMART fish samples. (Samples ordered on x-axis by increasing canopy >50% of all forest to illustrate ranges of explanatory variables. The legend identifies the variables in the same order as shown on the graph).

	Urban + Agric. + Roads	Forest <50% canopy + Non-For_Veg + Barren	Forest >50% canopy	Hydraulic Mining	Suction Dredge Mining
(1) Urban-Ag-Roads	1.00				
(2) For.<50%+Non-For.+Barren	-0.401*	1.00			
(3) Forest >50% canopy	0.299	-0.994***	1.00		
(4) Hydraulic Mining	0.019	-0.061	0.059	1.00	
(5) Suction D. Mining	-0.064	-0.031	0.040	0.255	1.00

Fig. 17. PEARSON CORRELATION MATRIX of reduced set of cumulative effects of drainages defined by 59 SMART samples. Bonferroni-corrected probabilities: * P<0.05, ** P<0.01, **P<0.001. [see text for (1), (2), etc.,].
(Urban-Ag-Roads = Urban, agriculture and road areas combined;
For.<50%+Non-For.+Barren = +Forest less than 50% canopy, Non-forest vegetation, and barren areas combined)

Fig. 18. Proportions of reduced WODIP-based explanatory variables, by area of drainage occupied, from drainages defined by 59 SMART fish samples.

(A) Model: Response: Density of Salmonids 1yr-old
Explan. vars.: Ag-Urban-Roads + Forest>50% + Hydraulic Mining
+ Suction Dredge Mining + Hydraulic Mining*Suct.Mining

Coefficients:

	Value	SE	t-value
(Intercept) 4.04			
Ag-Urban-Roads	-4.96	5.65	-0.88
Forest>50%	0.39	0.73	0.53
Hydraul.Mining	-0.40	0.19	-2.04#
Suct.Mining	-0.33	0.29	-1.16
Hydraul.*Suct.Mining	0.25	0.23	1.06

(B) Model: Response: Density of Salmonids 1yr-old
Explan. vars.: Ag-Urban-Roads + Forest>50% + Hydraulic Mining
+ Suction Dredge Mining

Coefficients:

	Value	SE	t-value
(Intercept)	3.86		
Ag-Urban-Roads	-5.45	5.68	-0.96
Forest >50%	0.66	0.68	0.97
Hydraul.Mining	-0.36	0.19	-1.90
Suct.Mining	-0.05	0.08	-0.56

(C) Model: Response: Density of Salmonids 1yr-old
Explan. vars.: Ag-Urban-Roads + Forest>50% + Hydraul.Mining

Coefficients:

	Value	SE	t-value
(Intercept)	3.85		
Ag-Urban-Roads	-5.46	5.67	-0.96
Forest >50%	0.68	0.67	1.00
Hydraulic Mining	-0.38	0.18	-2.13# (P=0.03)

Fig. 19. General linear model results using negative binomial fits to 59 SMART fish samples on the density of Native Salmonids ≥1yr-old (* = interaction between two variables; # signidicant coefficient at P<0.05; see text for refs. to A, B, and C).

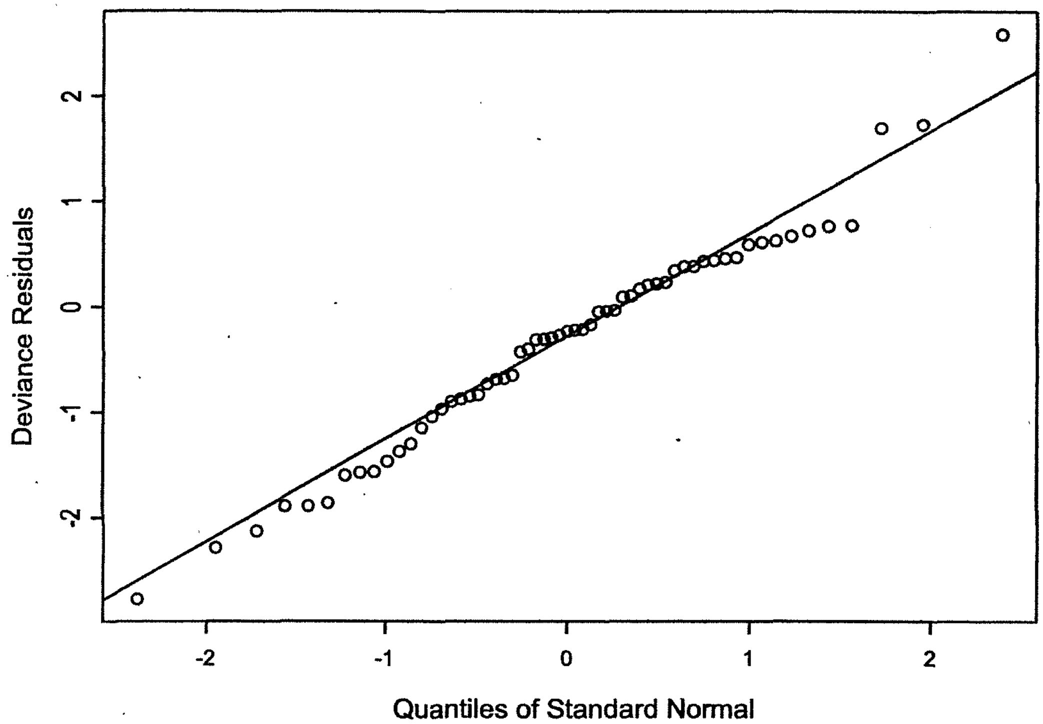


Fig. 20. Normal probability plot of deviance residuals from model in Fig. 19C.

	Predicted density if Hydraulic Mining had .... existed as recorded,	or, not occurred	Predicted change
Althouse Creek (lower)	30	52	71%
Josephine Creek (mouth)	30	45	50%
Days Gulch (mouth)	39	43	12%

Model: Density of Salmonids 1yr-old (#/1000 m^2)
= exp(3.85-5.46*Ag-Urban-Roads + 0.68*Forest>50% - 0.38*Hydraul.Mining)

Fig. 21. Predicted change in salmonid density (older that YOY) in selected streams if hydraulic mining effect had not occurred.

Effects of Recreational Suction Dredge Operations on Fish and Fish Habitat.

Konopacky Environmental

Final Report - 1996

Project No. 064-0

"The effects of REGULATED suction dredge mining are insignificant"

KONOPACKY
ENVIRONMENTAL

Effects of Recreational Suction Dredge Operations on Fish and Fish Habitat: A Literature Review in Association with a Petition of the Idaho Gold Prospectors Association to the Idaho Land Board

Final Report - 1996
Konopacky Project No. 064-0

Prepared for:
Idaho Gold Prospectors Association
Boise, Idaho 83709

Prepared by:
Konopacky Environmental
Meridian, Idaho 83642-6238

July 9, 1996

SUCTION DREDGING ; FACTS

1. a. Fish survival in times of drought is greatly enhanced by the presence of artificially created holes,(North American Journal of Fisheries Managment,14:87,1984) b. abandoned dredge holes provide holding and resting areas for fish.(M.S. Thesis, Humbolt St. Univ. 1988 by Stern)

2. Trout production was significantly increased by physically sculpting and altering the stream habitat, (Trans. American Fish Society 91:185)

3. Capacities of suction dredges in field conditions are only 2% of manufacturers ratings. (North American Journal of Fisheries Managment 1:21 1981)

4. Capacities of suction dredges decrease by 4 times as the nozzle size decreases by 1/2. (North American Journal of Fisheries Managment 1:21 1981)

5. Suction dredges provide clean, de-silted gravels ideal for fish spawning. In addition, they break up the hardened river bottom substrate that prohibits aquatic life entry. Similar to cultivating your garden.(Calif. Dept. of Fish and Game Memo. Sept. 17, 1962, suction dredge investigation by Lewis)

6. a. Suction dredges REMOVE TOXIC HEAVY METALS, ie; LEAD, MERCURY, ARSENIC (Final EIS, Calif. F&G, 4/94, p.64, Adopt.Reg. for suction dredges) b. Lead and mercury in fish have been linked to lower reproduction rates.(Bul. Enviro. Contam. & Tox. Vols. 41,43, pgs, 329, 858)

7. Disturbed gravels are re- colonized by aquatic insects within 40 days, fewer than 1% showed injury or died after passing through the suction dredge.(North Amer. Journal Fish. Mgmt. 1;21,1981)

8. Dredges are bieng used by the Forest Service to remove silts from Idaho rivers.(Video, Outdoor Idaho, October 1992)

9. The effects of REGULATED suction dredge mining are insignificant; (Final EIS, Cal. F&G, Apr. 4/94, p.64, Adopt. Reg. for Suction Dredges.) (B. C. Harvey, N. Am. J. Fish. Mgmt. 6;409, 1986) (V.G. Thomas, N. Am. J. Fish. Mgmt. 5;488, 1985) (NTIS Document PB-201 654 by J.B. Morrow, 1971)

10. Impact to fish and fish habitat from the REGULATED use of RECREATIONAL suction dredge operations on the upper Boise and Middle Fork of the Boise Rivers will be non-detectable to minimal. (Konopacky Project No. 064-0 for IGPA, July,.1996)

11. Suction dredges have many beneficial impacts including ; dispersing fine sediments and reducing substrate embeddedness that enhances spawning and invertebrate habitat, and creating holding pools for fish refuge. (R. Shepard, Applied Ecosystem Services Inc., Assessment for IGPA,.January,.1997)

SUCTION DREDGING ; FACTS

12. Science fovorable to suction dredge mining does exist, (see above), However,.All the available science on the effects of suction dredge operation are based upon UNREGULATED operations involving the impact of large scale operation and/or ignoring all established rules,.and best managment practices. In addition,.it is not comprehensive in that it does not take into account the concurrent impact of such things as fishing, droughts, and natural disasters / disturbances. On the other hand,.science on the effects of regulated FISHING is 100% consistent that the impact are significant;

1. Mortality of fish caught (and then Released) with artificial lures ranges from 10.5% - 23.8% depending on hook size and fish species. Fish that bleed, or are hooked in the gills have a 53% and 95.5% mortality rate respectively. (North American Journal of Fisheries Managment 13;337)

2. Wild trout (like the Bull Trout) have higher mortality because they attack and fight harder. (WA. F&G Mgmt. Div. Rep. by P.E. Mongillo 1984)

3. Twice daily wading during the egg fertilization to fry emergence stages killed up to 96% of the eggs and pre-emergent trout fry.Harvest and wading restrictions would substantially improve fish populations. (North American Journal of Fisheries Managment 12;454 1992)

4. Fish caught in warmer temperatures have a lower survival rate. Mortality rates of trout caught with worm baited hooks are as high as 73%. ((prog. Fish-Culturtist 32;231)

5. Negative effects to trout populations are correlated to human trampling of river riparian areas, (ie; spawn beds) (American Fisheries Society Spec. Pub. 19;459 1991

6. Fly fishermen are considered "heros" for trampling fish nests and harvesting scores of fish in a single day. (Idaho Statesman 1/21/95)

7. Konopacky Environmental could find no published or unpublished documentation of any mortality of trout embryos or pre-emergent fry in natural stream systems from the REGULATED use of a suction dredge. The total combined impact of legal fish harvest,.legal catch and release fishing, and legal wading use in a stream or river system can potentially cause a substantial amout of mortality in trout populations in the systems. (Final Report - 1996- Konopacky Environmental,.Project No. 064-0,. prepared for IGPA)

8. etc;
9. etc;
10. etc;

2.1 Location of Streams/Rivers in Reviewed Literature

Relative to the reviewed publications and other literature for this report, the study area included all streams and rivers noted in reports that addressed the effects of recreational mining on fish and/or fish habitat. Most, if not all, streams noted in the literature reviewed for this report contained one or more salmonid species.

2.2 Location of IGPA-Petitioned Reach of the Boise River

Per the most recent petition of the IGPA (1996), the reach requested for entry is the approximately 27.7 contiguous miles of the Boise River and Middle Fork of the Boise River upstream of Arrowrock Dam reservoir (Figure 1). The confluence of Middle and North forks of the Boise River form the Boise River proper.

Fish species present in the above-noted reach of the Boise River system include rainbow/redband trout *Oncorhynchus mykiss*, cutthroat trout *O. clarki*, bull trout *Salvelinus confluentus*, brook trout *S. fontinalis*, and mountain whitefish *Prosopium williamsoni* (Idaho Department of Fish and Game, pers. comm., June 20, 1996). The bull trout is presently a candidate for listing as a federal endangered species.

Two types of fishing regulations occur in the 27.7-mile long reach of the Boise River requested for entry by the IGPA (Idaho Department of Fish and Game 1996). General fishing regulations are in effect from Arrowrock Dam, including the reservoir, to the confluence of the North and Middle Forks of the Boise River (Figure 1). General regulations for the reach include being open to some form of fishing all year, except for April and part of May, and daily bag limits of up to sixteen trout (e.g., six rainbow trout and ten brook trout), fifty whitefish, and no bull trout. Special or more restrictive fishing regulations are in effect from the confluence of the North and Middle Forks of the Boise River to the upstream end of the above-noted 27.7-mile reach of river. Special regulations include a daily bag limit of two trout, in aggregate (i.e., all species of trout and salmon present), neither of which may be less than fourteen inches long, fifty whitefish, and no bull trout. Only artificial flies and lures with one barbless hook per fly or lure may be used in the reach (i.e., no bait). Trout season runs from the May 25 through November 30 during 1996 while the whitefish seasons runs from January 1 through March 31 and from May 25 through December 31 during 1996. Seasons vary on a bi-yearly basis.

Available published and unpublished literature on the effects of recreational mining, primarily with small (i.e., ≤4-in diameter) suction dredges (Figure 2), in streams was collected from various sources. Articles that assessed effects of mining with 4-in and larger suction dredges and large or heavy dredge-mining (e.g., Casey and Webb 1960; Morrow 1971; Throop and Smith 1986) were reviewed but not included in the analysis although some investigators reported no adverse effects from some commercial operations. Additional information (e.g., U.S. Army Corps of Engineers Permit) was also collected and reviewed given that such permits would be required from a federal agency for proposed in-stream activities in navigable streams. All reviewed articles primarily dealt with interactions between recreational mining and components of salmonid streams although some publications differentiated between responses by salmonids and other non-game fish species. Gathered information was divided into the following potentially affected components in a stream system: fish (i.e., eggs/embryos, fry/juveniles, adult fish), habitat, and aquatic macroinvertebrates. Comments by fish management agencies, states, and the federal government on aspects or recreational suction-dredging were also included in this report although no effort was made to list the regulations that pertained to recreational mining per state; such listing are found in North (1993) and Harvey et al. (1995) Other sources of fish mortality were addressed in the discussion section.

4.0 RESULTS

4.1 EFFECTS OF RECREATIONAL SUCTION-DREDGE MINING ON FISH

4.1.1 Mortality of Salmonid Eggs and Deposited Embryos

Four investigators reported the operation of small recreational-type suction dredges had negative effects on eggs and deposited embryos. In an Idaho Fish and Game-funded study, Griffith and Andrews (1981) reported that 100 percent of un-eyed cutthroat trout *Oncorhynchus clarki* eggs died within 1 hr of entrainment in a 3-in diameter suction dredge. In the same study, eyed cutthroat trout eggs had mean mortality rates of 29 percent and 35 percent at the end of 1-hr and 36-hr periods, respectively. Eyed eggs of hatchery rainbow trout *O. mykiss* experienced a 19 percent mortality rate after entrainment and at the end of a 10-day period: control eggs experienced an 18 percent mortality rate over the same time period.

4.1.2 Mortality of Salmonid Sac-Fry

In an Idaho Fish and Game-funded study, Griffith and Andrews (1981) reported hatchery rainbow sac-fry experienced an 83 percent mortality rate after entrainment and a 20-day monitoring period; control fish experienced a 9 percent mortality rate over the same period. Yolk sacs were detached from approximately 40 percent of the fry during entrainment.

4.1.3 Behavior of Salmonid Adults

Operation of small suction dredges did not affect the density or movement of adult rainbow trout in the North Fork of the American River, California. Harvey (1986) reported the density of trout in downstream dredged pool-riffle sequence averaged 22.9 fish while the upstream control sequences contained 25.5 fish. In the same study, tagged rainbow trout moved very little in the control or dredged area. No tagged fish moved farther than from a pool to one of the adjacent riffles or vice versa over the two-week test period. Harvey (1986) also reported that, during low flows in late summer, eight rainbow trout moved from a nearby riffle to occupy a dredge-created pool in a stream and that dredge operation in pools did not displace trout in the same pools. Stern (1988) reported that holding locations of adult spring-run chinook salmon and adult summer-run steelhead were not affected by dredge-mining operations (i.e., 2,211 m^2 of stream bed) in Canyon Creek, a California stream, from the previous two years. North (1993) reviewed four published articles and four unpublished articles on suction dredge mining and concluded that dredging did not directly affect free-swimming fish. Harvey et al. (1995) reported the use of suction dredge tailings for spawning purposes by chinook and coho salmon.

4.1.4 Behavior of Non-Salmonids

Operation of small suction dredges altered the abundance of riffle sculpins *Cottus gulosus* in the North Fork of the American River, California. Harvey (1986) reported that significantly (i.e., $P \leq 0.05$) fewer sculpins were found under test rocks that offered no cover or some cover one month after dredging operations in the stream.

4.2 EFFECTS OF RECREATIONAL SUCTION-DREDGE MINING ON FISH HABITAT

4.2.1 Turbidity or Suspended Sediment in Water Column

Four studies quantified the local effects on water turbidity that resulted from the operation of recreation gold dredges in salmonid streams. Harvey (1986) reported an increase from 4-5

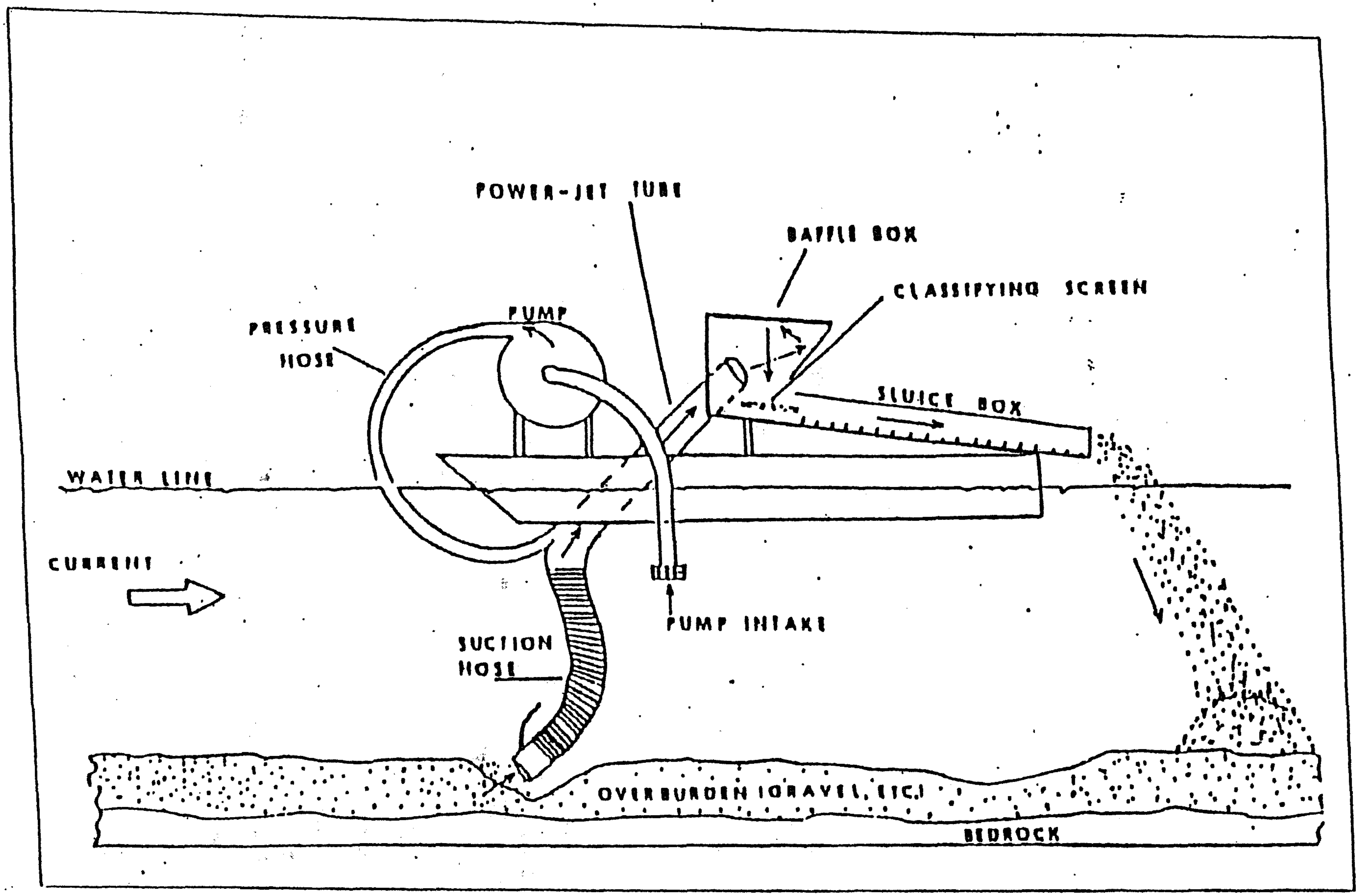


Figure 2. Cross-sectional view of a typical power-jet suction dredge used in recreational mining for gold. As proposed by the IGPA petition, the suction dredge intake nozzle (i.e., arrow from overburden into suction hose) would be ≤3 inches in diameter.

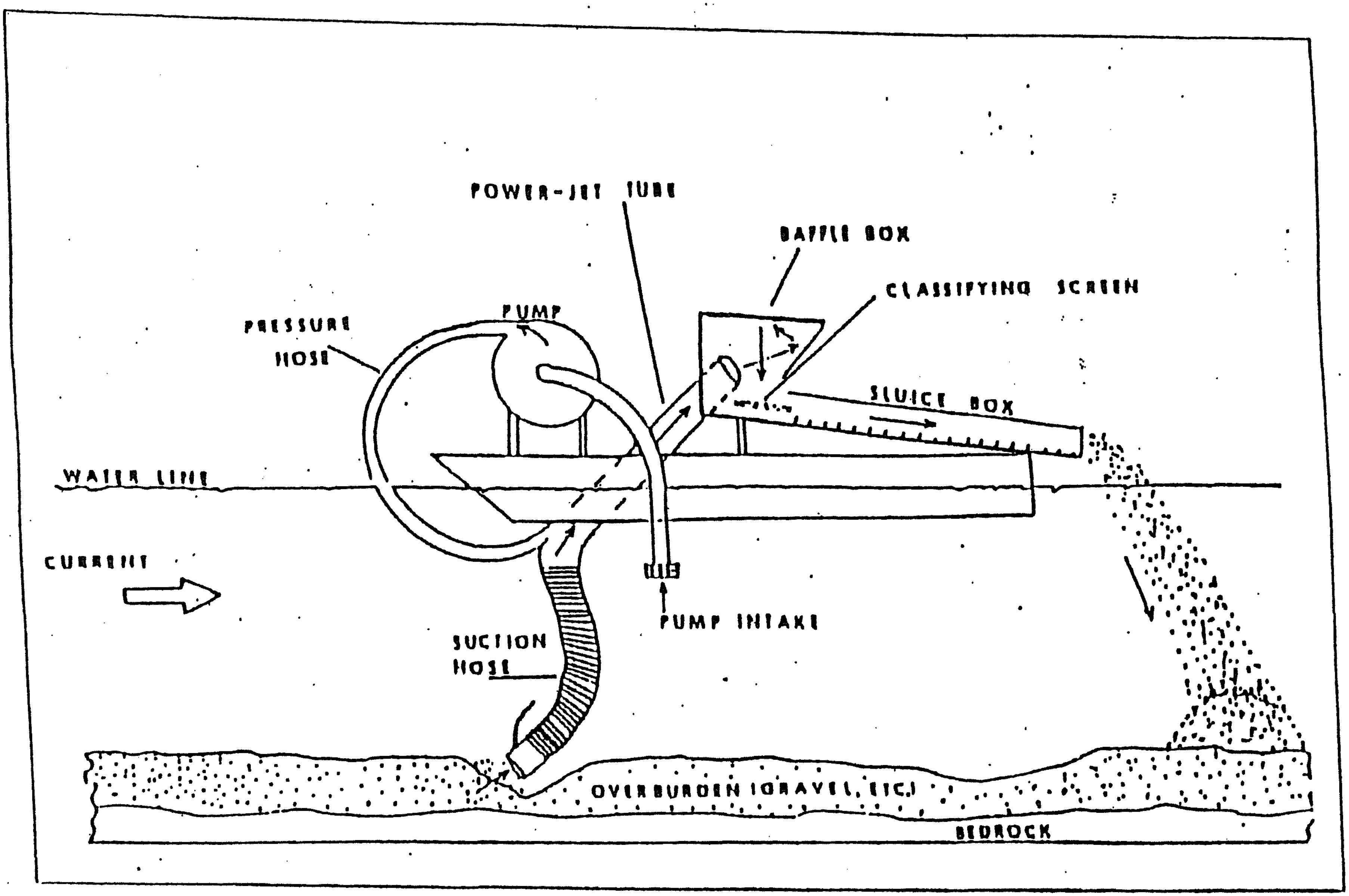


Figure 2. Cross-sectional view of a typical power-jet suction dredge used in recreational mining for gold. As proposed by the IGPA petition, the suction dredge intake nozzle (i.e., arrow from overburden into suction hose) would be ≤3 inches in diameter.

nephelometric turbidity units (NTUs) to 25-30 NTUs during and after dredging in the localized plume area downstream of the activity. He also reported active feeding by rainbow trout in the stream at the 25-30 NTU level. Thomas (1985) used a 2.5-in diameter suction dredge to disturb, from bank to bank, a 10-m (i.e., 33 ft) long reach of a Montana stream. She established an upstream 10-m long control reach and three 10-m long downstream response reaches. She reported that suspended sediment levels returned to ambient levels 30.5 m (i.e., 100 ft) downstream of the dredged reach. She also estimated that the bulk of the sediments, put into suspension by the dredge, was re-deposited within 6 to 11 m (i.e., 20 to 36 ft) downstream of the dredge. In comparisons with control sites, Stern (1988) reported very minor increases in turbidity (i.e., 1.58 to 1.98 NTUs) at sites 10 m downstream of dredges in Canyon Creek, California; increases declined further (i.e., 0.04 to 0.20 NTU) at sites 100 m downstream of dredges. Somer and Hassler (1992) reported very little variation in water turbidity upstream and downstream of reaches dredged by professional miners in two California streams. They reported turbidity levels exceeded 15 NTUs only near the dredge outfall. North (1993) reviewed four published articles and four unpublished articles on suction dredge mining and concluded that dredging affected turbidity temporarily but only in the immediate vicinity of the dredge.

4.2.2 Deposited Sediment on Stream Bottom

Two studies quantified the change in deposited sediments, downstream of a small dredge operation in a salmonid stream. Thomas (1985) reported that ambient sediment deposition levels (i.e., 86 g/m²/day) increased 10 to 20 times over background levels immediately downstream of a 10-m long stream reach that was dredged from bank to bank. Deposited sediment decreased exponentially with distance downstream of the dredged reach. Somer and Hassler (1992) reported that fine sediment or organic matter weights did not differ significantly (i.e., $P>0.05$) in artificial substrate samplers retrieved, after 2, 4, and 6 weeks, in reaches, from reaches upstream and downstream of reaches dredged by professional miners in two California streams. The samplers were placed into the streams on August 31-September 1 or near the midpoint of a August 3 through October 4 dredging effort. Somer and Hassler (1992) reported different daily sedimentation rates from reaches upstream and downstream of reaches dredged by professional miners in two California streams. They reported lower sedimentation rates in a reach downstream (i.e., 12 $g/m^2/day$) versus upstream (i.e., 13 $g/m^2/day$) of dredging in Canyon Creek. In contrast, they reported higher sedimentation rates in a reaches downstream (i.e., 1,711 $g/m^2/day$ at 40 m and 698 $g/m^2/day$ at 113 m) versus upstream (i.e., 29 $g/m^2/day$ at 100 m and 23 $g/m^2/day$ at 50 m) of dredging in the Big East Fork Creek. Dredge operations excavated below the gravel armor level and into a fine sand and silt layer that comprised most of the transported sediments.

4.2.3 Changes in Gravel Permeability

One reviewed study reported on the change in gravel permeability after dredging in a salmonid stream. Thomas (1985) reported that gravel permeability (i.e., volume of moving water through an orifice) increased in the dredged area of a Montana stream while no changes were detected upstream or downstream of the dredged section. She concluded that silt deposition from suction dredging should not be detrimental to the development of salmonid eggs.

4.2.4 Physical Changes in Habitat.

Harvey (1986) reported the basic pattern of physical change caused by small dredge operations was the formation of a hole in the stream bottom where dredging had occurred and the build-up of shallow sand-gravel areas downstream. Piles of large cobbles and boulders, too large to fit through the dredge, were also created by the dredge operator. Thomas (1985) stated that "pocket and pile" dredging techniques had a greater impact on stream channel morphology than dredging to a uniform shallow depth. She returned to two dredged sites after one year and could not determine where dredging had occurred in one site but could still detect the cobble-boulder pile at the second site. She concluded that a suction dredge could make "highly localized" changes in channel morphology. Similarly, Stern (1988) reported that flows in Canyon Creek, an anadromous fish stream in California, effectively obliterated instream mining disturbances from the previous season (i.e., 1,136 m^2 or 12,229 ft^2 of stream-bed). McCleneghan and Johnson (1983) investigated 235 dredge mine operations in California and reported that: 1) 176 operations met all regulations; 2) 14 operations were undercutting banks; 3) 1 operation was sluicing the bank; 4) 12 operations were channelizing the stream; 5) 7 operations were causing riparian damage; and 6) 25 operators were camping in the riparian zone. More important to the interpretation of their finding, they noted that: 1) some operators were in violation of more than one regulation; 2) their observations included some commercial placer-dredge operations; 3) 67 percent of the suction dredge operations used dredges with intakes of 4 to 10 in diameters; and 5) 53 percent of the miners were classified as professional versus recreational. Across all miners and operations, they reported that all state regulations were followed 88 percent of the time. North (1993) reviewed four published articles and four unpublished articles on suction dredge mining and concluded that dredging changed stream morphometry for a short period that lasted until the next high flow.

4.3 EFFECTS OF RECREATIONAL SUCTION-DREDGE MINING ON AQUATIC MACROINVERTEBRATES

4.3.1 Death, Injury, or Displacement of Invertebrates

Three investigators reported almost negligible negative effects to aquatic macroinvertebrates from entrainment on and passage through a recreational-type suction dredge. In an Idaho Fish and Game-funded study, Griffith and Andrews (1981) reported that less than 1 percent (i.e., 26) of the 3,623 invertebrates, entrained in a 3-in diameter suction dredge, showed injury or died within 24-hrs. Thomas (1985) reported significantly ($P<0.05$) fewer aquatic insects in a 10-m long reach of stream that is dredged from bank to bank than in 10-m long reaches just upstream and just downstream of the dredged reach. Somer and Hassler (1992) reported that aquatic invertebrate numbers did not differ significantly (i.e., $P>0.05$) in artificial substrate samplers retrieved, after 2, 4, and 6 weeks, in reaches; from reaches upstream and downstream of reaches dredged by professional miners in two California streams. The samplers were placed into the streams on August 31-September 1 or near the midpoint of a August 3 through October 4 dredging effort.

4.3.2 Invertebrate Diversity and Equitability

One study reported on the changes in diversity (i.e., number but not kind of species present in a sample) and equitability (i.e., evenness of the allotment of individuals among the taxa present) within invertebrate communities upstream and downstream of dredged sections of two streams in California. Somer and Hassler (1992) reported that aquatic invertebrate diversity and equitability did not differ significantly in artificial substrate samplers retrieved from stream sections upstream and downstream of a dredged sections.

4.3.3 Recolonization of Invertebrates

Three investigators reported a relatively fast recolonization rate of invertebrates following the use of a suction dredge in stream substrate. In an Idaho Fish and Game-funded study, Griffith and Andrews (1981) reported that most of the plots dredged in Summit Creek, a salmonid stream in Idaho, were completely recolonized 38 days after the dredge activity. Forty-five days after dredging with a 6-in diameter suction dredge, Harvey (1986) reported that the mean number of aquatic insects per sample in a recolonized area of Butte Creek, California did not differ significantly ($P>0.05$) from control stations. Thomas (1985) also reported that recolonization in a 10-m long stream reach, dredged from bank to bank, was essentially complete one month after dredging. She also reported that the number of insects in the dredged reach increased one month after dredging even when insect numbers in the upstream control and downstream impact reached had decreased; she concluded that most aquatic insects found the dredged areas were suitable habitat.

4.4 RESOURCE AGENCY COMMENTS/REGULATIONS ON THE OPERATION OF RECREATIONAL SUCTION DREDGES IN STREAMS

4.4.1 U.S. Army Corps of Engineers

Under Section 404 of the federal Clean Water Act, the U.S. Army Corps of Engineers regulates, via a permit process, the discharge of dredged or fill material into waters of the United States. The Corps (1996) recently clarified its position on the Excavation Rule as it related, in particular, to recreational dredging for gold in waters of the United States. In the special notice, the Corps defined those activities that they "determined to have *de minimis* impacts", "obvious low levels of impacts", and "inconsequential effects on aquatic resources." Within the clarification notice, the Corps defined "very small operations" as having "suction hoses ≤3 inches in diameter by which very small amounts of material can be moved, clearly *de minimis*. Such equipment is used where overburden is shallow and access to cracks and crevices in bedrock is easy. About ten percent of the operators (i.e., recreational) use this kind of equipment exclusively and we currently consider them to be excepted from permit requirements." The Corps then listed conditions under which excepted gold dredging activities are subject to suspension (e.g., work is conducted in a wetland).

In a related action, the Corps (Pers. comm., August 4, 1995) reviewed an application of a recreational gold miner from Oregon who proposed to use a suction dredge with a 4-in or less intake line and an engine of 10 horsepower or less on an occasional, weekend, or vacation basis. The Corps concluded that the proposed activity fell within the "intended definition of *de minimus* and that the proposed activity did not require a permit as long as the proposed activity was conducted within the exemption guidelines.

4.4.2 U.S. Forest Service

The authority for exploration, development, and removal of gold on public lands, whether by suction dredging or other methods, is the General Mining Law of 1872. Most National Forest land in the western United States are open to 1872 Mining Law activities although some local areas are withdrawn for specific reasons (e.g., wilderness areas). In a notice to U.S. Forest Service (USFS) Supervisors, Regional Foresters (Pers. comm., February 5, 1995) from USFS Regions 5 and 6 stated that the majority of the "small placer operations using suction dredges and similar equipment in Riparian Reserves and Late Successional Reserves throughout (USFS) Regions 5 and 6...are carried out under a Notice of Intention to Operate (NOI) because of the insignificant nature of their operation." The notice differentiated between recreational suction dredge mining and larger operations that involved the "cutting of trees or the use of mechanized earth moving equipment such as bulldozers or backhoes". Such larger operations would require the submission of a proposed plan of operations because of the pre-determined likelihood of a significant disturbance to surface resources.

Harvey et al. (1995) reiterated the above comments and added that a suction-dredge proponent would also be required to submit a Plan of Operations if the Forest Service determined the proposed disturbance was significant. All operations are to minimize adverse environmental impacts and the Forest Service can require mitigation measures, bonding, and reclamation when they determine that a Plan of Operations is required for a proposed suction dredge project.

In a letter to the Idaho Gold Prospectors Club, the U.S. Forest Service-Boise national Forest (Pers. comm., February 17, 1993; Appendix A) stated that the Boise National Forest had "a very good working relationship with you (i.e., Ron Mackelprang, President IGPA) and the Idaho Gold Prospectors Club. In fact, we have documented no cases of environmental damage due to recreational mining in or near the Middle Fork Boise River. Your group has worked hard to pick up litter and (develop) other partnership efforts with the Forest." The U.S. Forest Service concluded the letter by stating that "(w)e look forward to working with you this summer on several mutual projects."

4.4.3 Idaho Department of Fish and Game

In a letter to the Idaho Gold Prospectors Club, the Idaho Department of Fish and Game (Pers. comm., July 31, 1992; Appendix A) stated that "with regards to the Middle Fork of the Boise (River), recreation type dredging could take place during July and August without seriously impacting fish production. However, the State Land Board has removed the bed of the Middle Fork of the Boise River from mineral entry. The Board did <u>not</u> make that decision on biological information provided by the Idaho Department of Fish and Game" (emphasis added).

4.4.3 Idaho Department of Water Resources

All recreational and commercial dredge mining is presently regulated by the Idaho Department of Water Resources within one of two formats. Some recreational mining is permitted under a "one-stop" recreational permit which includes a list of state-federal agency pre-approved streams together with appropriate seasons and rules for dredge-miners that operate for

45 days or less per year with recreational equipment (Appendix B). All recreational and commercial dredge mining, that cannot meet the conditions of the "one-stop" recreational permit, must submit a more detailed "long-form" permit which contains more rules and detailed reviews by all involved state and federal agencies (Appendix B). Additional U.S. Forest Service permits (i.e., notice-of-intent, plan of operation) are also required, in all cases on national forest land, regardless of the Idaho Department of Water Resources permit.

4.4.5 California Department of Fish and Game

The California Department of Fish and Game (1994) completed an Environmental Impact Report that examined the effects of unregulated suction dredging on all aspects of the aquatic environmental which included stream beds and banks as well as riparian areas. All negative effects noted in this report above were also noted in the California report. As trustee for the fish and wildlife resources in the state of California, the Department concluded that "suction dredge mining can potentially result in the loss of this production, temporary loss of benthic/invertebrate communities, localized disturbance to stream beds, increased turbidity of water in streams and rivers, and mortality to aquatic plant and animal communities. However, based on the best available data (i.e., same data base as this report through April 1994), it is anticipated the project to adopt regulations for suction dredging as proposed, will reduce these effects to the environment to less than significant levels and no deleterious effects to fish." Proposed regulations (Appendix B) were intended to result in the maintenance of healthy lake, stream, and river systems while allowing for suction dredge mining in the state. Proposed regulations were consistent with state wildlife conservation and aquatic resource policies. To further ensure the maintenance of health in the aquatic systems in the state, the California Fish and Game Department would periodically review and amend regulations based on additional evidence and data. Lastly, the Department noted that "suction dredging is considered a legitimate activity on California's rivers and suction dredge operators have as much right as any other river user to enjoy and utilize rivers as long as their activities are within the laws and regulations of the State of California."

5.0 DISCUSSION

5.1 IMPACTS OF UNREGULATED RECREATIONAL SUCTION DREDGE-MINING ON FISH, HABITAT, AND AQUATIC MACROINVERTEBRATES

In general, almost all published and unpublished studies of unregulated suction dredge mining for gold in streams that were reviewed for this report identified some effect on fish.

habitat, and/or macroinvertebrates (i.e., fish food) in the study streams. Magnitude of impact ranged from non-detectable or even possibly positive (i.e., use of created pools for cover and cleaned tailings for spawning) to extremely negative (i.e., 100 percent mortality of uneyed cutthroat trout eggs). Across all types of impacts and excluding positive impacts and those impacts which would not occur under the present IGPA (1996) petition (i.e., no mining during incubation periods of resident or anadromous salmonids), most negative impacts were non-detectable to intermediate in size. Most of the larger negative impacts reviewed in this study were the result of violations of existing regulations that controlled the activity in a California study (McCleneghan and Johnson 1983) or were intentional at the laboratory level of study (Griffith and Andrews 1981). Relative to the California study, McCleneghan and Johnson (1983) found that most (i.e., 88 percent) of the observed recreational and professional suction dredge operators (i.e., 1-in to 10-in diameter) were mining within state regulations and that only a few operators were causing adverse impacts. Such impacts possibly to probably also occur in other states within which no regulations are in place for the activity. Most physical impacts (i.e., turbidity changes, reconfiguration of stream bottom) also occurred naturally (i.e., short to long-term storm events) and/or on a recurring basis but especially during annual spring run-off season. Regardless of the minimal nature of most impacts, however, the additional use of the stream resource by a suction dredge operator will produce some level of real or perceived change or impact as a result of the use of the stream for the activity. Some changes may not have a negative or deleterious effect on fish or fish habitat that is detectable other than at a human perception or visual level (e.g., turbidity, engine noise).

5.2 IMPACTS OF OTHER USER-GROUPS ON FISH, HABITAT, AND AQUATIC MACROINVERTEBRATES

5.2.1 Legal Fishing

The level of documented and undocumented negative effects on fish and fish habitat from other legal and regulated uses in the section of the Boise River petitioned for use by the IGPA (1996) is larger to much larger than the potential effect associated with their proposed activity. The Boise River is open to fishing by the general public throughout the petitioned 27.7-mile long reach of the Boise River and the Middle Fork of the Boise River during a majority of the year. By definition and allowed by State of Idaho regulations (Idaho Department of Fish and Game 1996), a single licensed fishermen in the reach can legally kill up to 16 trout per day (e.g., six rainbow trout and ten brook trout) over a 190 day season per year and 50 whitefish per day over a 312-day season (i.e., a single dedicated fisherman could legally kill up to 3,040 trout and 15,600 whitefish per year). If one assumed that one-half of the killed trout in the above example, are female, that each female has 300 eggs, and that 5 percent of the eggs mature to at least a catchable size (i.e., 6 inches), then <u>one</u> licensed fisherman could possibly account for the demise of additional 22,800 potential trout in one year. Similarly, the <u>same</u> fisherman could possibly account for the demise of additional 1,170,000 potential whitefish in the <u>same</u> year (i.e., same parameters as for trout except for 3,000 eggs per female). Konopacky Environmental could not find any documented case of a suction dredge killing an adult trout in any reviewed study or the unpublished literature.

In addition to actual killing of fish through harvest, another portion of the trout population in a stream can be unintentionally killed by fishermen. Even though a percentage of fish that are caught by fishermen are eventually released or escape during the time after initial hooking, a real mortality (i.e., range of 3 to 87 percent) is associated with catch-and-release fishing (Bouck and Ball 1966; Schill and Griffith 1986) that also exceeds any documented level of any mortality associated with suction dredge operation. Because there is no daily bag limit for the number of fish that can be caught and released in a stream reach, the potential mortality caused by <u>one</u> fisherman could be <u>high</u> and in addition to the mortality associated with the legal bag limit.

The IGPA-petitioned reach in the Boise River and Middle Fork of the Boise River is open to some form of fishing from January 1 through March 31 and from May 25 though December 31 during 1996 (Idaho Department of Fish and Game 1996). Various other non-commercial water-dependent activities, such as boating, kayaking, rafting, canoeing, and swimming are unrestricted and unregulated the entire year (USFS, pers. comm., July 9, 1996). As a result, fishermen and other periodic users/waders can potentially kill incubating embryos of all or some of the trout species present in the reach. Given that bull trout and brook trout are fall spawners and rainbow-redband trout and cutthroat trout are spring spawners, the simple act of walking/wading in the river can exert very large mortalities on incubating embryos over the entire IGPA-petitioned reach of the Boise River and the Middle Fork of the Boise River. Roberts and White (1992) reported that twice-daily wading on trout embryos and pre-emergent fry in redds killed up to 96 percent of the embryos and fry. A single wading killed up to 43 percent of the fish. With the exception of the intentional experiment of Griffith and Andrews (1981), Konopacky Environmental could find no published or unpublished documentation of any mortality of trout embryos or pre-emergent fry in natural stream systems from the regulated use of a suction dredge. The total combined impact of legal fish harvest, legal catch-and-release fishing, and legal wading use in a stream or river systems can potentially cause a substantial amount of mortality in trout populations in the systems.

5.2.2 Fish Management Activities

The Idaho Department of Fish and Game, in the past, has used electrofishing methods in the past to conduct inventories of fish populations within the IGPA-petitioned reach of the Boise River (Idaho Department of Fish and Game, pers. comm., June 20, 1996). Such activities, although legal and not completely necessary (i.e., other less intrusive methods such as diver-observation are available), were used by the agency to obtain data and information on the fish populations in the reach. Electrofishing does cause stress in fish through the electric shock and subsequent handling of the fish. Electrofishing can injure and kill trout embryos (Dwyer and Erdahl 1995) as well as juvenile and adult fish (Schreck 1976; Sharber and Carothers 1988). Other less intrusive but legal management activities (e.g., *stocking* of trout) can also have negative effects on wild trout populations through competition for food and space in the stream. Konopacky Environmental could find no published or unpublished documentation of cause-effect mortality of trout, in natural stream systems, from the regulated use of a suction dredge.

5.2.3 Road Maintenance, Agriculture, and Livestock Grazing

At least three other legal and regulated activities in the IGPA-petitioned reach of the Boise River have negatively impacted fish and fish habitat, in direct and indirect manners, for years. The large number of miles of maintained and non-maintained but unpaved roads contribute many tons of fine sediments to the stream via road use, wind, and periodic maintenance (i.e., winter plowing and summer grading). Although the roads are necessary for various uses, including fishing and hunting in the area, sediment contributions to the system can adversely affect fish embryos in redds (Tappel and Bjornn 1983), macroinvertebrate communities (McClelland 1972), and fish habitat (Bjornn et al. 1977). Although the action of a suction dredge may redistribute the fine sediments within the substrate of a stream system, a suction dredge or the operation of a suction dredge does not produce sediment or contribute sediment to a stream channel.

In addition to unpaved roads, regulated irrigation withdrawals and return flows as well as regulated agricultural and livestock uses in the IGPA-petitioned reach of the Boise River can have negative impacts on fish and fish habitat. Irrigation diversions in the IGPA-petitioned reach of the Boise River reduce the amount of water available for trout especially during the low-flow late-summer periods. Depending on the data base used, a total of 60 to 80 water rights or diversions of between 0.04 and 19.0 ft^3/sec exist in the 30 miles of river upstream of Arrowrock reservoir (Idaho Department of Water Resources, pers. comm., June 20, 1996). Return of used irrigation water unnaturally warms the water and adds sediment and possibly nutrients (e.g., fertilizer) to the water. Livestock grazing occurs on Boise National Forest lands adjacent to the IGPA-petitioned reach of the Boise River (Boise National Forest, pers. comm., June 20, 1996).

Cattle trailing and cattle/sheep in grazing allotments can negatively affect fish and fish habitat through trampling of fish embryos in redds in riffle crossing areas and the destruction of riparian vegetation through trailing and dispersed grazing. Although unregulated or illegal suction dredge use could add sediment to streams (e.g., mining of banks) and also impact embryos in redds, Konopacky Environmental could not find no published or unpublished account of the use of a suction dredge that heated stream water, added nutrients to stream water, added sediment to stream water, or destroyed riparian vegetation.

At least one state and one federal resource agency have stated that other regulated and legal uses in a stream drainage have a greater negative impact on fish and fish habitat than the operation of suction dredges by recreational miners. The California Department of Fish and Game (1994), after recognition of the long history of impacts to California rivers and streams associated with other recreational and commercial activities, concluded that the "cumulative detrimental effects of these activities are more significant to the overall health of fish and fish habitat than the impacts caused by suction dredging." Similarly, Harvey et al. (1995), in the development of a review and management strategy for suction dredging on U.S. Forest Service lands, conclude that "the scale of effects of individual dredges appears small, in contrast to other impacts affecting stream biota such as fishing, water diversions, road construction, and logging." Konopacky Environmental agrees with the two above agencies and suggests that regulated suction dredging can occur in a river system, such as the Boise River, with less impact on fish and fish habitat than other ongoing regulated and unregulated activities.

5.3 POTENTIAL IMPACTS OF REGULATED RECREATIONAL SUCTION DREDGE-MINING ON FISH, HABITAT, AND AQUATIC MACROINVERTEBRATES

The IGPA (1996) petition to use suction dredges to remove gold from a 27.7-mile reach of the Boise River system will have non-detectable to very minimal negative effects on fish and fish habitat in the Boise River system. The IGPA petition differs from most reviewed studies and would have such minimal effects because: 1) the petition already has "built-in" regulations (e.g., dredge season relative to incubation of fish embryos, ≤5-inch intakes); 2) the IGPA has informed the Board that the groups wishes to operate within a regulated format; 3) the IGPA has a documented history of self-imposed positive rules and aspects (e.g., litter patrols); and 4) the IGPA has good rapport with land management agencies (e.g., U.S. Forest Service). Such a limited effort in a limited reach of a river system can only have limited effects. Some of the limited effects probably occur naturally or are much smaller in magnitude than similar effects presently incurred by the fish and fish habitat by other legal and state-regulated activities within the Boise River system. In contrast, the California Fish and Game (1994) Environmental Impact Report stated that some positive effects of recreational gold mining with dredges included the removal of lead, mercury, and other heavy metals with a concomitant increase in dissolved oxygen through the mechanical action of the dredge in the stream.

5.4 CONCLUSIONS

After our review of the published and unpublished literature on the effects of recreational suction dredge use on fish and fish habitat in the western United States, Konopacky Environmental makes the following conclusions: 1) impacts to fish and fish habitat from the <u>regulated</u> use of recreational suction dredges, in the IGPA-petitioned reach of Boise River upstream of Arrowrock Reservoir, will be non-detectable to minimal; 2) a non-detectable to large range of impacts to fish and fish habitat can occur with the <u>unregulated</u> use of recreational suction dredge in streams like the Boise River; and 3) other ongoing, legal, regulated and unregulated activities in the Boise River, in the reach upstream of Arrowrock Reservoir, will have larger detrimental or negative impacts to fish and fish habitat than the recreational use of suction dredges.

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Summary of Dredging Publications
Effects of Suction Dredging
Summary of Conclusions

Josiah H. Cornell, III
P.O. Box 881
Grants Pass, OR.

"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"

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

Effects of Suction Dredging

A Summary of Dredging Publications

Written by Joe Cornell

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]

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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.

Author(s): Sigler, J. W., Bjornn, T.C., Everest, F.H., 1984
Title: Effects of chronic turbidity on density and growth of steelhead and coho salmon.
Source: Transactions of the American Fisheries Society 113:142-150
Purpose:
Method(s):
Conclusion(s):

(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
Purpose:
Method(s):
Conclusion(s):
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.

ADDITIONAL REFERENCES NOT YET ADDED

Author(s): Anonymous (1996)
Title: Effects of recreational Suction Dredge Operations on Fish and Fish Habitat: A literature Review in Association with a Petition of the Idaho Gold Prospectors Association to the Idaho Land Board.
Source: Konopacky Environmental, Meridian, Idaho, Proj. No. 064-0
Purpose:
Method(s):
Conclusion(s):

Author(s): Gurtz, M.E., and Wallace, J.B., 1984
Title: Substrate-mediated response of stream invertebrates to disturbance
Source: Ecology 65:1556-1569
Purpose:
Method(s):
Conclusion(s):

Author(s): Meehan, W.R., 1971
Title: Effects of gravel cleaning on bottom organisms in three southeast Alaska Streams.
Source: Progressive Fish-Culturist 33:107-111
Purpose:
Method(s):
Conclusion(s):

Author(s): Orcutt et asl (1968)
Title:
Source:
Purpose:
Method(s):
Conclusion(s):

Author(s): Prokopovich, N.P., and Nitzberg, K.A., 1982
Title: Placer mining and Salmon Spawning in American River Basin, California
Source: Bulletin of the Association of Engineering Geologists 19:67-76
Purpose:
Method(s):
Conclusion(s):

Author(s): Sigler, K.V., et l, 1984
Title: Effects of chronic turbidity on density and growth of steelhead and coho salmon.
Source: Trans. M. Fish Soc. 113:142-150
Purpose:
Method(s):
Conclusion(s):

Regarding Dredging, sluicing, and panning

Dredging, panning, and sluicing not only improve salmonid habitat but can also create new habitat.

Salmonid eggs and alevins (alevins are tiny newly hatched salmonids which still reside in the interstitial spaces among the gravel of the streambed) need clean gravels through; which interstitial water can flow, providing them with oxygen. Silts and fine sands reduce the porosity of the streambed, thereby, reducing the interstitial flow and the oxygen supply. It can also reduce the amount of interstitial space for alevins. Reduced porosity has been shown to be directly related to reduced survival of salmonid eggs and alevins.

If properly conducted (for example, according to the present guidelines in Washington State — WDW 1987) dredging, panning, and sluicing reduce the amount of fine sand and silt in the streambed and, thereby, improve its porosity. These activities will, therefore, result in better interstitial flow, a better interstitial oxygen supply for eggs and alevins, and more interstitial space for alevins. The net result is improved survival for salmonid eggs and alevins.

Thus, dredging, panning, and sluicing improve existing salmonid habitat and can also create new habitat. These activities should be encouraged.

Habitat for salmonid eggs and alevins — the importance of streambed porosity:

Pink Salmon: As William R. Heard pointed out in his (1991) review "Pink salmon choose a fairly uniform spawning bed in both Asia and North America. Generally these spawning beds are situated on riffles with clean gravel or along the borders between pools and riffles in shallow water with moderate to fast currents. . . . pink salmon avoid spawning in quiet deep water, in pools, in areas with a slow current, or over heavily silted or mud-covered streambeds."

Pink salmon *(Oncorhynchus gorbuscha)* spawning sites may be characterized as being clean gravels. However these sites may also have a few cobbles, a mixture of sand, but relatively little silt (Semko 1954; Kobayashi 1968; Dvinin 1952; Smirnov 1975; and Hunter 1959).

The faster the current, the larger the particle which will be suspended and carried off by it. Hence, a strong current provides some guarantee that silts and fine sands will not plug up the interstitial spaces. The more rapid flow is also turbulent. The eggs and alevins are provided with a good oxygen supply by the turbulent mixing of water into the interstices of the streambed.

The porosity of a streambed and the survival of eggs and alevins has been demonstrated to be directly related to the composition of the streambed, being lower where there are more fine sands and silt (McNeil and Ahnell 1964; Rukhlov 1969; Brannon 1965; Bams 1969).

Chum **Salmon:** In contrast, to pink salmon which preferentially select riffles, chum salmon *(Oncorhynchus ketd)* tend to select sites of upwelling spring water (Kobayashi 1968). These sites often have a lower flow rate than is found at pink salmon sites (Bams 1982; Soin 1954; Sano and Nagasawa 1958). Chum salmon spawning sites may be found directly below a pool which is partially obstructed at its lower end by a gravel bar. The water infiltrates the gravel bar, travels through the bar as ground water, and reemerges into the water column below the bar.

Interstitial flow is as important for the survival of their eggs and alevins, as it is for the pink salmon. However, in this case the oxygen is carried into the groundwater by convection (that is by the net movement of water into and then out of the streambed) rather than by turbulent mixing. However, in some cases turbulent mixing may also be an important factor at chum spawning sites.

Sockeye Salmon: Sockeye salmon *(Oncorhynchus nerka)* spawn either in streams or in areas along lake shores which have underwater springs. There is also a case of beach spawning where turbulence provides the oxygen supply (Olsen 1968). Spring-fed and Beach spawning sites often have lower oxygen levels than stream sites and sockeye eggs have some ecological and physiological adaptations which improve their survival under those slightly reduced oxygen levels. (Smirnov 1950; Soin 1956, 1964). However, their oxygen supply (and, hence, substrate porosity) remain an important factor affecting their survival.

Coho Salmon: Coho salmon *(Oncorhynchus kisutch)* mostly spawn in small steams in areas of gravel of 15 cm or less in diameter (Burner 1951). In some cases Burner found that the spawning sites contained mud, silt, or fine sand, but that this was removed in the nest-building activity. Chamberlain (1907) concluded that coho are the least selective of the salmon species about their spawning site — he found them spawning in almost every stream or river in a very broad range of sites from smoothly flowing to white water and from cobble to muddy His conclusion was also supported by Foerster (1935) and Pritchard (1940).

However coho appear to prefer small streams (Gribanov 1948) and select a site at the head of a riffle where there is a good interstitial flow (Shapovalov and Taft 1954). The porosity of the streambed and the flowrate of the stream are also important factors affecting site selection (Briggs 1953; Gribanov 1948). Survival has been shown to be related to the porosity of the streambed (Tagart 1984).

King Salmon: King Salmon *(Oncorhynchus Tshawytscha)* show strong selectivity for spawning areas with high interstitial flow rates (Vronskiy 1972; Russell et al. 1983). Mike Healey (1991) suggests that of all the salmon species, king salmon may be the most sensitive to reduced oxygen levels during the egg and alevin stages. Their sensitivity to the oxygen level was experimentally demonstrated by Silver et al. (1963). The strong relationship between survival and the percolation rate of oxygenated interstitial water was experimentally demonstrated by Shelton (1955) and demonstrated under field conditions by Gangmark and Broad (1955) and Gangmark and Bakkala (1960).

As Mike Healey (1991) points out, "There is no doubt that percolation is affected by siltation and that siltation in spawning beds causes high mortality (Shaw and Maga 1943; Wickett 1954; Shelton and Pollock 1966).

Caveats: Bear in mind that spawning habitat limitation may not be the mechanism limiting the abundance of any specific stock of salmon. There is an absence of support for the habitat limitation hypothesis, except in a few isolated cases. Nevertheless, the enhancement of habitat and the improvement of survival for eggs and alevins axe generally desirable goals.

Also bear in mind that in areas which have no fish, restrictions on dredging, sluicing, or panning aren't needed. An example of such as area is the region of a watershed above an impassible barrier, whether it is a dam, waterfall, or rapid.

In areas which have fish, recreational mining activities should be restricted to times of the year such that eggs and alevins aren't buried under silt and fine sediment while they are still in the gravel. Such regulations are already in place in Washington State.

Effects of dredging, sluicing, and panning on the porosity of the streambed:

Generally these activities involve the removal of sediment material from the streambed or, more often, from a gravel bar. The fine components of the sediment become suspended in the wash water and are carried downstream. The finer the sediment the further it will be carried. However, it will eventually settle, often in a quiet pool area.

What is involved here is the movement of the smaller particles out of a riffle area and into a pool area. Generally this will improve the streambed porosity in the riffle area. Recall that riffles are generally the preferred spawning habitat.

Medium sized particles may deposit in the riffle area. During the next major peak-flow event both the fine sediments and the medium sized particles will often be carried far downstream.

Thus, the effect of mining is to increase the downstream transport rate for fine and medium sediments. The consequence must be that the stream-system as a whole will have fewer of these sediments. This will result in greater streambed porosity. As the literature I have reviewed above shows, for all salmonid species greater porosity results in better survival and more available habitat for eggs and alevins.

In the case where the sediment is removed from a bar, rather than from the streambed, it is necessary to consider a longer time period — Stream courses aren't stationary but move within the confines of the streambanks. Fine sediments in gravel bars will be resuspended in the stream during these natural movements of the stream over the course of several years.

However, if the bars have been mined on a regular basis, their fine and medium particles will already have been removed before the river naturally resuspends them. Gravel bars which are free of silts and fine sand provide habitat. Although these bars may appear dry, there is often water and interstitial spaces below the surface, which can support alevins and redds (that is, nests of eggs) which were laid during high-water.

Recommendation:

The conclusion is that the recreational mining activities of panning, sluicing, and dredging enhance salmonid habitat. These activities should be encouraged. They provide one of the most cost-effective enhancement techniques as they are a beneficial side-effect of private recreation.

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Sincerelv

Dr. Robert N. Crittenden
March 2, 1996

United States Department of Agriculture | Forest Service | Nez Perce National Forest | Rt. 2, Box 475
Grangeville, ID 83530-9699
(208)983-1950
TTY: (208)983-2280

File Code: 2810

Date: January 13, 1997

Dear Suction Dredger:

Enclosed is a copy of the 1996 monitoring report for recreational suction dredging on the Nez Perce National Forest. If you have any questions please call me at (208) 983-1950. I look forward to seeing you in 1997

Sincerely,

Nancy J. Rusho
Forest Geologist

enclosure

1996 RECREATIONAL DREDGING ON THE NEZ PERCE NATIONAL FOREST

The following is a report on the 1996 recreational suction dredging program on the Nez Perce National Forest. This is the second annual monitoring report.

Background

In the past, the Forest Service accepted the Idaho Department of Water Resources (DWR) Recreational Dredging Permit (RDP) as a Notice of Intent (NOI) to operate on National Forest System lands. Due to increased concerns on effects of dredging to aquatic resources, the Forest Service felt it was necessary to monitor the recreational dredging operations. The DWR permit did not provide information on location of the dredging operation allowing us to adequately monitor dredging. Therefore, in 1995 the Nez Perce National Forest began to require that each recreational dredger file a NOI with the appropriate District Ranger so we could track the true number of dredgers operating on the Forest. Also, a seasonal employee was hired to inspect and monitor the recreational dredgers on the Forest.

The Nez Perce National Forest has several dredge operations that are permitted under the non-recreational dredging permit system with DWR. This system requires that the operator file a Joint Application for a Stream Alteration Permit with the DWR and the Corp of Engineers. Many of the operators that had a non-recreational dredging permits could have operated under the RDP. Those operations that could have fallen under the RDP system, were only required to file a NOI. Most non-recreational dredging operations that are outside the realm of the RDP are required to file a Plan of Operations. This report focuses on the Recreational Dredging operations, but the non-recreational operations are discussed briefly.

1996 Program

This year two individuals assisted with completing suction dredge inspections. In June, the Red River and Elk City Ranger Districts' Minerals Administrator moved out of the Region. Because we were short-handed, I assigned the suction dredge inspectors to help with other administration. Inspections in June showed that no dredges were being operated. A majority of the streams on the Forest open to dredging on July 1 and close on August 15. This corresponds well with when the major amount of dredging is occurring on the Forest.

Throughout the summer we had an estimated total of 40 dredges operating on the Forest. The following is a breakdown of the dredges, by nozzle size, that were operated:

1	8-inch
1	6-inch
17	5-inch
10	4-inch
4	3-inch
1	1 1/2-inch
6	unknown, but not larger than 5-inch

The dredge count is based largely on inspections, and to a lesser degree on submitted NOIs. A majority of the dredges were only operated from a couple of days to two weeks. Although most dredgers indicate they work 8 hour days, our inspections show that most work when the weather is warm, and late morning to early afternoon. There were significantly more dredges operated on the Forest in 1996, but inspections seemed to indicate that actual dredging time in the water was very similar to that in 1995. Early in the season the water was higher and cooler than last year, which may have hampered some dredgers from starting earlier.

The following is a breakdown of the dredging operations by drainage:

Mule Creek

Mule Creek was the location of claims that are available for the use of Gold Prospectors Association of America (GPAA) members. There were seven dredges that may have operated in Mule Creek, 1 3-inch and the rest are unknown, but probably in the 2-inch to 4-inch size class. In general, the GPAA members tend to only dredge a day or two and so it is easy to miss seeing them. There were also a dozen or so gold panners. Inspections did not show any problems.

Newsome Creek

There were potentially 7 dredges scheduled to operate in Newsome Creek, one never dredged. Of the six that did dredge, three dredges were 4" or smaller, and three were 5" dredges. The dredges were operated off and on during the season. Inspections did not show any problems. There were reports of dredging occurring in a closed area and of some sort of a highbanking operation on one of the tributaries. Evidence of both were seen via inspections, but the operator was not on hand at the time. These two problems will be followed up on in 1997.

Crooked River

Seven dredges operated in Crooked River off and on throughout the July 1 - August 15 season. Four dredges were 5-inch and three were 4-inch. One dredger closed a Forest Service campground by blocking off the entrance. This was resolved with no problems. In another instance a four wheeler was driven across the river leaving ruts in a marshy area alongside the river. The dredgers in Crooked River were the most dedicated as a whole. Turbidity samples taken were well below the allowable levels.

Relief Creek

One 4-inch dredge was operated for a few weeks. This dredge by far stirred up the most turbidity. At times there was a turbid flume for well over a mile. Turbidity samplings still show this to be below the allowable limits.

Leggett Creek

No dredgers were observed operating in Leggett Creek.

Little Moose Creek

One 4-inch 5 HP dredge was operated for about a week. No problems were noted.

Red River

One 8-inch dredge, five 5-inch dredges, one 4-inch dredges and one 3-inch dredge were operated during the dredging season. One 5-inch was operated off and on throughout the dredging season. The rest of the dredges were operated from a few days to two weeks. Turbidity samples were well below the limits.

South Fork Clearwater River

The South Fork is open year round and is the largest waterway that is dredged on the Forest. One 6-inch dredge, five 5-inch dredges, one 4-inch dredge and one 1 1/2-inch dredge operated during the season. Most of these dredges were only operated a few days to a couple of weeks. Inspections were not as regular after August 15 because both inspectors returned to school. Casual inspections were made. No serious problems were noted. Several people were concerned with the intensive dredging of a sand bar. The sand bar was located between the high water marks. In another area, dredgers camped in a wide area near a pack bridge. This created a safety problem for people with stock crossing the road and approaching the bridge. The animals would be forced to walk much closer to the busy highway prior to crossing the bridge. This problem will be corrected in 1997, if it occurs again.

Florence Basin

Florence Basin is the site of several GPAA claims. There were many panners that were in the area. It is believed that only two 3-inch dredges were operated in the Florence area during the summer season. These dredges were not observed operating.

Summary

In general the inspection reports did not indicate any severe problems at any of the suction dredging sites. Most sites showed some trampling of stream side vegetation where the operators accessed their dredges. Some sediment plumes were as extensive as being visible a mile downstream. Turbidity increased when dredge was being operated in a clay layer. Dredging activity seemed to be low due to the weather and high waters early on.

Because of shortages of minerals inspectors, the suction dredges weren't inspected as much as in 1995. It did not appear that this resulted in any problems, just less accurate data on the number of dredgers and the amount of time they spent dredging. This should be corrected by 1997.

Monitoring

We felt that we also needed to try to get a handle on quantifiable impacts of suction dredging. With that in mind, Nick Gerhardt, Forest Hydrologist, with input from fisheries biologists developed a monitoring plan. Suction dredging can have a variety of impacts to streams, affecting both the water column and stream substrate. For monitoring we decided to try to quantify the effects of dredging on these two components. Turbidity was the recommended parameter to measure water column effects and particle size distribution was recommended for stream substrate.

To measure turbidity, a special sampler is used to collect water samples above and below dredging operations. The Wolman Pebble Count method was used to measure particle size distribution.

Monitoring Results

The pebble count data that was collected in both 1995 and 1996 is still waiting to be processed (the Fisheries Biologist originally assigned to this task tranferred to Region 2). This data should be processed in the next couple of months. The turbidity measures were taken on the operations that were causing a lot of visible clouding of the water. The following lists the results of the turbidity measures that were taken:

TURBIDITY SAMPLES

8/8/96	Crooked River below dredge	1.5 NTUs
8/9/96	Crooked River above dredge	0.81 NTUs
8/9/96	Crooked River below dredge	2.2 NTUs
8/10/96	Red River above dredge	1.2 NTUs
8/10/96	Red River below dredge	3.4 NTUs
8/5/96	Relief Creek above dredge	0.66 NTUs
8/5/96	Relief Creek below dredge	7.1 NTUs
7/30/96	Red River above dredge	0.88 NTUs
7/30/96	Red River below dredge	1.00 NTUs
7/30/96	Red River above dredge	0.47 NTUs
7/30/96	Red River below dredge	1.6 NTUs
7/30/96	Red River below dredge	2.3 NTUs
7/30/96	Red River above dredge	0.74 NTUs
7/30/96	Red River below dredge	1.3 NTUs

The turbidity samples that were taken did not exceed State Water Quality Standards. The Idaho Water Quality Standards were amended in 1994 to incorporate turbidity criteria for streams with designated or existing cold water biota beneficial uses. The criteria read as follows:

> Turbidity, below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more the ten (10) consecutive days.

Turbidity measures are taken below and above the dredging activity. Those samples taken below the operation are taken below the mixing zone, not directly in the most turbid area.

Conclusions

In general, a majority of the suction dredge operators were very cooperative and helpful. **Very few problems were encountered directly related to the dredging activity.** One dredge may have been operating in a closed area without an approved Plan of Operations. This area will be checked more closely in 1997. For 1997 we will continue the inspections, but try to concentrate on accurate counts and on processing the pebble count data.

MORE PERTINENT INFORMATION FOR SUCTION DREDGE MINING

Badali, Paul J. 1988, Prepared Statement to State of Idaho, Dept of Water Resources, Recreational Dredging seminar, February 3, 1988, 13 pp. A synopsis of the statement by Badali follows:

Turbidity from dredge, even large dredges, operating on medium and larger sized streams returns to background levels within a short distance downstream, and is present only when the dredge is actually operated, a few hours per day. It appears to have little effect on adult fish feeding .

Inter cobble habitat is reduced downstream as sediments are deposited. But this change is short lived on streams with high flushing spring flows, which most gold streams have, appears to be a beneficial change to some species, and is partially offset by the creation of new inter cobble habitat in the cobble pile. The hole created by the dredging activity replaces the lost habitat.

Spawning bed destruction by the dredging activity has not been shown to be a problem. Salmonids have been observed spawning in gravel beds which are made up mostly from sorted material washed downstream from previous dredge tailing piles. If anything, dredging appears to add to the spawning gravel budget of a stream. With little stream bed movement, spawning gravel becomes scarce and of very low quality. Without flushing flows, something else must be done to loosen up the substrate, and flush out the fine sediments to create good spawning conditions if natural stocks are to survive. This is exactly what suction dredging will do. SUCTION DREDGING SHULD BE ENCOURAGED BY WILDLIFE AGENCIES ON WATERS WITH CONTROLLED FLOWS AS A CONSERVATIION AND FISHERIES MANAGEMENT MEASURE.

The presence of the dredger and dredge does not appear to be an annoyance to fish.

On Canyon Creek, the effects of multiple years of dredging, and multiple dredges on the creek do not appear to be cumulative. The Trinity River and the Klamath River in Northern California have received intensive suction dredge pressure in the lat 15 years, and their fish populations ARE PRESENTLY AT THEIR HIGHEST RECORDED NUMBERS. IF THERE IS A CUMULATIVE EFFECT, IT WOULD APPEAR TO BE BENEFICIAL.

A Balanced Perspective on Dredging.

Regulations are strictly enforced, and enforcement personnel closely monitor mining activity. Today's miners are environmentally conscious, and to some degree, they even police each other. Also, mining clubs and other organizations have been formed that teach responsible mining methods to new entrants, and admonish those who would act irresponsibly.

DREDGE MECHANICS

A dredge is a small mechanical platform that is mounted on floats. It consists of a small engine, a water pump, an inclined sluice ramp, and sometimes an air compressor to enable the dredger to breathe underwater. A suction hose is attached to the front of the dredge. Water is propelled through this hose by an injection of water from a water pump. This pumped water is injected into the dredge hose at a very shallow angle, and thereby causes greater volumes of water to be propelled up the dredge hose by what is known as the "venturi principle". None of the dredged water or material passes through any pump or mechanical device. The dredged material enters the front of the dredge, where it spreads out and slows down, and flows down over a series of small barriers known as "riffles, and then out the back of the dredge. It is now important to understand that gold is the heaviest element found in a stream. Gold has a "relative weight" of 19. (Water has a "relative weight" of 1.) Therefore, gold is 19 times as heavy as water of equal volume.

Water and streambed materials will readily travel down this sluice mechanism and out the back of the dredge. Because gold is so heavy, it will drop out of the material flow and become lodged in these "riffles". This is how miners capture the gold and not everything else. Other things that are relatively heavy, though not as heavy as gold, will also become lodged in the sluice. This includes "black sand" which contains quantities of iron, fishing lures, tools, metal trash, lead sinkers, nails, bottle caps, beer can tabs, and just about any other form of human junk that is unearthed by the dredge. Also, poisonous mercury from ancient mining methods is often captured in a dredge, and can now be safely disposed of. A dredge is somewhat of a "vacuum cleaner", and in addition to capturing gold, can help significantly to remove trash from a streambed. This "concentrated" material is removed from the dredge sluice at the end of the day, and usually taken back to a campsite or other location where it is "panned down" with a gold pan. The gold is captured, and the trash is properly disposed of.

SIZE AND SCALE:

Compared to the natural lay of a stream, dredging activity is quite insignificant. Even in the most heavily dredged regions, the area affected by dredging is almost always less than even one percent of the area of a stream. A dredger who moves a single cubic yard of material has done a very hard day's work. This is because a dredger very seldom works a full day in the stream. Dredging is exhausting work. The streambed materials are often impacted, and require difficult digging with tools to penetrate. Also, anything too large to go through the dredge hose must be dug up and moved manually to a location nearby, and a dredger must stop a great many times per day to clear a dredge hose that has become plugged. In addition, a dredger must get fuel to the dredging location, along with food and supplies. A dredger must also perform maintenance on his/her dredge, and get into a wetsuit and secure all tools that they will need. Also, the water in the stream will often be colder in the early part of the day, so a dredger often will not start before mid-day. A dredger must also stop occasionally to rest and consume food or drink, and refuel their engine. A typical dredger will usually be accomplishing "productive work" between two and four hours a day in the stream. And, due to the exhaustive nature of the activity, along with things such as weather considerations, a dredger will seldom work every day.

The typical dredging operation will involve working a hole down through the streambed material until they reach solid bedrock, where gold, being the heaviest thing in the stream, has settled. Gold, as well as all other streambed material is moved downstream by raging winter floods. This gold will readily become lodged in cracks and crevices in the bedrock. It is primarily these imperfections in the bedrock that the dredger is looking for. The dredger suctions the easily moved materials with the dredge hose. Anything that is too large for the dredge hose must be manually moved to one side. Once the bedrock is reached and cleaned, if reasonable gold has been found, the dredger will usually expand their hole off in another direction, dropping material back into the area they originally dug out. There are particular areas of a stream or river where gold is most likely to be found, but it is still mostly a matter of chance.

DREDGING DAMAGES EQUATIC PLANTS.

First of all, there is nothing that will plug up a dredge and rob the sluice section of gold any faster than running vegetation and the silty, clay-laden soils that they grow in, through a dredge. Every dredger knows this. They simply don't do it.

Secondly, the calm areas of a stream or river where plants can find the needed soils to become established is not an area where gold will usually be found. The gold, and heavier streambed aggregates that contain gold, will have settled out considerably upstream in much faster water. Every dredger knows this.

DREDGES FRIGHTEN FISH, AND CAUSE THEM STRESS.

Actually, the opposite is true. In a dredge hole five feet wide by six feet deep, it is not uncommon to see over a dozen juvenile fish in the hole, in close proximity to the operator. They are usually looking for edible tidbits that are unearthed by the dredger or they have ducked into the hole to rest from the currents. There are hundreds of hours of media videotapes showing this.

The motor on a dredge is shock mounted to the frame, and is almost not audible underwater. Many times, the only way that a dredger knows that his/her engine has run out of gas is by the fact that their air supply quits, and the dredge hose stops suctioning.

This requires a mad scramble to the surface. The most prominent sound when operating a dredge is a "whooshing" sound made by aggregates going up the dredge hose. This is much like the normal rushing sound that you will hear underwater in any stream. Fish routinely swim all around a dredge looking for food. They are not a bit frightened of it.

DREDGES RAISE THE TEMPERATURE OF THE WATER, WHICH KILLS FISH.

This claim is completely false. First of all, the only thing that is warm or hot on a dredge is the engine. Absolutely no water comes in contact with the air-cooled motor, or it's hot exhaust. Dredges are not like outboard motors where the hot (and oily) exhaust is vented underwater, and the engine is cooled by water. If a dredge has any effect on the temperature of water at all, it probably cools it slightly, due to the aeration and evaporation of the water as it flows over the riffles of the sluice.

Scientists have measured water temperatures of numerous streams and rivers above and below a dredge, and were unable to measure any discernable difference whatsoever with the instruments that were available to them. Given the design of a dredge, this is not surprising.

THE DREDGE HOLE:

Dredging is very hard work, so a miner generally tries to find a location where he/she will not have to dig down more than a few feet to reach bedrock. The ideal bedrock is just a few inches beneath the streambed. However, a dredge hole can sometimes be as deep as four to six feet. More than this is quite rare. If not continuously worked, a dredge hole will usually fill back in after a short period of time due to the natural flow of aggregates in a stream. Winter floods will erase all traces of it.

As mentioned before, dredging involves working a hole down to bedrock, and piling cobbles too large to feed into the dredge to one side. This leaves a hole in the streambed with a pile of cobbles beside it. Much of the time, there is not even a cobble pile, because as the dredger moves his/her activity along the streambed, it is easier to drop the cobbles behind them, back into the hole where they were working previously. There is also a "tailing pile" immediately downstream of the dredge. This tailing pile is composed of the smaller aggregates that came out the back end of the dredge. And, a larger rock or boulder may have been tumbled to one side by the dredger, although it is most common for a dredger to work around a boulder or tumble it into the dredge hole.

The annual spawning migration is a very strenuous trip for fish, and there is a significant mortality of fish during this migration. The fish become weakened by their constant struggle against the water currents. Most importantly though, is the fact that fish migrate during the time of year when the water is at it's warmest. Warmer water contains less oxygen, heightens the chance of disease, and saps the strength of fish. Fish will often pause in an area of river where a cooler side-stream enters the river to regain their strength. These areas are known as thermal refuges. Migrating fish will frequently duck into vacant dredge holes where the water is calm and the temperature is stratified with the cooler water being near the bottom. Frequently, a dozen or more adult fish can be observed using dredge holes. In many instances, fish seem to prefer dredge holes to natural refuges, possibly due to the depth and calm water.

COBBLE PILES:

These are rocks that will not pass through the dredge hose and consequently are piled to one side by the dredger. They usually range in size from roughly 12 inches in diameter down to about 2 inches, depending upon the size of the dredge. Larger than this, the rocks are generally too heavy to pile. These piles represent a certain percentage of the aggregate removed from a dredge hole.

At this point in time it would seem proper to mention that dredging into riverbanks, undercutting riverbanks, and doing anything that would cause erosion of riverbanks is strictly forbidden by dredging regulations. There are heavy penalties for violating these regulations and every dredger knows it. And, enforcement personnel frequently monitor dredging operations. Dredging is a tightly regulated and monitored activity.

Secondly, dredging is usually not done adjacent to riverbanks, but closer to the deepest part of the stream or river, as this is where the gold has settled. In those places where the deepest channel is along the side of a river or stream, the bank is usually not composed of soil but rather by ledge, or gravels. The soil was eroded away eons ago by the natural river currents. It should also be mentioned that these cobble piles are very porous so the water flows through them as well as around them. When water encounters a cobble pile or even a boulder resting in a stream for that matter, the water splits, flows around both sides, and then closes back in on itself behind the obstruction, leaving a "pigtail" of turbulence that trails several feet downstream. There is no changing of the course of a river or stream. This is a cobble pile, not a diversion dam.

Fish generally spawn in the late fall in favorable gravel beds that they select as best they can. After a period of incubation, the small fish (fry) emerge from these gravels during the spring months. Many biologists regard this period immediately following emergence, (known as the "juvenile rearing" stage) as one of the most important stages in the life of a fish. It is important that as many of these (fry) as possible survive to the next stage, (smolt stage), which prepares them for their migration to the ocean.

Immediately after emerging, these fish are very small, they are relatively poor swimmers, and it is during this time that they are in great danger of predation. Fish lay eggs by the billions, but only a very small fraction of them ever survive to adulthood. The juvenile stage is a period of very heavy losses. It is extremely important that these juveniles find food to grow as much as possible, and it is infinitely important that they are able to find shelter from predation during this stage of their growth. This is where cobble piles come into the picture. Cobble piles provide an excellent refuge for these small fish. The passageways between rocks go deep within the pile, there is sufficient water flow to provide adequate oxygen, and they are virtually free from silt that is very important. Due to the varying sizes of the rocks and the resultant caverns, fish of various sizes can find a place within the pile that is most suitable for them. As they grow, they can move to a different area.

Shelter from predation is not the only benefit of a cobble pile. Biologists note that these juvenile fish attempt to remain within a very localized area if they are able to do so. During periods of high flow such as dam releases, thunderstorms, etc that cause elevated flow, these fish are often swept away from their preferred location, as they cannot always find refuge from these currents. Cobble piles provide that needed shelter from these swift waters.

TAILING PILES

These are the piles of small to medium dredged aggregates that come out the back of a dredge.

A streambed is an environment that is constantly being changed by water flow. Each year, the riverbed erodes a little bit more and some of the streambed material is moved. This streambed material can range from fine silt to huge boulders and there can be other things that fall into the stream or river from it's banks such as parts of trees and brush. Streambed composition varies from place to place and from year to year.

When fish spawn in the late fall, they try to select a streambed area that is shallow, relatively flat, free of fast currents, and comprised of loose gravel in which they can lay and bury their eggs. Successful reproduction by fish is highly dependent upon the available quantity and quality of these spawning sites. Once fish lay their eggs, these sites are known as (redds).

Since the composition of tailing piles is often similar to the loose, gravely material that spawning fish prefer, they occasionally select a tailing pile as their spawning site. Fish greatly prefer natural spawning beds to tailing piles, and the extent to which fish select tailing piles is dependant upon the availability of natural beds. A recent biological study in Northern California found that out of a total of 372 "redds", 12 of them, or roughly 3 percent, were on tailing piles. Elsewhere, it has been observed that when natural beds are scarce, the selection of tailing piles increases. In rare instances where spawning fish have entered streams in which the streambed has become compacted or silted-over, and there are no natural beds available, tailing piles offer virtually the only suitable opportunity to spawn.

There are two primary concerns with regard to the survival rates of the eggs within these redds. Scouring and siltation can cause mortality within these redds. Scouring occurs when the unstable material of a streambed is moved downstream. This movement is usually greatest during the winter floods. Siltation, or the covering of redds by silt, is of far more concern than scouring. Although the extent of mortality by scouring is not of a known quantity, mortality by siltation is often complete as the eggs and pre-emergent fish become smothered by silt. Biologists have even suggested that a certain amount of scouring is actually necessary to limit silting in some of these spawning beds.

Due to the fact that newly created tailing piles have not had the opportunity to go through a winter flood, and become flattened and stabilized, there is more movement and scouring in these piles than there would be in a normal streambed spawning site. This can possibly result in greater mortality for eggs that were laid in tailing piles. It has been noted, however, that once these tailing piles have become flattened and stabilized by winter floods, they can remain viable as a suitable spawning site for a period of several years. This is extremely important in streams where there are few or no natural sites created. Even during the first season when scouring would likely be at it's greatest, these tailing piles afford at least some opportunity to successfully spawn in a stream that might otherwise provide none. And this opportunity can continue for several years. Also, these stabilized tailing piles should be less susceptible to silting due to the fact that even though they are flattened and stabilized they can often remain slightly elevated above the surrounding streambed. And, these tailing piles start out as washed streambed material; therefore they are free of silt in the first place. It is not known how many of the "natural beds" that are counted by biologists are actually former tailing piles that have become flattened.

DREDGING CREATES TURBIDITY IN THE STREAM

First of all, dredging is only permitted within the wetted area of a stream. Dredging into a "loamy" area along stream banks is forbidden. The streambed materials that are suctioned by a dredge are materials that are constantly washed by stream currents. Therefore, these materials are virtually free from the finer particulate material that can "cloud-up" the water and remain suspended for a prolonged period of time. Most of the material that comes out of the back of a dredge sinks immediately, usually within two or three feet. Some of the finer particles can travel further downstream in a narrow plume that is sometimes visible from above the water. Depending upon the speed of the flowing water, this visible plume largely dissipates within 25 to 50 feet downstream of the dredge, and it is rare for it to extend beyond 100 feet.

To get some idea of the level of turbidity that is usually created by a dredge, we must understand some facts about dredging. A dredger cannot operate in water where there is an appreciable level of turbidity at all. When visibility is impaired, dredgers cannot see what they are doing. They cannot see the gold that is trapped in crevices, and rocks that are too large will get suctioned by the dredge nozzle and plug the dredge hose. These plug-ups are very difficult to remove. In addition, dredgers cannot see the looming danger of boulders that could tumble in on them, and injure or kill them.

It is common (in some states) for dredgers to set up within 50 or 100 feet downstream of each other with no visibility problems. Yet, events such as dam releases or thunderstorms will cause the level of turbidity in the stream to rise to the level that dredgers often have to abandon their activity for several days. Even within a normal dredge plume, the level of turbidity is only a mere fraction of what is created by naturally occurring and long-enduring events such as storms, and winter floods, which fish routinely endure.

As with many other aspects of the relationship between dredgers and fish, this particular aspect also has a benefit. Biologists have noted that juvenile fish who are suddenly threatened by a predator will readily duck into a dredge plume or any other turbidity for cover.

Excessive clouding of a stream or river with a dredge is strictly forbidden by dredging regulations. There are severe penalties for doing so. As mentioned before, dredging is heavily regulated and monitored by enforcement personnel.

DREDGING KILLS INVERTEBRATES IN THE STREAMBED

This is to be expected, but it is very minimal. Anytime soil is disturbed, organisms that live in that soil are killed or exposed to predators. When we dig for fishing worms in our back yard, multitudes of soil-dwellers are affected. Can you imagine the devastation when we rototill a garden? Fortunately, they will re-colonize very rapidly. A biological study done in 1981 found that less than 1 percent of the invertebrates in four different rivers that were entrained in a suction dredge perished. Re-colonization of the affected areas was complete within 4 to 6 weeks. It should be noted that during the time of this experiment, dredge design was significantly different than it is today. Years ago, dredges were equipped with a header box, or "crash box" as it is sometimes known. Dredged material would enter the front of the dredge and crash into the back wall of this box. The material would then drop down, slow down, spread out, and then flow down over the riffles of the sluice, and out the back of the dredge.

Dredges are no longer designed with this header box. Modern dredges now employ a device known as a "diffuser" pipe. The dredge hose connects to the bottom of this diffuser pipe, which increases in size and flattens out as it enters the front of the dredge. This causes the dredged material to slow down and spread out. It then flows down over the riffles in the sluice. Incidentally, this change in design was not made because of any concern for biological organisms because there was not a perceived problem with this, but rather to reduce the incidence of plugging, which was a problem with the header box design.

This would be an appropriate place to also mention that this unearthing of invertebrates is very beneficial to fish. It is important that juvenile fish find sufficient food to enable them to grow as much as possible in preparation for their future migration. Juvenile fish can routinely be observed swimming through a dredge plume, searching for these invertebrates, which are plentiful. Ironically, one does not have to be a scholar to question the fact that when fish are being fed with grain in a fish hatchery, it is considered an ultimate act of conservation, but when fish are feasting on their natural diet in a dredge plume, it is somehow biologically unimportant. A dredger who spends a month or two in a given section of river has fed a lot of fish.

FISH ARE SUCKED INTO A DREDGE AND KILLED

This is very unlikely. Even the smallest of fish are nimble enough to avoid entrainment by a dredge nozzle. Fish routinely hover around a dredge nozzle, often closer than 12 inches. When the dredge nozzle is moved toward them, they quickly dart out of the way.

An experiment was done in 1981 whereby biologists intentionally fed 36 fish into a dredge to determine what harm would occur as a result of this entrainment. There was no mortality. All 36 of the fish survived. The fish ranged in size from juveniles to adults. (It should also be noted that during that period of time, dredges were manufactured using the old "crash box" design.) This experiment is so profound and potentially unbelievable that I will cite it. (Griffith and Andrews: 1981).

Recent biological opinion is that entrainment of fish by a dredge is unlikely, and even if they should become entrained they will likely survive it.

Dredging is a very visible form of mining. Dredgers do not crawl into a hole in the side of a mountain. They do not dig in a pit that is surrounded by a privacy fence. Their activity is out there for all to see. One can usually look down into a river and see their dredges floating on the water. There is often a visible plume trailing downstream from them. One can hear the distant drone of a lawnmower-sized engine, and if the stream is exceptionally clear one can often see the dredge hole and cobble pile that are underwater. Dredgers frequently park vehicles beside a roadway, near to where they are working. To some, this intrusion into nature is disturbing. However, at the same time, dredging is perhaps the most reversible form of gold mining that there is. The winter floods that occur after each dredging season obliterate virtually all traces of dredging activity. The dredge hole is completely filled in, the cobble pile is leveled, and the tailing pile is flattened and spread out, offering itself as a potential stable spawning site for years

CRITICAL INFORMATION PERTAINING TO SMALL SCALE MINERAL PROSPECTING AND MINING.

The following information may be informative to the stakeholders for the process of developing the Gold and Fish Pamphlet, Washington State.

EPA; ROYER, PRUSSIAN AND MINSHALL:

"No difference between sediment composition within mined areas and those in reference areas particularly in the amount of deposited fines"
'No downstream influence on bed morphology by dredge sediments'
"This study was "Worst Case Scenario.
Impacts by suction dredging are contained within mined areas persist for about 1 month after mining season.

MOTHER LODE RESEARCH from California Final Environmental Impact Report. Suction Dredging, Highbanking, and Sluicing.

'Suction dredging did not do long term damage or cause significant overall loss of specie habitat or population compared to other uses. Suction dredging ranks far down on the list of environmental degradation causes.'

Highbanking; 'not considered significantly adverse'. Takes place on gravel bars, gravel pits, etc. "Cannot return muddy water directly into the stream, to either a small settling pond or into the ground.'

'Small sluices are not prohibited and neither are metal detectors.

"However, in the face of changes of environmental degradation by a few, wiser heads in agencies have demanded FACTS. And when they've received facts have discovered there is NO single incidence of a

significant loss of species or their habitat due to prospecting thus discovering no reason to remove a RIGHT from a sector of the public."

NEZ PERCE NATIONAL FORREST, 1997.

1996 monitoring report on suction dredging:
' Up to 8" dredges (1)
'Mule Creek—dozen panners—Inspections did not show any problems."
Conclusion; Per suction dredging—"very few problems were encountered directly related the dredging activity."

RCW 77.55.231.

'(1) Conditions imposed upon a permit must be REASONABLY related to the project. They must provide proper protection for fish life. But the department may not impose conditions that attempt to optimize conditions for fish life that are out of proportion to the impact of the proposed project.'

SOUTH DAKOTA MINING ASSOCIATION V LAWRENCE COUNTY.

"The Federal Mining Act of 1872, 30 U.S.C. subsection 21-22, prevented the County from enforcement of an ordinance to grant new or amended permits for surface metal mining on any claim in the Spearfish Canyon area. "
Also,,,.Perez v Campbell, 1971, "Any state legislature which frustrates the full effectiveness of federal law is rendered invalid by the SUPREMACY CLAUSE regardless of the underlying purpose of its enactors. When it is impossible to comply with both the state and federal law, or where the state law stands as an obstacle to the accomplishment of the full purpose and objectives of Congress.

Peters v Union Pacific R.R.Co, 1996. Congress codified its declaration of the federal government's policy towards mining: "Congress

declares......policy of the Federal government in the national interest to FOSTER AND ENCOURAGE private enterprise in (1) the development of economically sound and stable domestic mining, minerals, metal and mineral reclamation industries, (2) the orderly and economic development of domestic resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security, and environmental needs, (3, (4).....”

The Mining Act provides for free and open exploration of public lands for valuable mineral deposits. 30 U.S.C. subsection 21a.

The Supreme Court has stated that the Congressional intent underlying this section is to reward and encourage the discovery of economically valuable minerals located on public lands. 30 U.S.C. subsection 22.

U.S. v Coleman, 1969. Congress.....”Locators of mineral deposits on federal lands under Subsection 22 shall have the EXCLUSIVE RIGHT to extract those minerals if they comply with Federal law and state laws that do not conflict with the Federal law.”

Congress—Purposes and objectives in the Mining Act: Include encouragement of exploration for and mining of valuable minerals located on Federal land, providing federal regulation of mining to protect the physical environment while allowing the efficient and economical extraction and use of minerals, and allowing state and local regulation of mining SO LONG AS SUCH REGULATION IS CONSISTENT WITH FEDERAL MINING LAW.

Final Decision: SDMA v Lawrence County: “A local government cannot prohibit a lawful use of the sovereign’s land that the superior sovereign itself permits and encourages. To do so OFFENDS both the PROPERTY CLAUSE AND THE SUPREMACY CLAUSE OF THE FEDERAL CONSTITUTION.”

“HARM”—EPA DEFINITION (FINAL). November 8, 1999.

Section 9 of ESA—Makes it illegal to take an endangered species of fish of wildlife, “take” is to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

NMFS—Interprets Harm...As an act which "ACTUALLY" KILLS OR INJURES fish or wildlife. Such an act may include significant habitat modification and degradation where it "ACTUALLY" KILLS OR INJURES fish or wildlife by significantly impairing behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering.

"NMFS is not seeking to impose a regulation that denies landowners economically viable use of their property."

"NMFS—An act must be REASONABLY CERTAIN to impair essential behavioral patterns of listed species in order to constitute "HARM" within this definition. In all instances a causal link must be established between the habitat modification and the injury or death of listed species."

"NFMS may permit non-federal parties to "TAKE" a listed species if such a taking is incidental to, and not the purpose of, an otherwise legal activity."

FINAL DEFINITION----"Harm in the definition of "TAKE" in the ACT means an act which ACTUALLY KILLS OR INJURES fish and wildlife. Such an act may include significant habitat modification or degradation which ACTUALLY KILLS OR INJURES fish or wildlife by significantly impairing essential behavioral patterns including, breeding, spawning, rearing, migrating, feeding, or sheltering."

WDFW—2003 MINER'S REQUEST FOR STUDIES ON PANNING, SLUICING, AND HIGHBANKING:

WDFW, Carol Turcott (Information Office) "I am told that most likely there are not any studies on gold panning, sluicing or highbanking included in the department's Gold and Fish Pamphlet files."

TRACEY LLOYD, WDFW BIOLOGIST, REGION 2; SUMMARY—COMMENTS SUGGESTIONS FROM WASHINGTON PROSPECTORS TO BE CONSIDERED FOR REVISION OF GOLD AND FISH PAMPHLET. Post Rally, 2003. Dr. Peter Birch attended Rally of 2003.

Item #15. Eliminate DNR's lease requirements for DNR owned and managed lands for small-scale mining and prospecting if done consistent with the G and F Pamphlet.

Item #19. Let's get rid of the 200' between excavation sites. What does this rule have to do for fish protection?

Item #29. Reducing the embedded spawning habitat in some areas has been identified as needed in many "LIMITING FACTORS ANALYSIS REPORTS".

Item #32. Compare how nozzle sizes were regulated in the Blue Book (1987) and the 1999 Gold and Fish Pamphlet.

Item #44. De-regulate areas where fish aren't present, (type 4 and 5 waters) exposed gravel bars, beaches, above fish barriers, etc from the Hydraulic Code. Tracey's Comment: "Sounds like a good idea to me and consistent with the purpose of the Hydraulic Code."

Item #78. Make it CLEAR the Gold and Fish Pamphlet is not required for metal detectors. Place this statement on the front cover at the bottom, in different color lettering that stand out.

NINTH COURT OF APPEALS (2005):

The Court says; "Environmental activists must prove harm to species, not just allege it, to invoke the Endangered Species Act......must present actual evidence that a species is likely to be harmed before an injunction can be issued against a property owner and that a lack of evidence of a past harm is indicative of the likelihood of future harm. Plaintiffs presented no evidence that bull trout were being harmed to support their claim."

"The Ninth Circuit said that if the evidence shows a bull trout has not been harmed in 40 years, it isn't likely to be harmed in the next 40 years."

Bruce Beatty, Washington Miner's Council, G and F Stakeholder.

HIGHBANKING IS A RARE AND INFREQUENT, BUT TEMPORARY OCCURANCE!

California v US,, In 1989, The water user who puts the project water to beneficial use obtains a 'vested property interest' in the water right.

Ickes v Fox, The principle of the proprietary interest in the project water right is in the project water users who put the water to beneficial use has bee reaffirmed by the Supreme court on 2 occasions (Nebraska v Wyoming and Nevada v U.S.

Arizona v California—U.S. Supreme Court extended the "Reserved Rights Doctrine "to include other federal reservations—for the first time ever the U.S. Supreme court recognized federal proprietary water rights. 1980 Indian and Federal Reserved Rights.

30 U.S.C. 612.
The federal Government has the right to manage the surface and "surface" resources on mining claims and sites located under the mining law after July 23 1955, and many claims located before that date.

A state cannot override federal law.

QUESTION: "IS THERE A MEMORANDUM OF UNDERSTANDING (MOU) BETWEEN THE U.S. AND WASHINGTON STATE FOR WATER APPROPRIATION ON FEDERAL RESERVED LANDS?"

AMERICAN BAR ASSOCIATION 2006. "Business Law Today".
A water right in the west is the right to take a quantity of water either from a surface water body…and to use that water for a beneficial purpose. Once used for a beneficial purpose, a water right becomes "vested" to the property on which the water is used. Once vested the property in perpetuity, regardless of ownership, provided the use remains unchanged and continues without abatement. This is known as the "Prior Appropriations doctrine".

Special words

Implied, Impliedity.
Non-consumptive v Consumptive.
Hydraulically connected to stream, provides upwelling for eggs and sac-fry.
9 Miners inches.
Current Gold and Fish Pamphlet authorizes 'minor hydraulic projects.

Carol Piening, Environmental Planner
Aquatic Resources
1111 Washington St. SE
Olympia, Wa. 98504-7027

Subject: Wa. DNR HCP Proposal. November 14, 2006.

Dear Carol

To begin with, I am a small-scale miner/prospector that may be impacted by this HCP. This HCP, if I understand things correctly, refers to only historical navigable rivers and their 'historical' channels. It is extremely rare that a small-scale miner will mine for precious minerals in these waters but may mine for gold and precious minerals in the tributaries of such navigable waterways. I have attended a DNR Olympia workshop, a DNR meeting at the Pierce County Library and then most recently a scoping meeting in Seattle, Washington hosted by NOAA. Having done so, I see NO application of small scale mining as a category to be included in the HCP formulating process, when all is said and done, this issue is thoroughly covered by current WDFW HCP formulation and resultant Gold and Fish Pamphlet. Also, having engaged many WDFW Commissioners, Legislators, Agency personnel (DNR and DOE) concerning this subject, it has yet to be related to me that there is any "takings" be it killing of fish and aquatic species or even causing "harm" as NOAA described harm last Wednesday night.

CONFUSION: The Dictionary definition of prospecting is (Funk and Wagnel's College Dictionary): "Prospector is one who searches or examines a "region" for mineral deposits or precious stones." In the State of Washington, DNR "Mineral Leasing on Department-Managed Uplands", Jan. 16, 2004, the definition is by leasing a parcel with a lot of requirements that are out of the realm of the small-scale prospector/miner. **DNR NEEDS TO ACCOMMODATE THE SMALL SCALE PROSPECTOR WITH OUT FFES OR CONTRACTS IN ORDER TO ALLOW HIM/HER TO LOCATE MINERAL DEPOSITS 'PRIOR' TO MORE INTENSIVE EVALUATION TECHNIQUES THAT REQUIRE A CONTRACT OR NEED FOR A MINIMUM OF $2,000,000.OO LIABILITY INSURANCE PLAN.** In other words he/she needs to 'locate' the parcel first, using small scale mining and prospecting techniques. Otherwise, DNR is not allowing the search of minerals thus stifling the economic mission of DNR and the State of Washington.

Take note: The Fraser Institute Survey Results Rank Best and Worst Mining Locales. [See Enclosure] "Current local (state) policy environment encourages or discourages exploration. Washington and California rank at the bottom in the world rankings. Washington is missing out on high-paying mining jobs, payroll and sales taxes, and additional service related jobs and taxes generated from mining operations.

These two categories will try to inform you more about small scale mining through a listing of a few irrefutable facts. These two categories are scientific and legal in nature, they are:

SCIENCE BASED;

FACT: Suction Dredge Mining (SDM) has been studied for over forty years with plenty of peer reviewed articles. One of the latest is by Peter B. Bayley, (You received a copy last Wednesday). **All studies have shown to date, the ONLY "long term" environmental effects detected from SDM were beneficial in nature.**

FACT: The use of a suction dredge is the BEST MANAGEMENT PRACTICE for the removal of mercury and lead from active streams, Mercury is a "locatable mineral and we have a right to mine it.

FACT: WDFW indicates that there is no science for panning, sluicing, gold wheels rocker boxes, etc, etc, but there is for SDM. These small scale mining and prospecting techniques are NOT regulated in other states. This action by WDFW in the formulation of the current Gold and Fish Pamphlet is a violation of RCW 34. 05.

FACT: Turbidity is a measurement of the cloudiness of water, not a measurement of pollution. Pollutants may be in the turbidity but it WAS NOT ADDED to the environment. See the study WDOE did on the Similkimeen River at the 2004 Miners Rally, Oroville, Wa.

FACT: SDM is an extraction and removal activity, and therefore does not ADD Pollutants to the water body.

FACT: As stated above in the first paragraph of this Science Based section, this includes enhancement of fish habitat, aquatic insect life, the overall health of the river or stream, and actual improvement in river and stream bed morphology.

FACT: Salmon redds are a poor location for SDM because there are much better places to look for heavy minerals. SDM piles do not appear to occupy a significant portion of available spawning habitat. Fish eggs and yolk sac fry are protected by seasonal regulations that keep small scale suction dredges out of the rivers and streams.

FACT: Entrainment is non existent on juvenile and adult fish. However, developing eggs of salmonids are significantly adversely affected by entrainment through the suction dredge.

FACT: Colonies of invertebrates generally re-colonize areas disturbed by SDM within a relatively short period of time ranging from one to two months. Impacts to benthic invertebrate communities, from SDM, appear to be less than significant. THEY ARE USUALLY LOCALIZED AND TEMPORARY IN DURATION.

FACT: A SD Miner will only average 4-5 hours per day in the operation, processing 1-3 cubic yards of stream bed material. Approximately 20% of a cubic yard will actually pass through the suction nozzle. The other rocks and boulders must be moved by hand. Actual substrate per hour is about 2% of manufactured maximum rating.

FACT: Dr. Peter B. Bayley, Dept of Fisheries and Wildlife, Oregon State University, "Cumulative Effects Analysis" on the effects of suction dredging forest wide, 2003. Dr. Bayley concluded:

1. "The statistical analysis did not indicate that suction dredge mining has no effect on the three responses measured, but rather any effect that may exist could not be detected at the commonly used type I error rate of 0.05."
2. "The reader is reminded of the effect of scale. Localized, short-term effects of SDM have been documented in a qualitative sense. However, on the scales occupied by fish populations such local disturbances would need a strong cumulative intensity of many operations to have a measurable effect."
3. Dr Bayley concluded… "Given that this analysis could not detect an effect averaged over good and bad miners and that a more powerful study would be very expensive, it would seem that public money would be better spent on encouraging compliance with current guidelines than on further study".

FACT: I recall that I read one study conducted by the US Army Corps of Engineers and the conclusion was that this subject of SDM need not be studied further.

FACT: Hardened eyed cutthroat, rainbow and chinook salmon eggs survive passage through the dredge.

FACT: Fish occupy dredge pools during low flows in the summer.

FACT: Dredging displaces invertebrates rather than eliminating them.

FACT: The activity of dredging provides rough elements for winter protection for fry., for foraging territories, therefore providing rearing habitat.

FACT: Fish avoid gravels that were tightly cemented.

FACT: Juvenile fish preferentially avoid high suspended sediment concentrations in silty streams, seems fish have evolved behavioral and physiological adaptations to survive short term elevated conditions by natural spates and floods. SDM is very short term compared to natural spates and floods.

FACT: 8"-10" dredges failed to reach turbidity levels of more than 5 NTU's at 500' behind the dredge, therefore, complied with Alaska State Regulations. "Therefore, suction dredging appears to have no measurable effect on the chemistry of the Forty Mile River within this study area."

FACT: Steelhead and salmon seek out dredge turbidity plumes to feed upon dislodged invertebrates even though clear water was available nearby.

FACT: High winter flows fill in dredge holes, disperse tailing piles, moved silts and sediments for channel maintenance and also forming and reforming bars and riffles and obliterating most dredge holes and tailing piles.

FACT: Dredged areas have increased inter-gravel permeability and Thomas found no significant change below dredge areas.

FACT: If natural spawning substrate is in short supply a large proportion of redds may be located on dredge tailings.

FACT: Increased water depth can provide fish refuge from predatory birds.

LEGAL BASED: The following facts and items are to be kept mindful by not only the miner but also by the regulating agencies. I feel that by the time you have exhausted your research of the following a conclusion by the DNR agency would be that there is ample protection for endangered and listed as threatened species and their habitat. DNR simply needs not to add another layer.

Constitution of the State of Washington; Article XXI, Water and Water Rights, section 1. Public Use of Water. The use of waters of this state for irrigation, mining and manufacturing purposes shall be deemed a public use.

1872 MINING ACT, (Title 30 U.S.C. Chap 2 sec 22) as amended,... "Nothing contained in this act shall be construed to impair, in any way, rights or interests in mining property acquired under existing laws. This act allows mining and prospecting to be allowed on public lands by STATUTE. Refer also to 36 C.F.R. 261.1 (4); 36 C.F.R. 251.50; 36 C.F.R. 228 (A); 43 C.F.R. 1800; 43 C.F.R. 3000; U.S.F.S. manual 2811.5 (6) paragraph 4.2813.14.

SHB 1565, 1997, Small Scale Prospecting and Mining—Revisions. "The Legislature finds that small scale prospecting and mining: (1) Is an important part of the heritage of the state; (2) provides economic benefits to the state; and (3) CAN BE CONDUCTED IN A MANNER THAT IS **BENEFICIAL** TO FISH HABITAT AND FISH PROPAGATION. Now, therefore, the legislature declares that small scale prospecting and mining shall be **REGULATED IN THE LEAST BURDENSOME MANNER** THAT IS CONSISTENT WITH THE STATE'S FISH MANAGEMENT OBJECTIVES AND THE FEDERAL ENDANGERED SPECIES ACT." This law was directed to the WDFW, not Department of Natural Resources. From this act came the current Gold and Fish Pamphlet.

40 C.F.R. 131.12 (1993); Ensures existing in-stream uses and the level of water quality necessary to protect the existing uses shall be maintained and protected, that the state standards be sufficient to maintain existing uses of navigable waters ... "33 U.S.C. 1313©(2)(a) "A state water quality standard shall consist of the designated uses of the 'navigable waters involved and the water quality criteria for such waters based upon such uses."

Idaho Watersheds Project vs Verl Jones, Rancher, NINTH CIRCUIT COURT, 4/25/05. The Ninth Circuit Court overturned the District courts decision and rules that courts cannot defer to environmentalists' mere assertion of harm to a species. The court reversed and remanded the case to the lower court for trial to consider the evidence and lack of evidence presented. The Court has clarified the type of evidence that must be demonstrated in order for an environmental plaintiff to obtain an injunction under the ESA. "The Ninth Circuit said that if the evidence shows bull trout has not been harmed in 40 years, it isn't likely to be harmed in the next 40 years certainly not likely enough to support an injunction shutting off the Joneses' water."

Federal Water Pollution Control Act, (CWA). Under the act Congress quite literally said MINING ACTVITIES, MINING OPERATIONS, HYDRAULIC MINING AND DREDGES as ALL BEING **NONPOINT SOURCES** though they all have channels through which values flow and are captured. Senator Muskie in debate on CWA, S 2770 (the bill for CWA) Section 304(e) calls upon the Administrator (EPA) to issue information to the States and other Federal agencies on PROCESSES, PROCEEDURES, AND METHODS FOR CONTROLLING POLLUTION RESULTING, in general, **FROM NONPOINT SOURCES, INCLUDING AGRICULTURAL ACTIVITIES, MINING OPERATIONS, CONSTRUCTION WORK, AND OTHER SOURCES.**

Arizona v. California, 373 U.S. 564 (1963). This case reserved to each state the exclusive use of the waters of her own tributaries. There are enough U.S. Supreme Court cases out there as well as prior statutes to show that he states have definite jurisdictional rights within its borders. The states have definite jurisdiction over the lakes and tributaries to the navigable waters. 33 C>F>R> 328.3(a)(3) (1993). "The Government must prove that these waters have some potential connection with interstate commerce." "The Army Corps of Engineers exceeded it congressional authorization under the CWA, and that, for this reason 33 C.F.R. 328.3(a)(3) (1993) is invalid. Therefore the Corps cannot include intrastate waters that need have nothing to do with navigable or interstate waters, expands the statutory phrase "waters of the U.S." beyond it definitional limit. Congress originally did put tributaries in the CWA. Congress has since removed that out of the CWA.

U.S. v. State of Oregon, 295 U.S. 1 (1995), "The waters between the meander line boundary were not navigable in the fact on the date of admission to Oregon to the Union, or afterward, on his finding of fact: 'Neither trade nor travel did then or at any time since has or could or can move over said Divisions, or any of them, in their natural or ordinary condition according to the customary modes of trade or travel over water; nor was any of them on February 14, 1859, nor has any of them since been used or susceptible of being used in the natural or ordinary condition of them as permanent or other highways of channels for useful or other commerce.'"

Title 30 Mineral Lands and Mining, Chapter 15 Surface Resources, Subchapter II Mining Claims 612 (b) Reservations in the United States to use the surface and surface resources show that, Congress supports the states right and jurisdiction over state waters in the public lands for unpatented mining claims:30 U.S.C. 612 (b) "Provide further, that nothing in this subchapter and sections 601 and 603 of this title shall be construed as affecting or intended to affect or in any way interfere with or modify THE LAWS OF THE STATES which lie wholly or in part westward of the ninety-eighth meridian [West of the Mississippi] relating to the ownership, control appropriations, use and distribution of ground or surface waters within any unpatented mining claim,"

In SWANCC, the Supreme Court held that the Army Corps of Engineers had exceeded its authority in asserting CWA jurisdiction pursuant to section 404 (a) over isolated, intrastate, non navigable waters under 33 CFR 328 (a) (3) based upon their preamble to the "Migratory Bird Rule', 51 FR 41217 (1986).

Supreme Court Case No. 02-626, March 20, 2004. "South Florida Water Management District v. Miccosukee Tribe of Indians." The Court stated the fundamental premise that water diversions within the same water system would not require an NPDES permit. Water from the same body of water doesn't add a pollutant since it is like a pot of soup. Stirring doesn't change anything. CWA requires an NPDES only when a pollutant is added to navigable waters.

NOTE: If EPA is definite that we are point sources and must be regulated under NPDES...what processes, procedures and operating methods have EPA found for our activity to eliminate or reduce discharging pollutants (which is every thing coming off the end of your sluice box? They have none!

Within the CWA the Congress specifically identified under section 306 National Standards of Performance which were intended for new sources of pollution in 28 industries that reflected the greatest degree of 'effluent reduction' that could be achieved by use of the 'latest available control technology'. The scope of what Congress actually authorized to be regulated under the Act which consisted of "plants" and "facilities" that are fixed locations with outfall channels or pipes.

CWA. "Present water pollution control programs concentrate on the control of pollutants PLACED IN surface waters, on the assumption that to control these INPUTS will assure desireable qualities in the ground waters."

James O'Dell of EPA in Cincinatti , Ohio reinforces the position that no NPDES permitting is required for small scale suction dredging, only required for any thing over 50,000 cubic yards.

For suction dredges operations to require a NPDES permit, five elements must be present: (1) a pollutant (other than dredged of fill material must be (2) added (3) to navigable waters (4) from (50 a point source.

Appalachian Power Case. "Those constituents occurring naturally in the waterways or occurring as a result of other industrial discharges, do not constitute an addition of pollutants by a plant through which they pass."

"Moving pollutants within the same general area within a water segment does not involve an "introduction" of pollutants just as the EPA itself has argued successfully before the Court that concerning Section 402 NPDES permits that addition from a point source occurs "only if the point source itself physically introduces a pollutant into water from the **OUTSIDE WORLD". (Gorsuch Case). Congress stated, "It is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985" and "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited".**

Within EPA NPDES regulations (TITLE 40, PART 122, SUBPART C Sec 122.45 (g) whereby pollutants in "influent" would not require technological elimination from "effluent": "if the discharger demonstrates that the intake water is drawn from the same body of water into which the discharge is made." Congressional intent did not state: no person shall discharge "pollution" but rather "pollutants."

EPA: "Beneficiation is the initial attempt at liberating and concentrating the valuable mineral from the extracted ore. This is typically performed by employing various crushing, grinding, and froth floatation techniques.
NOTE: BY IN LARGE, SMALL SCALE MINING TECHNIQUES INVOLVING THE USE OF WATER IS A GRAVITATION EXTRACTION METHOD, **NOT BENEFICIATION.**

With in the Act is SECTION 302 which is a section dealing with Water Quality Effluent Limitations because other limitations, technological or performance based, are NOT applicable because EPA had determined in 1985 that operations that processed **1,500 cubic yards** annually or dredges that processed less than **50,000 cubic yards** annually were exempt from the technological limit of .2ml/l they applied to larger operations and there is no technology available either. The Bayley study shows that our activity is statistically not even detectable.

In a nutshell, calling fallback discharge a "pollutant" in 402 where the courts have stated it's not under 404 (based upon Congressional intent of the CWA) is inconsistent with the CWA as a whole. If Congress under the CWA specifically defines "dredged materials" as non-pollutants, then the state is barred from claiming that it does pollute ground water or surface waters (because that would redefine this type of waste discharge). The state cannot legally call suction dredging clay or any other naturally occurring or preexisting dirt or gravel a pollutant in order to force regulatory control and jurisdiction because (1) It was not introduced by the act of dredging and (2) it is not listed as a pollutant under 33

U.S.C. 1362 (6), and to do so otherwise would conflict with the definitions laid out in the federal statute.

"Industrial waste" means any liquid, gaseous, radioactive or solid waste substance or combination thereof resulting from any process of industry, manufacturing, trade or business, or from the development or recovery of any natural resources. Waste is further refined to mean, "Sewage, industrial wastes, and all other liquid, gaseous, solid, radioactive or other substances which will or may cause pollution or tend to cause pollution of any waters of the state." Further, "Pollution or water pollution means...turbidity, silt...into any waters of the state, which will or tend to...create a public nuisance or....injurious to public health, safety or welfare, or to recreational or other beneficial uses or to...fish or other aquatic life or habitat thereof."

Turbidity is not pollution since pollution is defined as the addition of something from the outside world. DE-MINIMUS amounts of turbidity as a result of incidental fallback is not pollution that is subject to a permitting process. U.S. v. Lambert, 18 Env't Rep. Cas. (BNA) 1294, 1981 WL 14886 (M.D.Fla. 1981), affd, 695 F. 536 (11th Cir. 1083), the court stated that back-spill from excavation "does not constitute the discharge of a pollutant" [under the Act], when the dredge spoil simply falls back into the area from which it has just been taken. Such an event cannot reasonably be considered to be the addition of a pollutant."

Is the question of "point source" or "non-point source" really relevant since this seems to say we are not "adding" any pollutants? (on the plus side we are removing toxic heavy metals, like mercury and lead.) Small scale mining, therefore, to me, that the activity is exempt from the CWA, certainly section 404 and likely 402 since the law specifies **"ADDITION" and what the small scale miner/dredger is doing is "SUBTRACTION".**

Joseph Green, Research Biologist, retired EPA Employee has concluded that "the issue of localized conflict with suction dredgers and other outdoor recreational activities can be put to a more reasonable perspective...the total acreage of all analyzed claims related to the total acres of water shed is about 0.2 percent [2/10ths percent]/ the percentage of land area within riparian zones on the Siskiyou National Forest occupied by mining claims is estimated to be only 0.1 percent...THE ISSUE AGAINST SUCTION DREDGING IN THE STREAMS OF THE U.S. APPEARS TO BE LESS AN ISSUE OF ENVIRONMENTAL PROTECTION AND MORE OF AN ISSUE OF CERTAIN ORGANIZED INDIVIDUALS AND GROUPS BEING UNWILLING TO SHARE THE OUTDOORS WITHOUT LIKE INTEREST."

On the federal level the Resource Conservation and Recovery Act, RCRA describes that tailings from gravity separation are non-hazardous.

The only condition of water that is identified specifically by congress is HEAT.

In **Gorsuch**, The District of Columbia Circuit addressed the issue of whether water quality changes caused by dams must be regulated under the NPDES system. The EPA argued as in Gorsuch, as it does here, that for NPDES requirements to apply, dam-caused water quality changes must result from the 'addition' of pollutants. EPA also argued, as it does here, that there can be no addition unless a source "physically introduces a pollutant into water from the outside world." The Gorsuch court reviewed whether EPA's construction of the term "added" was reasonable. **It found that CWA logically permitted EPA's construction of "added", that Congress had in all likelihood given the EPA discretion to define the term "added", and that the EPA construction was not "manifestly unreasonable."**

EPA's Section 402 treatment of the Ludington (dam) facility's wastewater, far from evincing irrational or arbitrary agency behavior, represents a reasonable distinction between those pollutants already in the water moved and transformed by the essential operation of a hydroelectric power dam and those waste products "added" to the water by tangential process in generating electricity.

Because of the Equal-footing and the Submerged land Act the states have sovereign authority over lands beneath navigable waters. This includes the minerals and aquatic life, but this does not include the beds of streams in the public lands. If a miner has a valid claim then he would OWN those minerals. The controls of the non-navigable waters are the states concern. This includes water quality, but the state does not own the beds of these streams, and any permit requirements for public benefit must be consulted with those affected, ORS 517.125. Also, the beds of streams in the public lands are managed by the Federal land management agencies.

40 CFR 440 Subpart M is the rule that implements the CWA for placer gold mining operations that process more than 1,500 yards per year and dredges that process more the 50,000 yards per year. In the preamble to the revision of 40 CFR Subpart M, (FR Vol. 53 No. 100 Tuesday May 24 1988 rules and regulation), The Regulatory Flexibility Act was the authority quoted to continue to EXEMPT small scale gold placer mining from the requirements of the CWA (and NPDES). "the provisions of this subpart M are not applicable to any mines of beneficiations process which process less than 1,500 cubic yards of ore per year or to dredges which process less than 50,000 cubic yards of ore per year." The EPA explains this very clearly in the document: Technical Resources Document, Volume 6 Gold Placer 1994, "The size of a placer mining operation determines whether or not it is subject to compliance with the CWA administered by the EPA under 40 CFR 440 Subpart M. Mines handling less than 1,500 cubic yards per year and dredges handling less than 50,000 cubic yards annually are exempted from effluent guidelines," The EPA also states, **"Small scale extraction methods include panning, and suction dredging...[these] extraction methods employ the basic principle of gravity separation,"...Technology- based limitations specifically applicable to the gold placer mine subcategory of the Ore Mining and Dressing Point Source Category are codified in 40 CFR 440 Subpart M. These standards are only applicable to LARGE PLACER MINING OPERATIONS (defined as mines which**

beneficiate more than 1,500 cubic yards of ore per year). There are no regulations under the CWA specific to small scale placer mine operations."

On the Public Lands managed by Federal authority, the MULTIPLE USE LAND ACT gives to mining precedence over other uses, but will allow other non-conflicting beneficial use of the waters as well. In addition, dredgers remove mercury and lead and collect lures, fish hooks, fishing line left behind by previous era miners and fishermen. Dredgers leave deep, cold holes in the stream bottom for fish to hold in when stream temperatures rise or in winter freeze over.

In 2001 a seminar took place to test the accuracy of turbidimeters. Joseph Green, a retired EPA biologist testified that approximately six (6) manufacturers attended the seminar, and in blind studies with the factory representatives operating the turbidimeters, the turbidimeters were found to have an error rate of at least 30%.

Lastly: Congressional intent concerning moving small volumes of materials (Pollutants already within Waters of the U.S.). Senator Domenici stated that "we never intended under subsection 404 that the Corps of Engineers be involved in the daily lives of our farmers, realtors, people involved in forestry ,anyone that is moving a little bit of earth anywhere in this country that might have an impact on navigable streams." Senate Debate, id.at 924. Both the Senator and the Courts recognized that the waters could have an altered form and effect from certain point sources but that they were not intended to be regulable under the CWA. **To briefly state the issue before us, suction dredges IN THE PROCESS OF EXCAVATION divert water including pre-existing pollutants that have previously been introduced into waters of the U.S. from non-point sources or point sources (as the case may be) and divert the "influent" through a discreet conveyance (a channel) that is partially or wholly submerged within the same water segment whereby heavy particles (some of which are desirable elements) are trapped by gravity as the flow through.**

It is hoped that the above basic SCIENTIFIC FACTS and the basic LEGAL FACTS presented above will be helpful in determining the "need" for concern by DNR in the allowance of Small-Scale mining and Prospecting on State owned lands. Again, in the light that WDFW is conduction new rule making processes for the next Gold and Fish Pamphlet and another HCP, I feel that it is prudent of the Agency to NOT concern themselves with the activity known as small-scale mining and prospecting as it is wholly de-minimus in stature. Duplication of effort by state agencies is not likely to benefit the State of Washington and serve the public good.

Bruce M. Beatty, Small Scale Miner/Prospector, Available for questions and testimony.
4602 Alameda Ave. West
University Place, Wa. 98466
(2530564-0954
Fax (253)564-1674, bruce@inlinks.net,

James L. Buchal, Appearing *Pro Hac Vice*
MURPHY & BUCHAL LLP
2000 S.W. First Avenue, Suite 320
Portland, OR 97201
jbuchal@mbllp.com
Telephone: 503-227-1011
Facsimile: 503-227-1034

R. Dabney Eastham, Cal. Bar No. 115533
44713 Highway 96
Seiad Valley, CA 96086
dabneylaw@sisqtel.net
Telephone: 530-496-3677
Facsimile: 530-496-3319

Attorneys for The New 49'ers, Inc. and
Raymond W. Koons

UNITED STATES DISTRICT COURT

FOR THE NORTHERN DISTRICT OF CALIFORNIA

OAKLAND DIVISION

KARUK TRIBE OF CALIFORNIA, Plaintiff, v. UNITED STATES FOREST SERVICE, *et al.*, Defendants.	Case No. 04-4275 (SBA) **DECLARATION OF JOSEPH C. GREENE IN OPPOSITION TO PLAINTIFF'S MOTION FOR SUMMARY JUDGMENT** Date: June 21, 2005 Time: 1:00 p.m. Ctrm: 3, 3d Floor Judge: Hon. Saundra B. Armstrong

I, Joseph C. Greene, declare as follows:

1. I am a research biologist. I live in Philomath, Oregon. I worked for about 32 years as a research biologist for the United States Environmental Protection Agency, starting when that agency was known as the Federal Water Quality Agency, and I retired from the E.P.A. in 2002. Among other assignments, I measured and evaluated water soluble toxicants from Superfund sites. I spent about four years during my career with the E.P.A. serving as a faculty member at Oregon State University in Corvallis, Oregon on an intergovernmental exchange program and developed a program and a laboratory for the practice of ecotoxicology, the science of determining the toxicity

of samples of effluents and other materials by measuring the reaction of living organism assemblages to such samples. I have served as a chairman of testing committees for the American Society for Testing and Materials. I have chaired a number of international symposia, workshops, and congresses in my field as well as been an invited speaker to numerous national and international professional scientific meetings in my field. My full resume, which also lists my publications, is fourteen pages long.

2. I have reviewed the declaration of Toz Soto filed in support of the plaintiff's summary judgment in the above-captioned lawsuit as well as the "Summary of Fishery Issues Concerning Suction Dredge Mining" prepared by Jon Grunbaum and dated April 20, 2005.

3. The papers authored by Mr. Grunbaum and Mr. Soto are rife with qualifying statements. Examples are, "could", "could be", "appear to be", "are quite possible", "assume", "may not be", and "should be." These are not scientific statements and in general represent subjective opinions. I will try to provide answers to many of the comments that they expressed using scientific data from the literature and information from State and Federal Agencies involved with regulating mining practices and protecting elements in the freshwater environment.

4. **Geographical Scale of Small-Scale Suction Dredging** I would like to begin my discussion of the effects of small-scale mining, using suction dredging techniques, by emphasizing the scale of the activities. It has been observed that environmentalists opposing suction dredging use data gleaned from reports that studied effects of environmental perturbations that are occurring on a system-wide basis. For example, they would characterize the affects of turbidity from a suction dredge as if it would impact downstream organisms in a manner that system-wide high water flow events might. This approach is entirely inconsistent with the way in which suction dredges operate or generally impact their downstream environment.

5. The California Department of Fish and Game (1997) described typical dredging activities as follows' "An individual suction dredge operation **affects a relatively small portion of a stream or river**. A recreational suction dredger (representing 90-percent of all dredgers) may spend a total of *four to eight hours per day* in the water dredging an area of 1 to 10 square meters. *The average number of hours is 5.6 hours per day*. The remaining time is spent working on equipment and

processing dredged material. The area or length of river or streambed worked by a single suction dredger, as compared to total river length, is relatively small compared to the total available area." Exhibit 1 to this declaration is the bibliography or list of the studies and other documents cited in my declaration.

6. Mr. Grunbaum cited a report by a USFS Technical team. I am not certain if it is the same study, but I have one that is an Oregon Siskiyou National Forest Dredge Study. In chapter 4, Environmental Consequences, some perspective is given to small-scale mining. "The average claim size is 20 acres. The total acreage of all analyzed claims related to the total acres of watershed is about *0.2 percent*. The average stream width reflected in the analysis is about 20 feet or less and the average mining claim is 1320 feet in length. The percentage of land area within riparian zones on the Siskiyou National Forest occupied by mining claims is estimated to be only *0.1 percent*." The report goes on to say, "Over the past 10 years, approximately 200 suction dredge operators per season operate on the Siskiyou National Forest" (SNF, 2001).

7. A report from the U.S. Forest Service, Siskiyou National Forest (Cooley, 1995) answered the frequently asked question, "How much material is moved by annual mining suction dredge activities and how much does this figure compare with the natural movement of such materials by surface erosion and mass movement?" The answer was that suction dredges moved a total of 2,413 cubic yards for the season. Cooley (1995) <u>used the most conservative values</u> and estimated that the Siskiyou National Forest would move 331,000 cubic yards of material each year from natural causes. Compared to the 2413 (in-stream) cubic yards re-located by suction mining operations the movement rate by suction dredge mining would equal *about 0.7% of natural rates*.

8. **<u>Clearwater National Forest, Final Biological Opinion and Magnuson-Stevens Act Essential Fish Habitat Consultation for the 2003.</u>** Mr. Grunbaum stated that, "The Siskiyou NF over the hill in S. Oregon and the Clearwater NF in Idaho have both determined that there are significant issues associated with dredging – and have embarked on EIS processes to analyze suction dredging effects." I have previously mentioned some comments from the Siskiyou National Forest. Now let us examine what was determined and published in the Final Biological Opinion and Magnuson-Stevens Act Essential Fish Habitat Consultation for the 2003 Recreational Suction

Dredging in Lolo Creek (NOAA, 2003). "The reviewers (including NOAA, Idaho Fisheries, and USFWS) observed that the dredge mining *had little physical effect on the stream channel beyond the immediate areas where gravels were either dredged or deposited.*" The report made the following additional comments:

9. *Comment: The best areas for locating gold are generally* ***not*** *the best salmonid habitat*. For example, miners prefer to dredge in the upstream end of pools, in seams and pockets of exposed bedrock, and sometimes on the inside of river bends where the current begins to slow and heavier materials accumulate;

10. *Comment*: Ocean conditions are a key factor in the productivity of Northwest salmonid populations, and appear to have been in a low phase of the cycle for some time and are likely an important contributor to the decline in many stocks;

11. *Comment*: When considered in the context of a stream with spawning areas spread over several miles, the amount of the habitat temporarily altered by *the activity is* ***small***;

12. *Comment*: Griffith and Andrews (1981) observed high mortality of rainbow trout eggs and fry that were intentionally passed through a suction dredge. Old style suction dredges that were used in earlier studies had a crash box or header box at the head of the sluice to slow and spread the suctioned material before it went through the slice box. New dredges don't have this feature (NOAA, 2003). The crash box has been removed. Water now arrives at the head of the sluice where the hose diameter flares (widens) to about 3 to 4-times the width of the suction hose. This causes the water velocity to drop and flow directly over the riffles and off the end of the sluice box;

13. *Comment*: Juvenile steelhead could be attracted to the outfall from the suction dredges if benthic invertebrates are dislodged and passed through the dredge. If this were to occur the likelihood of entrainment is not likely to increase, since juveniles would congregate on the downstream side of the outfall, which is too far from suction nozzle for fish to become entrained;

14. *Comment*: When intentionally passed through a suction dredge juvenile and adult rainbow trout *all survived* (Griffith and Andrew, 1981);

15. *Comment:* Dredges are generally operated in environments where the stream energy is too high for steelhead fry or fingerlings (which seek to conserve energy in slower water), and the substrate is too coarse for redds;

16. *Comment:* There have been no reported incidents of juvenile steelhead or salmon being sucked into a dredge nozzle; and

17. *Comment:* It does ***not*** appear that food availability would appreciably change as a result of dredging (NOAA, 2003).

18. Research has found the feeding ability and health of sculpin and salmonids are not significantly impaired by the increased turbidity of suction dredging (Hassler T.J., W.L. Somer and G.R. Stern, 1986).

19. While significant increases in turbidity can stress juvenile salmonids, especially through gill irritation, it would not likely cause mortality (Bash, J., C. Berman and S. Bolton, 2001).

20. Short-term impacts to juvenile steelhead trout could occur (in Lolo Creek, Idaho) during the dredging season from fish being displaced away from dredging activity and from localized reductions in macroinvertebrate food availability. There could also be a temporary food abundance due to displacement of aquatic invertebrates out of the substrate.

21. The Biological Opinion for suction dredging in Lolo Creek (USFWS, 2003) stated that the 18 projects proposed for 2003 suction dredging would not likely jeopardize the continued existence of the Snake River steelhead. The potential even for cumulative impacts from many years of small-scale suction dredge operations is minimal.

22. Occasional fish may be killed (i.e., "eggs, larvae, immature fish, salmonid alevins, juvenile salmonids"). The Forest Service in consultation with regulatory agencies has determined that **this mortality would not threaten the survival of any threatened or endangered species** (CNF, 2004).

23. **<u>Causes of the Declines in Aquatic Animal Populations.</u>** It is implicit in statements found in Grunbaum's paper, such as: "Considering the *uncertainty surrounding dredging effects*, the declines in many aquatic animal populations, and increasing public scrutiny of management decisions, the cost of assuming that human activities such as suction dredging cause no harm

deserves strong consideration by decision makers", that small-scale suction dredgers are an important contribution to the decline in "aquatic animal populations".

24. These inferences ignore current scientific knowledge. For example, it was stated in the NOAA Idaho Suction Dredge Study (NOAA, 2003) that, "Ocean conditions are a key factor in the productivity of Northwest salmonid populations, and appear to have been in a low phase of the cycle for some time and are likely an important contributor to the decline of many stocks".

25. A study representing the first paleolimnological analysis of past sockeye salmon population dynamics (approximately 500 years) was performed in a stained nursery lake (Packer Lake, Alaska). Result of the investigation "suggest that the number of sockeye salmon spawners fluctuated widely. *Comparison of temporal shifts in inferred sockeye salmon abundance from Packer Lake with other Clearwater nursery lakes reveals a broadly consistent pattern,* ***likely influenced by past climatic changes*** (Gregory-Eaves, Finney, Douglas and Smol, 2004).

26. A report out of the National Center for Public Policy Research (Carlisle, 1999) further addresses the issues of salmonid population declines and steps taken to restore them.

27. "Until recently, fish biologists assumed that only changes in the freshwater habitat of salmon could explain the variability in the salmon population. Scientists were thus quick to conclude that human modification of this habitat was the reason for the salmon population decline. Forestry practices have changed in recent years to protect salmon from harm. Buffers mandate that no construction or other development take place within a specified distance from a stream bank to prevent harm to breeding pools or other vital habitat. Other land-use laws have also been implemented to severely restrict development near rivers and wetlands. This is the reason why there have been no new dams built in Washington in the past 35 years. Citizen groups have also organized to clean many streams while agricultural land-use practices and wastewater treatment have steadily improved over the last 25 years (Kaczynski, V., 1998). Together these efforts have helped Pacific Northwest streams become significantly cleaner than they were in the 1970s and thus more ecologically amenable to salmon. A federally funded 1991 study by the Battelle Marine Science's Laboratory, for example, concluded that Puget Sound - home of the Puget Sound chinook

salmon that was recently listed by the NMFS - is the cleanest it has been since before World War II (Anderson, R., 1999). *Nevertheless, the salmon has not rebounded.*

28. Despite billions of dollars in expenditures, widespread implementation of policies to aid the salmon and a cleaner environment, the salmon population continues to decline. The NMFS and environmental activists insist that more stringent regulations and more restrictions on development and additional spending are needed. *This turned out to be incorrect.*

29. The marked decline in the salmon catch beginning in the mid-1970s corresponded to an increase in the temperature of the Pacific Ocean off the coasts of Washington, Oregon and California. ***This warming has had a most detrimental impact on salmon survival rates.***

30. Dr. Victor Kaczynski (1998), a fish biologist and consultant on fishing issues in the Pacific Northwest, says that "per classical ecological theory, a 70% decline in zooplankton biomass results in a 70% reduction in predators dependent on zooplankton directly and in their food chain (such as coho salmon) while an 80% reduction would result in a food supply that could only support 20% of the prior predator biomass (such as coho salmon)." With a reduction in zooplankton levels by more than 70% in the past two decades, West Coast salmon have declined by at least 70% as well.

31. In addition, the salmon numbers are further reduced because the warmer water attracts predators such as mackerel and Pacific hake. These fish doubly threaten the salmon by consuming the reduced zooplankton food supply and by eating the salmon themselves. A report on this subject is attached as Exhibit 2 to this declaration.

32. **Lamprey Ammocetes Mortality.** Mr. Soto states that, "Lamprey ammocetes could be entrained by suction dredges and cause direct mortality or indirect mortality from exposure to predators" (emphasis added). It has been reported that "Research on entrainment mortality of lamprey ammocetes has not been published. However, based on field observations, it is not likely they would suffer direct mortality because of their tough skin and flexible body" (SNF, 2001).

33. **Benthic Invertebrate Populations.** Mr. Grunbaum states, "The majority of the studies showed that suction dredging can adversely affect aquatic habitats and biota. Most of the researchers warn that adverse affects to aquatic habitats and organisms are *quite possible*." Mr.

Soto, following the same line of reasoning stated, "Benthic invertebrate populations are impacted from suction dredging which are important food sources for rearing salmonids."

34. There are published reports referring to the direct impact of suction dredging on aquatic invertebrates. It is important to note that the studies took place in: California (3 streams; Stern, 1988; Harvey, 1986; Somer and Hassler, 1992); Montana (Thomas, 1983); Idaho (4 streams; Griffith and Andrews, 1981); and, Alaska (2 streams; Royer, Prussian and Minshall, 1999; Huber and Blanchet, 1992). All reached the same conclusion, ***the impacts on benthic invertebrates are highly localized and that re-colonization occurs rapidly.***

35. Harvey (1986) reported that' "Dredging significantly affected some insect taxa when substrate was altered. A re-colonization experiment showed that numerical recovery of insects at dredged sites was rapid. *Local turbidity increases below active dredging probably did not affect invertebrates and fish.*"

36. In Gold Creek, Montana Thomas (1985) found, "Significant changes in aquatic insect abundance were restricted to the area dredged; downstream areas were not affected. *Re-colonization was substantially complete 1 month after dredging.*"

37. Four Idaho streams were used to evaluate some of the effects on aquatic organisms that may result from the use of small suction gold-dredges. The results showed that, "fewer than 1% of the 3,623 invertebrates entrained showed injury or died within 24-hours. Most of the dead were *Centroptilum* mayflies that were undergoing emergence at the time of dredging. *Most of the re-colonization of dredged plots by benthic invertebrates was completed after 38 days*" (Griffith and Andrews, 1981).

38. Somer and Hassler (1992) found that in a California creek, "The effects of dredging on invertebrates varied with taxa and were site-specific at the level of dredging during the study. Total numbers of invertebrates that colonized samplers and their diversity indices did not differ significantly above and below the dredges."

39. The U.S. Environmental Protection Agency funded a study in Fortymile River and Resurrection Creek, Alaska (Royer, Prussian and Minshall, 1999), where the larger 8-inch and 10-inch dredge nozzles were used. Results from the study concluded that, "The abundance and

diversity of macroinvertebrates was greatly reduced in the first 10 meters below the dredges at Site 1, relative to the upstream reference site. For example, macroinvertebrate abundance was reduced by 97% and the number of taxa by 88% immediately below the dredge. The abundance and diversity of macroinvertebrates returned to values seen at the reference site by 80 to 100 meters downstream of the dredge. A similar decline in macroinvertebrate abundance and diversity was observed in Site 2. *One year after dredging at both Site 1 and Site 2, recovery of the macroinvertebrate diversity appeared to be substantial.*

40. The second component of this project was to examine the effects of recreational suction dredging on a smaller stream in Alaska. The results from Resurrection Creek indicated that there was no difference in the macroinvertebrate community between the mining area and the locations downstream of the mining area, in terms of macroinvertebrate density, taxa richness, and EPT richness. In general, *our results are in agreement with other studies that found only localized reductions in macroinvertebrate abundance in relation to recreational suction mining*" (Royer, Prussian and Minshall, 1999).

41. The California Department of Fish and Game (CDFG, 1997) concluded, "Suction dredging can have significant short-term and localized adverse impacts on local benthic invertebrate abundance and community composition. However, *over the long-term, the impacts appear to be less than significant.* Colonies of invertebrates generally recolonize areas disturbed by suction dredges within a relatively short period of time ranging from one to two months." "*Impacts to benthic invertebrate communities of suction dredging with 6 inch or smaller sized nozzles appear to be less than significant.*" "*Effects to benthic and/or invertebrate communities, turbidity and water quality appear to be less than significant*. They are usually localized and temporary in duration."

42. **Cumulative Effects from the Operation of Multiple Dredges.** It has been suggested that a single operating suction dredge may not pose a problem but the operation of multiple dredges would produce a cumulative effect that could cause harm to aquatic organisms. However, "No additive effects were detected on the Yuba River from 40 active dredges on a 6.8 mile (11 km) stretch. The area most impacted was from the dredge to about 98 feet (30 meters) downstream, for most turbidity and settleable solids (Harvey, B.C., K. McCleneghan, J.D. Linn, and C.L. Langley,

1982). In another study, "Six small dredges (<6 inch dredge nozzle) on a 1.2 mile (2 km) stretch had no additive effect (Harvey, B.C., 1986). *Water quality was typically temporally and spatially restricted to the time and immediate vicinity of the dredge* (North, P.A., 1993).

43. A report on the water quality cumulative effects of placer mining on the Chugach National Forest, Alaska found that, "The results from water quality sampling do not indicate any strong cumulative effects from multiple placer mining operations within the sampled drainages." "Several suction dredges probably operated simultaneously on the same drainage, but did not affect water quality as evidenced by above and below water sample results. *In the recreational mining area of Resurrection Creek, five and six dredges would be operating and not produce any water quality changes* (Huber and Blanchet, 1992).

44. A survey was conducted in the Siskiyou National Forest, Illinois sub-basin in 2002. Bayley (2003) assessed potential cumulative effects of suction dredge mining using fish response data from 59 stream reaches. A copy of the report of this survey is attached as Exhibit 3 to this declaration. Responses utilized were pool densities of salmonids over one-year-old, of young-of-the-year salmonids, and a stream habitat measure, width-to-depth ratio. Intensity of suction dredge mining was estimated from a direct survey. *Cumulative suction dredge mining was found to be non-significant for each of the three response variables tested in a general linear model* (Bayley, 2003). Bayley concluded that "**Given that this analysis could not detect an effect averaged over good and bad miners and that a more powerful study would be very expensive, it would seem that public money would be better spent on encouraging compliance with current guidelines than on further study."**

45. Furthermore, individuals that have not, in fact, operated suction dredges may not realize that it is a self-limiting operation. The dredge operator must be able to see his work area to operate safely and manage the intake of the dredge nozzle. *If high levels of turbidity were to flood the dredger's work area and render him "blind" he would have to move the operation to another location.*

46. The California Department of Fish and Game stated in its Draft Environmental Impact Report that "Department regulations do not currently limit dredger densities but the activity itself is

somewhat self-regulating. Suction dredge operators must space themselves apart from each other to avoid working in the turbidity plume of the next operator working upstream. *Suction Dredging requires relatively clear water to successfully harvest gold* " (CDFG, 1997).

47. **<u>The Effects of Elevated Turbidity and Suspended Sediment.</u>** *Suction dredging causes less than significant effects to water quality.* The impacts include increased turbidity levels caused by re-suspended streambed sediment and pollution caused by spilling of gas and oil used to operate suction dredges (CDFG, 1997).

48. The impact of turbidities on water quality caused by suction dredging can vary considerably depending on many factors. Factors which appear to influence the degree and impact of turbidity include the amount and type of fines (fine sediment) in the substrate, the size and number of suction dredges relative to stream flow and reach of stream, and background turbidities (CDFG, 1997).

49. Because of low ambient levels of turbidity on Butte Creek and the North Fork American River, California, Harvey (1986) easily observed increases of 4 to 5 NTU from suction dredging. Turbidity plumes created by suction dredging in Big East Fork Creek were visible in Canyon Creek 403 feet (123 meters) downstream from the dredges (Somer and Hassler, 1992).

50. In contrast, Thomas (1985), using a dredge with a 2.5-inch diameter nozzle on Gold Creek, Montana, found that suspended sediment levels returned to ambient levels 100 feet below the dredge. Gold Creek is a relatively undisturbed third order stream with flows of 14 cubic feet per second. A turbidity tail from a 5-inch (12.7 cm) dredge on Clear Creek, California was observable for only 200 feet downstream. Water velocity at the site was about 1 foot per second (Lewis, 1962).

51. Turbidity below a 2.5 inch suction dredge in two Idaho streams was nearly undetectable even though fine sediment, less than 0.5 mm in diameter, made up 13 to 18 percent, by weight, of the substrate in the two streams (Griffith and Andrews, 1981).

52. "Effects from elevated levels of turbidity and suspended sediment normally associated with *suction dredging as regulated in the past in California appear to be less than significant with regard to impacts to fish and other river resources* because of the level of turbidity created and the short distance downstream of a suction dredge where turbidity levels return to normal" (CDFG, 1997).

53. "Suction dredges, powered by internal combustion engines of various sizes, operate while floating on the surface of streams and rivers. As such, oil and gas may leak or spill onto the water's surface. *There have not been any observed or reported cases of harm to plant or wildlife as a result of oil or gas spills associated with suction dredging*" (CDFG, 1997).

54. Furthermore, individuals that have not, in fact, operated suction dredges may not realize that it is a self-limiting operation. The dredge operator must be able to see his work area to operate safely and manage the intake of the dredge nozzle. *If high levels of turbidity were to flood the dredger's work area and render him "blind" he would have to move the operation to another location.*

55. **<u>The Effects of Dredging on Fish Movement.</u>** Grunbaum stated "Synergistic effects of high water temperatures and the disturbance and/or turbidity and/or pollution and/or decrease in food base and/or loss of cover associated with suction dredging has the potential to reduce the juvenile fish carrying capacity in the vicinity of the recently dredged area. Displaced juvenile salmon and trout *are likely to be* displaced to a less optimal location where overall fitness and survival odds are also less.

56. Let us begin by removing the, "loss of cover associated with suction dredging." Dredgers are not loggers. Responsible suction dredge miners do not dredge stream banks (it is illegal). Dredging occurs only in the wetted perimeter of the stream. Therefore, it is unlikely suction dredging will cause a loss of cover.

57. Solar radiation is the single most important energy source for the heating of streams during daytime conditions. The loss or removal of riparian vegetation can increase solar radiation input to a stream increasing stream temperature. *Suction dredge operations are confined to the existing stream channel and do not affect riparian vegetation or stream shade (SNF, 2001).*

58. **Suction dredges do not add pollution to the aquatic environment. They merely re-suspend and re-locate the bottom materials (overburden) within the river or stream.**

59. It has been clearly shown through the scientific research stated in the section on benthic invertebrate populations that there would not be a decrease in the food base for fish and that the impacts on benthic invertebrates are highly localized and that re-colonization occurs rapidly. The

NOAA Idaho Dredge Study (NOAA, 2003) "found qualitative differences in invertebrate species above and below the dredging, but no significant differences in numbers of invertebrates or diversity indices. *Given the relatively small area where dredging would occur in the proposed action, it does not appear that food availability would appreciably change as a result of dredging*."

60. Furthermore displacement of fish may not occur or be only temporary. It has been demonstrated that, "Tagged rainbow trout moved very little in either the dredged or control areas." No tagged fish moved further than from a pool to one of the adjacent riffles or vice versa in any 2-week period. Although the total amount of movement by fish in the dredged and control areas at Butte Creek, CA. was not significantly different overall, some tagged fish clearly responded to dredging. Some of the physical change caused by small dredging operations caused movement of fish from areas where pool volume was reduced or water velocity altered. Three of six small fish in one small pool moved into the downstream riffle when dredging added sand that reduced the volume of the pool by 25%. After the sand was flushed out by a temporary high flow, two of those three fish returned to the pool. In contrast, during low flows in late summer, all eight fish in one riffle occupied a hole created by dredging. Commonly, dredging occurred in pools and caused no major change in volume but increased embeddedness of cobbles and boulders. Rainbow trout generally remained in place in these pools (Harvey, 1986)."

61. Stern (1988) found that, "A high level of suction dredging was evident in Canyon Creek, but adverse effects on anadromous fish habitat were minimal to moderate. Excavated holes, gravel tailings, and fine sediment deposition, which affected over 1000 m^2 of streambed each season, were obliterated by peak flows during the course of a normal water year". *High stream turbidity and total suspended solids levels immediately below dredges were localized and never reached concentrations that would directly cause physiological harm to Salmonids* (Cordone and Kelley, 1961).

62. Suction dredging could alter pool dimensions through excavation, deposition of tailings, or by triggering adjustments in channel morphology. Excavating pools could substantially increase their depth and increase cool groundwater inflow. This could reduce pool temperature. If pools were excavated to a depth greater than three feet, salmonid pool habitat could be improved. In addition, *if excavated pools reduce pool temperatures, they could provide important coldwater habitats for salmonids living in streams with elevated temperatures (SNF, 2001).*

63. Suction dredging would increase frequency where dredging excavates pools. An increase in pool frequency could temporarily improve stream channel diversity, a condition beneficial to many fishes and aquatic organisms. Deepened pools would usually return to their original depths following the high flow events *(SNF, 2001).*

64. **<u>The Effects of Dredging on Water Temperature and Channel Morphology</u>.** Dredge mining had little, if any, impact on water temperature (Hassler, T.J., W.L. Somer and G.R. Stern, 1986). However, the Oregon Siskiyou Dredge Study states, "There is no evidence that suction dredging affects stream temperature" *(SNF, 2001).*

65. Solar radiation is the single most important energy source for the heating of streams during daytime conditions. The loss or removal of riparian vegetation can increase solar radiation input to a stream increasing stream temperature. *Suction dredge operations are confined to the existing stream channel and do not affect riparian vegetation or stream shade (SNF, 2001).*

66. Increases in sediment loading to a stream can result in the stream aggrading causing the width of the stream to increase. This width increase can increase the surface area of the water resulting in higher solar radiation absorption and increased stream temperatures. *Suction dredge operations are again confined to the existing stream channel and do not affect stream width (SNF, 2001).*

67. Stream temperature can also increase from increasing the stream's width to depth ratio. The suction dredge operation creates piles in the stream channel as the miner digs down into the streambed. The stream flow may split and flow around the pile decreasing or increasing the wetted surface for a few feet. However, within the stream reach that the miner is working in, the change is so minor that the overall wetted surface area can be assumed to be the same so the total solar radiation absorption remains unchanged *(SNF, 2001).* ***Suction Dredging results in no measurable increase in stream temperature*** *(SNF, 2001).*

68. "Small streams with low flows may be significantly affected by suction dredging, particularly when dredged by larger dredges (Larger than 6 inches) (Stern, 1988). However, the

California Department of Fish and Game concluded, "current regulations *restrict the maximum nozzle size to 6 inches on most rivers and streams which, in conjunction with riparian habitat protective measures, results in a less than significant impact to channel morphology*" (CDFG, 1997).

69. **Other Impacts.** "Many people want outdoor settings to be left in a natural condition for quiet enjoyment. Thus dredging is perceived as a conflict with these activities. The noise of the suction dredge engines and exhaust fumes and the presence of the suction dredge activities may be the very thing many people go outdoors to escape. However, recreational suction dredgers also enjoy the outdoors.

70. It should be noted that suction dredging is considered a legitimate activity on California's streams and suction dredge operators have as much right as any other river user to enjoy and utilize streams as long as their activities are in compliance with the laws and regulations of the State of California". (CDFG, 1997).

71. The issue of localized conflict with suction dredgers and other outdoor recreational activities can be put into a more reasonable perspective using the data provided in Section I of this report. For example, the total acreage of all analyzed claims related to the total acres of watershed is about *0.2 percent*. The percentage of land area within riparian zones on the Siskiyou National Forest occupied by mining claims is estimated to be only *0.1 percent*." The report goes on to say, "Over the past 10 years, approximately 200 suction dredge operators per season operate on the Siskiyou National Forest (SNF, 2001). The issue against suction dredge operations in the streams of the United States appears to be less an issue of environmental protection and more of an issue of certain organized individuals and groups being unwilling to share the outdoors with others without like interests.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

DATED: This 17th day of May, 2005.

/S/ Joseph C. Greene
Joseph C. Greene

CERTIFICATE OF SERVICE

I certify that on May 17, 2005, I electronically filed the foregoing DECLARATION OF JOSEPH C. GREENE IN OPPOSITION TO PLAINTIFF'S MOTION FOR SUMMARY JUDGMENT, with the Clerk of the Court, using the CM/ECF system, which will send notification of such filing to the following:

Joshua Borger, *srmeredith@envirolaw.org*

James Russell Wheaton, *sarah-rose@thefirstamendment.org*

Roger Flynn, *wmap@igc.org*

Barclay Thomas Sanford, *Clay.Samford@usdoj.gov*

Brian C. Toth, *brian.toth@usdoj.gov*

s/ James L. Buchal
JAMES L. BUCHAL
Attorney for The New 49'ers, Inc. and Raymond W. Koons

ATTESTATION OF SIGNATURE

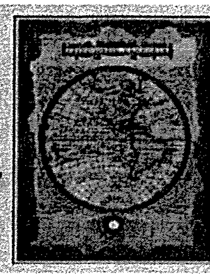
I hereby attest that I have on file all holograph signatures for any signatures indicated by a "conformed" signature (/S/) within this efiled document.

Executed this 17th day of May, 2005.

s/ James L. Buchal
JAMES L. BUCHAL

The Library...

"Education's purpose is to replace an empty mind with an open one."
--Malcolm Forbes



Regulating Turbidity in Oregon Waters Caused by the Disturbance of Bottom Materials Through the Use of Small Scale Suction Gold Dredges

by
Mr. Joseph C. Greene and Ms. Claudia J. Wise

Prepared for presentation to the staff from the Oregon Department of Environmental Quality, at the Meeting for Comments, regarding the Proposed Renewal of the NPDES General Permit 700-J,

Grants Pass, OR, February 1, 2005

Any comment in this report is the authors personal opinion and is not affiliated in anyway to an Agency or Agency policy

TURBIDITY EFFECTS IN RIVERS AND STREAMS

Turbidity measurements are the most common means for obtaining water-clarity data, and for inferring suspended-sediment concentrations.

Turbidity is a principal characteristic of water and is an expression of the optical property that causes light to be scattered and absorbed by particles and molecules rather than be transmitted in straight lines through a water sample. It is caused by suspended matter or impurities that interfere with the clarity of water. These impurities may include clay, silt, finely divided inorganic and organic matter, soluble colored organic compounds, plankton and other microscopic organisms.

EPA defines suspended and bedded sediments as particulate organic and inorganic matter that suspend in, or are carried by the water, and/or accumulate in a loose unconsolidated form on the bottom of natural water bodies. The definition also includes organic solids such as algal material, particulate leaf detritus and other organic material. It is the localized disturbance of these materials, while dredging, that leads to complaints from some citizens.

The major effect turbidity has on humans might be simply aesthetic – people don't like the look of dirty water.

The premise that this review of literature tries to address is whether or not turbidity is really an environmental pollutant when caused by small scale suction gold dredges or just a matter of displeasure to some that want all waters in the State of Oregon flowing in the summertime to be crystal clear.

Let us first look at some impacts of suspended and bedded sediments. EPA states that (US EPA, 2003) "they are a unique water quality problem when compared to toxic chemicals, in that suspended solids and bedded sediments occur naturally in water bodies in natural or background amounts and are essential to the ecological function of a water body. Suspended solids and sediments transport nutrients, detritus, and other organic matter in natural amounts which are critical to the health of a water body. Suspended solids and sediment in natural quantities also replenish sediment bed loads and create valuable micro-habitats, such as pools and sandbars. Therefore, a basic premise for managing suspended and bedded sediments in water bodies to protect aquatic life uses may be the need to maintain natural or background levels of suspended or bedded sediments in water bodies."

Elevated levels of suspended and bedded sediments have been shown to have wide ranging effects on both pelagic and benthic invertebrates (Cordone and Kelly, 1961; Maurer et al., 1986; Peddicord, 1980; Waters, 1995; Wilber and Clark, 2001). Effects can be classified as having a direct impact on the organism due to abrasion, clogging of filtration mechanisms thereby interfering with ingestion and respiration, and in extreme cases smothering and burial resulting in mortality. Indirect effects stem primarily from light attenuation leading to changes in feeding efficiency and behavior (i.e., drift and avoidance) and alteration of habitat stemming from changes in substrate composition, affecting the distribution of infaunal and epibenthic species (Donahue and Irvine, 2003; Waters, 1995; Zweig and Raberi, 2001).

The conventional wisdom (at least since the publication of Newcombe and MacDonald, 1991) is that both the degree of exposure, measured as total suspended solids or Turbidity, or decreased water clarity, and the duration of the exposure are important. It follows that the longer the duration and the greater the exposure, the more severe the effects.

We have no disagreement with the above statements. <u>But, one must put then into a proper context.</u> Let's look at an example of the research that would demonstrate the harmful effects of suspended and bedded sediments. The following examples were taken from the US EPA report for developing water quality criteria for suspended and bedded sediments (US EPA, 2003):

- In the Platte and Missouri Rivers, decreases in both sediment supply and scouring flows have resulted in the growth of stable riparian forests (including many exotic Eastern tree species), and the loss of sandbar habitat for several wildlife species eg., cranes and piping plovers (Johnson, 1994);
- In the Colorado River decreased sediment supply, but continuing scouring flow, has resulted in the loss of riparian wetland habitat dependent on sandbars (Stevens, 1995).

The magnitude and timing of sedimentation may, indeed, influence structure and re-colonization of aquatic plant communities. The effects of reduced primary production on aquatic invertebrates and fishes are compounded when suspended and bedded sediments settle on remaining macrophytes. The macrophyte quality is also reduced as a food source. The periphyton communities are likely to be most susceptible to the scouring action of suspended particles or burial of sediments.

However, the issue of turbidity in Oregon waters, relative to small scale gold dredging, is taken entirely out of context of most of the scientific investigations performed to demonstrate the deleterious effects of suspended and bedded sediments. The research and concern for the reduction of environmental quality caused by suspended and bedded sediments in the water column is an issue of bed-load movement due to large stream flows during storms and from snowmelt or the operation of large channel clearing commercial dredges and does not, in any way represent the negligible fallback of bottom materials off of the end on a small scale gold dredge.

Any use of EPA criteria by the Oregon Department of Environmental Quality, requiring adherence to turbidity standards developed from data analyzing large rivers and streams during high flow seasonal events would be a gross misuse of the published research results if applied to manage the turbidity caused by small scale dredging operations.

<u>THE USE OF TURBIDIMETERS TO MEASURE SUSPENDED-SEDIMENT CONCENTRATIONS</u>

Turbidity measurements are the most common means for obtaining water-quality data, and for inferring suspended-sediment concentrations.

The proliferation of instruments for measuring turbidity and the sedimentary properties of water has occurred despite a lack of nationally accepted standards for collection or use of data derived from these techniques. For example, there are currently many designs of "turbidity" meters that use different approaches and light sources to determine "turbidity" in situ or in a sample. Some methods are based on the International Organization for Standardization (ISO) Standard 7027; some are based on the U.S. Environmental Protection Agency Method 180.1; and some are based on neither, yet all derivative data are reported as "turbidity". This is but one of a number of indicators pointing to a need for better understanding and standardization of data produced by turbidity meters and other sediment-surrogate technologies (Gray and Glysson, 2003).

THE NATURE OF TURBIDITY

Turbidity is a crucial parameter in water-quality regulation, but it is not a well-defined quantity. Different sensors and standards may produce substantially different results from the same sample. This ambiguity complicates the development of turbidity monitoring programs, regulations based on measured turbidity, and the application of estimates of water clarity and sediment concentration based on those data (Gray and Glysson, 2003).

BLIND SEDIMENT REFERENCE SAMPLE MEASUREMENT

A session at the recent Federal Interagency Workshop on Turbidity and Other Sediment Surrogates involved calibration of instruments and measurements of blind reference samples. Fourteen Workshop attendees participated, using nine different types of turbidimeters. Meters were calibrated following manufacturer recommended practice. Participants who calibrated with standards from different manufacturers had differences of less than 5 percent from one standard to the next.

Three lots of blind reference samples were prepared representing three sediment size distributions and two concentrations. The reference samples were prepared by the U. S. Geological Survey, Branch of Quality Systems. Concentrations and material size distributions were not identified on the numbered sample bottles to ensure unbiased measurement.

The measurements show a large variance in measured turbidity under the conditions of the Workshop sampling session. Variance in results could be introduced by many sources including factors associated with the operator, measurement technology, sub-sampling, and other factors in the uncontrolled environment. Although this Workshop session does not represent controlled conditions, the environment was more controlled than that typically experienced in the field, and more controlled than that experienced if each person were in a different field location (Landers, 2003).

There is no way that this level of poor reproducibility should be scientifically acceptable. Furthermore, if scientists cannot perform these measurements and get comparable results it is not reasonable to expect a non-scientist, such as a small scale gold dredge operator, to perform turbidity measurements and get results that are any better or of any particular value.

IMPACTS ON BENTHIC ORGANISMS

Since gold dredges are regulated out of Oregon's surface waters for about nine months of the year, to protect fish reproduction and early life stage growth, I limited references to fish and focus primarily on the measured effects on invertebrates.

Benthic invertebrates (larvae of mayflies, caddisflies, etc.) fared much better than salmonid eggs and fry, with a short-term survival rate of nearly 100% after dredge passage. Most of the re-colonization of benthic vertebrates was completed after 38-days (Griffith and Andrews, 1981). Only emerging insects appeared prone to damage. Long-term survival could be reduced, depending on the amount of physical damage, predation, and the suitability of their new habitat downstream. Other studies concluded that impacts of dredging on benthic organisms "appear to be highly localized" (Harvey et al., 1982; Thomas, 1985). Part of the reason is that the "different

	Blind Sample Lot 1	Blind Sample Lot 2	Blind Sample Lot 3
Sediment			

Concentration	150 mg/L	600 mg/L	600 mg/l
Sediment Size Characteristics	Fines: <62um	Fines: <62um Sands: 63-200um	Fines: <62um Sands: 63-200um
Percent Sands	0	6 - 7	20
Number of Measurements	12	15	14
Median of Measured Turbidity (NTU)	53	268	221
Standard Deviation Of Measured Turbidity (NTU)	11 (21%)	112 (42%)	85 (39%)
Range of Measured Turbidity (NTU)	42 – 63	156 – 380	136 - 306

habitat requirements result in a range of effects on individual species (and life history stages)". For instance, if sand is dredged up to the surface, those insects which can use a sandy substrate may become more abundant if provided enough time to re-colonize, whereas those organisms which require un-embedded cobbles and boulders would decline in abundance. Smaller dredges (i.e., 2 ½ inches) in a low sediment stream add a minimal impact on the benthic community (Thomas, 1985).

The U. S. Geological Survey (1997) investigated suction dredge gold-placer mining operations along Fortymile River, Eastern Alaska. They concluded that the chemical and turbidity data variations seen in water quality due to suction dredging activity fell within the natural variations in water quality. This conclusion was further supported by the other water-quality data collected throughout the region. The study was performed using 8- and 10-inch dredges.

A second study in Fortymile River also used 8- and 10-inch dredges (Royer, T. V., A. M. Prussian, and G. W. Minshall, 1999). Water chemistry, heavy metal concentrations, riverbed morphology, algal (periphyton) standing crop, and aquatic macroinvertebrate abundance and diversity were measured in relation to the two dredges. At the first site the dredge operation had no discernable effect on alkalinity, hardness, or specific conductance. The primary effects of the suction dredging on water chemistry were increased turbidity, total filterable solids, and copper and zinc concentrations downstream of the dredge. These variables returned to upstream levels within 80 – 160 m downstream of the dredge. The results of this sampling revealed a relatively intense, but localized, decline in water clarity during the time the dredge was operating.

Cross-sectional profiles indicate that the impact of the dredge piles relative to the width of the river was small. The results indicate that the dredge piles were largely obscure after one year following the scouring flows that accompany snow-melt in the drainage. However, at a second site the piles were clearly discernable after one year.

The abundance and diversity of macroinvertebrates was greatly reduced in the first 10 m below the dredge at one site, relative to the upstream reference site. For example, macroinvertebrate abundance was reduced by 97% and the number of taxa by 88% immediately below the dredge. The abundance and diversity of macroinvertebrates returned to values seen at the reference site by 80 to 160 m downstream of the dredge. A similar decline in macroinvertebrate abundance and diversity was observed at a second site. "One year after dredging at both sites, recovery of macroinvertebrate diversity appear to be substantial" (Royer, Prussian and Minshall, 1999).

The second component of this project was to examine the effects of recreational suction dredging on smaller streams in Alaska. The results from Ressurection Creek indicated that there was no difference in the macroinvertebrate community between the mining area and the locations downstream of the mining area, in terms of macroinvertebrate density, taxa richness, and EPT richness. In general the results of Royer, Prussian and Minshall (1999) are in agreement with other studies that have found only localized reductions in macroinvertebrate abundance in relation to recreational suction mining.

Lewis (1962) rented a 5-inch dredge to investigate its use on the benthic community. He concluded that 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. He concluded, "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.

The last statement by Lewis (1962) strikes at the heart of the requirement written into the DEQ draft permit. Simply stated it is better to open a hole to dredge and continue to expand that hole upstream. The new permit suggests, after exceeding some turbidity limits, the dredge should be moved 300 feet upstream to start opening another hole. Harvey et al. (1982) also made a point about this when he stated, "Since most invertebrates are found in the top 4-inches (10 cm) of the streambed, a dredge which covers a large area has a greater effect than one which excavates a deep pit to bedrock". Griffith and Andrews (1981) reported that , "Dredged sites were repopulated in Idaho streams from adjacent areas in slightly more than a month in one area, while in another area repopulation took 3-months to 1.2-years, depending on the distance upstream to a source or pool of invertebrates. The amount of bed load movement in a stream also probably affects the benthic recovery time (Thomas, 1985).

The Oregon Department of Fish and Wildlife (1980) reported that very little turbidity results from normal use of smaller suction dredges (4-inches or less) in stream gravels. The majority of heavy suspended solids settle out within a few yards.

THE FEDERAL GOVERNMENTS VIEW AND THE LAW

I was surprised to find a statement by the U. S. Army Corps of Engineers (1994) which came out against the positions held then, by environmentalists and the regulatory community. The purpose was to show the findings of *de minimus* (inconcequential) effects on aquatic resources for 4-inch and less suction dredges and hand mining. The Corps summarized the situation in 1994 as follows: "**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 regulation imposed in many cases." 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.

"The U. S. Environmental Protection Agency, has ignored this concept, although numerous studies, including the EPA's own 1999 study Royer, Prussian and Minshall (1999) of suction dredging, repeatedly and consistently support the Corps findings of *de minimis* (inconcequential) effects."

"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 (U. S. Army Corps of Engineers, 1994)."

On January 17, 2001 the Department of Defense, U. S. Army Corps of Engineers and the Environmental Protection Agency published, in the Federal Register, Further Revisions to the Clean Water Act Regulatory Definition of Discharge of Dredged Materials; Final Rule. It states, "The clean water act generally prohibits the discharge of pollutants into waters of the U. S. without a permit issued by EPA or a State approved by EPA under section 402 of the Act, or, in the case of dredged or fill material, by the Corps or an approved State under Section 404 of the Act." Today's definition addresses the Clean Water Act section 404 program's definition of "discharge of dredged material" which is important for determining whether a particular discharge is subject to regulation under Clean Water Act section 404."

It goes on to say that, "On August 25, 1993 we issued a regulation (the "Tulloch Rule") that defined the term "discharge of dredged material" as including "any addition, including any redeposit, of dredged material, including excavated material, into waters of the U. S. which is incidental to any activity, including mechanized land clearing, ditching, channelization, or other excavation that destroys or degrades waters of the U. S." Obviously this definition was challenged in court.

The Federal Register goes on to state, "On May 10, 1999, we issued a final rule modifying our definition of "discharge of dredged material" in order to respond to the Court of Appeals' holding in NMA, and to ensure compliance with the District Court's injunction. That rule made those changes necessary to conform the regulations to the courts' decisions, primarily to modify the definition of **"discharge of dredged material"** to expressly exclude regulation of **"incidental fallback"**.

The preamble to that rulemaking also describes and summarized relevant case law, for example, noting that the NMA decision indicates incidental fallback "...returns dredged material virtually to the spot from which it came" and also describes incidental fall back as occurring "when redeposit takes place in substantially the same spot as the initial removal."

Our May 10, 1999, rule making amended the substantive aspects of the definition of "discharge of dredged material" to provide that we no longer would regulate "any" redeposit, and that "incidental fallback" was not subject to regulation. That continues to be the case under today's final rule. As noted in section II B of today's preamble, the May 10 rulemaking was considered by the NMA court in its September 13, 2000, opinion and found to be in compliance with the AMC and NMA opinions and associated injunctions.

The combined Defense Department rule 33 CFR Part 323 and Environmental Protection Agency rule 40 CFR Part 232 were signed by Secretary Carol M. Browner and dated January 9, 2001.

NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES)

The NPDES permit program was established under Section 402 of the Clean Water Act, which prohibits the unauthorized discharge of pollutants from a point source (pipe, ditch, well, etc.) to U.S. waters, including municipal, commercial, and industrial wastewater discharges and discharges from large animal feeding operations. Permittees must verify compliance with permit requirements by monitoring their effluent, maintaining records, and filing periodic reports.

After reading the Final Rule 40 CFR Part 232 and 33 CFR Part 323 it is clear that incidental fallback from small scale suction dredges is not a pollutant and it will not be regulated by either the U. S. Army Corps of Engineers or the U. S. Environmental Protection Agency. Therefore, the small scale suction dredges in Oregon rivers and streams should not require NPDES permits to operate.

CONCLUSIONS

It would appear that after all the work to find scientific studies to demonstrate that small suction dredges, "have inconsequential effects on aquatic resources" the Federal law had already recognized that in court rulings and the resultant rule making published in the Federal Register on January 17, 2001. The U. S. EPA and Army Corps rule making amended the substantive aspects of the definition of "discharge of dredged material" to provide that they no longer would regulate "any" redeposit, and that "incidental fallback" was not subject to regulation. Furthermore, as early as 1994 the Corps summarized the situation as follows: "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 regulation imposed in many cases."

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Wilber, D. H. and D. G. Clarke. 2001. Biological effects of suspended sediments: a review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. North American Journal of Fisheries Management. 12:855-875.

Zweig, L. D. and C. F. Rabeni. 2001. Biomonitoring for deposited sediment using benthic invertebrates: a test on 4 Missouri streams. Journal of the North American Benthological Society. 20:643-657.

Mr. Greene has, after 25-years of service, retired from the U. S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Corvallis, OR. He served there as a Research Biologist. Mr. Greene held a courtesy faculty appointment for 7-years at Oregon State University in the Department of Civil, Construction and Environmental Engineering. Four of the seven years were spent on campus as an Adjunct Professor while working on environmental research projects in the Western Region Hazardous Substance Research Center, Ecotoxicology Laboratory (which Mr. Greene constructed and supplied for the university). Mr. Greene has been Chairman of committees and author of testing methods found in both the American Society of Testing and Materials (ASTM) and Standard Methods for the Examination of Water and Wastewater. He is an internationally recognized authority on the use of aquatic and terrestrial bioassays in the assessment of environmental pollution.

Ms. Wise is a Physical Scientist currently employed at the US Environmental Protection Agency, Corvallis Environmental Research Laboratory, Corvallis, OR. She has 28-years experience in chemical and biological instrumentation methods studying phytotoxicity of soil and plant growth effects. For 8-years she was assigned to the Western Fish Toxicology Station where she coauthored journal articles dealing with bioaccumulation of heavy metals in invertebrates and fish. Ms. Wise has contributed to many projects and has coauthored numerous journal articles for work performed in the Terrestrial, Ecotoxicology, and Freshwater Branches. Her current assignment is with the Watershed Ecology Stable Isotope Research Facility.

NLRL 4/27/05

FAX

September 1, 2006

Paul Schlanger
Anchor Environmental
Seattle, Wa.
Fax 206-287-9131

Subject, Small Scale Mining Research Bibliography and Related Materials for the HCP/Gold and Fish Pamphlet.

From Bruce M. Beatty
4602 Alameda Ave. West
University Place, Wa. 98466
Fax 253-564-1674
253-564-0954
bruce@inlinks.net,

This fax is concerning what we talked about on Sept 1, 2006 concerning the above subject. Hope this helps in your determination of the 'white papers'.
Content:

1. Life magazine cover July 14th, 2006. One page. The article below the picture of the three girls panning is one I wrote to the 'Letter to the Editor' of the Tacoma News Tribune, but alas, was not ever printed.
2. Wa. Dept of Ecology on the Similkameen River during the 2004 miner's Rally, Oroville, Wa. Including an article from the ICMJ magazine. 5 pages.
3. Bibliography, 3 pages that were included in the developed rules by the small-scale miners themselves; "Small Scale Mineral Prospecting and Placer Mining in Washington State. This is in the hands of the WDFW Agency and the WDFW Commission.

Note: This is the first of three sets of information I will be sending to you. Total pages-9

Bruce Beatty

5/15/06

List of documents for support of Commission Petition.

1. E-mail, Jan 29, 2006, for Graham Willmore.
 WDFW Grant Idea. "Microstructure of Nacre"
http://physicsweb.org/articles/news/10/1/13/1. (link to complete article.) NEED THIS)
2. E-mail from Jeff Boatwright, Monday, Jan 30,2006; Subject Turbidity Standards Advisory Committee. Ref http://www.kpma.ca/sed-fish.htm. (Needs cut and pasting) Canadian science.
3. WDFW Habitat Program Environmental Services Division. From Stephen Penland to Tom Davis. Subject STANDARDS FOR THE GOLD AND FISH PAMPHLET HPA., July 31, 2003.
4. List of references from Chris Parsons in denial letter for Jim Creegan's HPA. July 18, 2005. (Cindi Creegan did a review of these studies and they are for large scale mining of gravel bars in Alaska.) On I got from WDFW was in a foreign language.
5. DRAFT ENVIRONMENTAL IMPACT STATEMENT, SUCTION DREDGING ACTIVITIES, MONITORING REPORT; Siskyous national Forest, Coos, Curry, and Josephine Counties, Oregon. December 2001.
6. Testimony of THE HONORABLE THOMAS M. SULLIVAN, CHIEF COUNCIL FOR ADVOCACY, U.S. SMALL BUSINESS ADMINISTRATION. Before the Missouri State Senate Financial and Governmental Organization, veterans affairs and elections committee on SB 0069 "creates the small business regulatory fairness board to serve as liaison between the agencies and small business", Feb 10, 2003.
7. 1997 Inland Northwest Regional Water Resources Conference, April 28-29, 1997. Session: Water Law and Water Rights;: Background and Future. "First in time, first in right".
8. SMALL-SCALE SUCTION DREDGING IN LOLO CREEK AND MOOSE CREEK, CLEARWATER AND IDAHO COUNTIES, IDAHO. Draft Environmental Impact Statement, March 2004. (Also have the copy from the Federal Register Environmental Documents: April 4, 2003 (vol 68, number 650 pages 16465-16466.
9. MONITORING REPORT: ASSESSMENT OF THE EFFECTS OF SUCTION DREDGING ON STREAM HABITATS IN THE MIDDLE FORK BOISE BASIN. Tim Burton, Boise Nat Forrest , Draft 2-15-96.
10. PLACER MINING AND SALMON SPAWNING IN AMERICAN RIVER BASIN, CALIFORNIA Nikola P. Prokopovich, Geologist and Katherine A. Nitzberg. Bulletin of the Association of Engineering Geologists Vol. XIX, No. 1. 1982. pp 67-76.
11. E-mail form Jeff Boatwright, March 26, 2006 Subject "Another sample of the top down". 12 pages. Consists of testimony by a Mrs. Cubin of EPA to a Committee of US Representatives. (this one is outstanding.)

12. Joe Gree's presentation to the Region 10 EPA meeting in Salem, March 2006. Excellent color pictures and content. 22 pages.
13. E-mail from Charles Chase, secondary to Guy Michael, secondary to Jeff Boatwright, Sunday Jan 15 2006, Effects of Suction –Dredge Gold Mining on Benthic Invertebrates in a Northern California Stream. William L. Somer and Thomas J. Hassler. U>S> Fish and Wildlife Service, California cooperative Research unit, Humbolt State University, arcadia, California 955221., USA. (Abstract only. We may already have this one from Senator Carrol in that original packet)
14. Waldo Mining District, Tom Kitchar Prresident, Feb 20, 2006, RE: COMMENTS REGARDING ECONOMIC EFFECTS OF PROPOSED RULEMAKING REVISING WATER QUALITY CRITERIA FOR TURBIDITY, TEMPERATURE AND OTHER STANDARDS, CLEAN WATER ACT. Response to DEQ "Turbidity Rule Cost Survey Questionaire."
15. EXERPTS FROM SUCTION DREDGE STUDIES; Published by the Washington Alliance of Miners and Prospectors with additions by steve Herschbach of Alaska Mining and Diving Supply. This contains exerps from many of the sources we have on hand but many we don't have on hand . This is well done.!!! 11 pages.
16. HYDRAULIC SUCTION FOR STREAM RESORATION. Only have one page of this . Produced by Ecotone Inc. Environmental Consulting firm. http://www.econtoneinc.com/hydraulicpump.html. Scott McGill (410) 692-7500 or e-mail at smcgill@ecotoneinc.com,
17. NOAA Restoration Center Image Catalog. "Community –based Restoration Program (CRP) Duck Creek Water Quality and Anadromous Fish Habitat Restoration." http://www.photolib.noaa.gov/habrest/duc.htm. (Use of dredges for stream restoration with photos.)
18. E-mail from Tom Kitchar, March 3, 2006, Subject Suggested additions for Joe. (very good)
19. Coalition for Green Gold. (if it ain't green, it ain't gold.) Ecological Mining, Certification and The Mining NGO, 3 articles by Brian Hill, Director, Institute for Cultural Ecology, 400 Hill Street, San Francisco, California 94114. E-mail bhill@igc.org.
20. EFFECTS OF ANGLER WADING ON SURVIVAL OF TROUT EGGS AND PRE-EMERGENT FRY. Bruce C. Roberts and Robert G. White. 1992. North American Journal of Fisheries management. US Fish and wildlife Service, Montana Cooperativae Fishery Research Unit. Montana Stat University, Bozeman, Montana 59717, USA.
21. SLIDE STIRS LOGGING DEBATE. Joe Rojas Burke, 12/19/03. Landslide of Little Fork of the Kilchis River in tons of mud and debris. (Tillamook State Forrest) (Plawman, fish and wildlife biologist, "new gravel provides more raw material for building egg nests, called redds. The slide has added elements to the stream that are good for salmon.)
22. NOAA IDAHO DREDGE STUDY. Us Department of Commerce, June 27, 2003, (E-mail from Joe Green.) Subject: Essential Fish habitat Consultation for Recreational Suctiona Dredging in Lolo Creek. "Endangered Species Action

section 7 Consultation, Final Biological Opinion and Magnuson-Stevens Act Essential Fish habitat Consultation for the 2003 Recreational Suction Dredging in Lolo Creek (18 projects). Actual exerpts:

23. AGENCIES JOIN FORCES TO MOVE MUSSELS. National District Digest, US Army Corps of Engineers. (Note: I was out of ink and have a poor copy of this one.) http://www.lrn.usace.army.mil/pao/digest/1002/story08.htm.
24. HOW SUSPENDED ORGANIC SEDIMENT AFFECTS TURBIDITY AND FISH FEEDING BEHAVIOR. By Mary Ann Madej. Sound Waves, monthly newsletter, Coastal Science and Research News from Across the USGS. November 2004. (fish feeding occurred at much higher turbidities than previously invisioned)
25. Newspaper article, The Wenatchee World. MUSSEL TUSSEL: Vulnerable Species vs Miners, Group worries that environmental concerns will scrap Oroville Rally.

All for now.

Bruce

September 6, 2006

Paul Schlanger,
Anchor Environmental
1423 3rd Ave. Suite 300
Seattle, Wa. 98101

Subject: Materials from the Small-Scale Mining Community/ HCP/ Gold and Fish Pamphlet Related.

Dear Paul,

Per our phone conversation on September 5th, here are the materials that I received from Mr. Mark Erickson, President, Resources Coalition. I sincerely am confident that you will find the contained contents useful in your work in developing the 'white papers'. I believe this is far better than me trying to fax you reference lists when we can send to you the entire volume contained in the reference list.

Enclosed is:

1. Current Gold and Fish Pamphlet, 1999. (I have copies of the 1980, 1985, and 1987 mining guidelines should you need to see them. I cannot send them, however.) (only copies I have).
2. Copy, Vol of Washington State Department of Ecology, "Effects of Small-Scale Gold Dredging on Arsenic, Copper, and Zinc Concentrations in the Similkameen River". March 2005.
3. Copy, Miner's proposed rules; "Small-Scale Mineral Prospecting and Placer Mining in Washington State." Washington Miners Council, July 2006.
4. Compilation. "Small-Scale Mineral Prospecting and Placer Mining, Scientific Documentation, Federal and State Regulatory Agency Statements, and Permitting Requirements." June 2006.
5. Compilation. "Small-Scale Mineral Prospecting and Placer Mining, Power Point Presentation to EPA, Scientific Documentation, EPA Website Removal and documentation." June 2006. [Power Point Presentation is in color and is VERY important because of the originator, Joseph Green, former EPA Biologist, now a miner]

NPDES/CWA:
I have extensive materials that indicates that the CWA and the NPDES permitting issue is not appropriate nor relative to this activity. This activity is an extraction and removal activity and 'not' a polluting activity. Federal law does not apply here. Army Corp of Engineers now state, " that suction dredging with nozzles of to 6" in diameter is "de-minimus" and thus a "trifling matter" and not worthy of WASTING agency resources on because any trifling effects do not "degrade or destroy waters of the U.S." CWA was developed with Congress stating "All authority granted to a State in this section has been eliminated".

EPA has determined that in Montana, there is NO "water quality limited stream" controls because suction dredges do not add ANY WASTELOAD to the streams which is correctly identifying that the activity removes "pollutants" and does not add one speck of material that was not already within the water body.

I can make myself, and Ron Wilson and Greg Christensen, I'm sure, can make themselves available for discussion of the NPDES and CWA as it relates to small-scale mining and prospecting. Perhaps we can meet in Olympia, Tacoma or Seattle or possibly points North of Seattle.

Bruce M. Beatty
4602 Alameda Ave. West,
University Place, Wa. 98466
253-564-0954
Fax 253-564-1674
bruce@inlinks.net,