The Effects of Dredging on Fish Habitat Within the Jack Creek Watershed

Henry Ebben

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Professional Profile

Field Biologist/Researcher
Research Chemist

Professional Accomplishments

Field Biologist and Forest Manager

Developed and supervised the comprhensive wildlife and ecology plan for the Green River Watershed serving the greater King County Metropolitan community, better known as WRIA 9. The goal of this project was to improve the quality of the water being supplied to the city of Seattle and surrounding cities, and to enhance the fish and wildlife ecosystem within the boundaries of the protected watershed. The four year project developed enhanced natural filtration of the water supply, and improved fish and wildlife habitat through managed logging, stream enhancement, and drainage control.

Teacher/Lecturer

Instructed the curriculum of General Biology at Yelm High School

Guest lecturer at Pierce Community College and Tacoma Community College in the field of Biology. And supervised and instructed students from each of these schools during the Green River project as credit towards their internships.

Veteran

Combat Marine veteran, served in Panama, Desert Shield/Storm, Liberia, and Somolia.
Two time recipient of the Purple Heart, and Awarded the Silver Star for actions in Desert Storm. Medically retired from active duty due to complications arising from wounds acquired in combat.

Work History

US Marine	United States Marine Corps, Camp Lejeune, NC	Oct 1988-July 1994
Field Biologist	King County King Street Center	Aug 1998-Sept 2003

	201 S Jackson St Rm 503 Seattle, WA 98104-3855	
Academic Teacher	Yelm High School 1315 W Yelm Ave Yelm, WA 98597	Sept 2000-June 2003
Precious Metal Extraction Specialist	Dutch Heavy Mining Company 3388B Merlin Road PMB#348 Grants Pass, OR 97526	June 2003-Present

Education

AAS General Studies	Pierce College Puyallup, WA	June 1992
B.S. Biology/Chemistry	Saint Martins University Lacey, WA	May 1995
M.S. Biology	University of Washington Seattle, WA	June 1997

References

References are available upon request.

Introduction:

There is much debate concerning the effects of dredging as it pertains to fish habitat and the natural cycle of annual migration of salmonoid species. As a miner and a scientist, i wanted to investigate this issue and determine for myself the nature of the impact on the species and the environment as a whole. My study is specifically related to fish spawning, and the chemistry of the stream bed before and after dredging has been completed. The Jack Creek Watershed is home to a native population of Cutthroat Trout. There is no migrating run of fish wildlife on the creek.

Method:

there are several environmental factors that are directly related to healthy fish habitat, including : Temperature,Salinity, pH, Disolved oxygen, Ammonia, Water hardness, and Synergistic interactions. This study is directly taken from dredge locations from previous years and an active site that is now being excavated. The corelation of vegetative cover to water temperature was strongly considered, and all of the sites have equal to similar vegetative cover and shading. The sites are within a 200 yard stretch of the stream, and have similar flow and bedrock makeup.

Each site was compared to a portion of the creek that has not been disturbed, and is upstream so as not to have been affected by any previous tailings from the other sites. There is no previous dredging activity in the upstream area that could corrupt the findings of the test.

Site 1 is the base test and the strata had not been disturbed, samples were from 12 inches below the current stream bed, and tested for the factors listed above.

Site 2 is the active site, and is currently under excavation.

Site 3 is an excavation from 1 year ago.

Site 4 is an excavation from 2 years ago.

The base findings for site 1 were as follows:

pH:	3.9
Salinity:	.05%
Temperature:	51deg F
Dissolved Oxygen:	3.9 $mg.L_{-1}$
Ammonia:	345 ppm

The base findings of site 2 were as follows:

pH:	4.9
Salinity:	.05%
Temperature:	50.5deg F
Dissolved Oxygen:	4.8 mg.L_{-1}
Ammonia:	213ppm

The base findings for site 3 were as follows:

pH:	5.1
Salinity:	.05%
Temperature:	49.7deg F
Dissolved Oxygen:	4.9 mg.L_{-1}
Ammonia:	210 ppm

The base findings of site 4 were as follows:

pH:	5.9
Salinity:	.06%
Temperature:	49.2deg F
Dissolved Oxygen:	5.7 mg.L_{-1}
Ammonia:	243 ppm

Water hardness is also a consideration, and is directly related to the presence of ammonia present in the water. Water hardness is the total of calcium and magnesium "salts" (ions) measured in the culture water (Wedemeyer 1996) but can generally be thought of as the total calcium carbonate ($CaCO_3$) concentration of the water, in at least waters with low or zero chlorine levels. Water hardness is an important consideration in salmonid culture due to the effects of water hardness on the solubility of other ions. For example, in contrast to ammonia, many other ions including copper and zinc can enter fish in toxic amounts via the gills (Bradley and Sprague 1985; Anadu et al. 1989; Wedemeyer 1996), especially as the pH of the water decreases (becomes more acidic) (Wedemeyer 1996). Further, many ions become unavailable to fish in low pH waters. As a result, fish need to spend a great deal of energy, up to 3% of their total needs (Wedemeyer 1996), to keep their ion levels in balance. To avoid the toxicity of ions in "soft" waters, water should be relatively hard (i.e. calcium carbonate ($CaCO_3$) levels greater than 200 mg.L_{-1}) (Barton 1996; Wedemeyer 1996). The water hardness was conisderably strengthened by the dredging process, which negated the development of toxic levels of nitrates in the new redds.

Trace metals were aslo discovered at all sights, to include zinc, copper, gold, silver, lead, and mercury. the base sight showed significantly higher levels of the heavier metals, and less that .06% of the elements escaped the dredge and thus were removed fromt he stream bed.

Results:

pH: The levels of pH dropped in acidity by more than 30%. this signficantly increases the surviveabilty of egg fry, and also helps reduce the synergy of the formation of nitrates that are toxic to the fish. it is not determined as to the length of this effect, but the pH levels have dropped each year due mostly to the aeration of the substrate removed and replaced form the stream bed. an extended study of this effect is waranted.
Salinity: no effect
Temperature: temperature levels were lower in the excavated tailings, due mostly to the added abiltiy to be aerated. Cooler temperatures are desired by spawning fish.
Dissolved Oxygen: Oxygen levels were dramtically higher in the excavated areas, even in the sights with lower water turbidity, leading to the conclusion that the water hydraulics are forcing oxygen into the excavated tailings that were previously to compact to accept the flow.
Ammonia: this element was lower in all excavated areas, due mostly to the lower pH levels and increased oxygen. the formation of nitrates was greatly reduced by this development.

Discussion:

From the base findings of the experiment, i can conclude that the excavation of the stream bed performed by dredging had not only a minimal environmental impact, it had a positive one. the health of the stream bed in all of the sites was substantially more suitable for egg redds than the base site. All factors that influence fish development and growth were optimised by the excavation process.

Furthermore, the dredge locations have created new fish habitat which was not previously seen to hold fish, and now does. Jack Creek reaches very low levels throughout the summer, but these new holes are now sanctuaries for the native population.

It appears that the excavation of stream beds is a process that must happen, for a healthy fish eco-system. This occurs naturally by flood process in most cases, but lower water levels, and human diversion of water sources had negated the natural process. In many cases, dredging may be the only viable alternative to this issue, and undoubtably would improve fish habitat.

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