Salmon Aquaculture Environmental Monitoring Data Report

Results of Sampling Program for Year 2004

by

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Executive Summary

This data report contains salmon aquaculture farm site monitoring data collected by the B.C. Ministry of Environment (formerly Ministry of Water, Land and Air Protection) from their audit of the fish farm industry undertaken from April to September, 2003. The sampling program was initiated at the direction of the Regional Waste Manager, Vancouver Island Region to assess compliance with the performance-based *Finfish Aquaculture Waste Control Regulation* that was proclaimed on September 12, 2002. Objectives, instructions and protocols for this program can be found in the ***Protocols for Marine Environmental Monitoring*** document dated September 5, 2002 http://www.env.gov.bc.ca/epd/epdpa/industrial_waste/agriculture/aqua_home.htm.

A total of 6 farms were sampled in 2004. Of these, only 2 farms were sampled for benthic invertebrates. In general, the sampling gradient included 30 m stations, 1-2 Reference Stations and 1-3 Tenure Edge stations. A few farms were sampled near the edge of the net pen array and extra distances were included in some farm locations. Table 1 summarizes sediment geochemistry measurements and basic biology factors measured.

All sites had measurements of free sulphides as well as redox measurements. The inclusion of both types of measurement tended to best predict biotic effects. Biotic and geochemical effects were noted at varying distances from the farm. Table 1 summarizes sediment geochemistry measurements and basic biology. Substrates were primarily silt or silty sand, with a few sites containing some gravel, wood debris or terrigenous material, shell debris and rock/cobble. Table 1 shows that mild to strong anoxia (redox value <0) was found at 4 of the 6 farms at varying distances. Sediment free sulphides showed very high values (> 1700 uM) near the net cages at 4 of the 6 farms.

Those sample locations which had an impoverished biota also tended to have unusual sediment geochemical conditions, suggesting a cause/effect relationship. However, there are a few exceptions to this pattern. The samples with redox values below 0 did not always have an impoverished biota. Such conditions can occur frequently in natural sediments where there is limited bottom current and/or natural organic deposition. Under fish farms, negative redox values may occur only in the near-surface layer where rapid organic deposition is occurring. Thus, the sub-surface sediments may be oxygenated and allow reasonable biotic growth. However this condition is expected to be uncommon. More likely, spatial and temporal patchiness of fish farm depositions make on-the-spot redox measurements highly variable. Thus, there may be patches of anoxia with are not extensive enough to inhibit biological growth, but may cause variability in geochemical sampling results.

In cases where sulphide levels were high (>1000 to 1700 uM) and redox levels below zero, some biotic compromise is expected. Biotic compromise was evident at the 2 farm sites sampled for biota. One of these showed anoxia and elevated sulphides. The presence of a moderate proportion of *C. capitata complex* was also evident near the cages at these 2 farms. Species richness values were within reasonable levels for all samples except 0 m at Indian Bay. Species richness showed a clear gradient of increase away from this farm. The biotic diversity indices (Shannon-Weiner and Simpson's 1-D) tended to follow the pattern of species richness.

The sediment particulate copper levels tended to be below the provincial guidelines (PEL = 108 μg/g copper) for all but 3 farm sites (Midsummer Island, Shelter, Sir Edmund Bay), where it was just over the limit. Zinc was above provincial guidelines (PEL = 271 μg/g) at two farm sites, and copper was above guidelines (PEL=108 μg/g) at 2 farm sites.

Table 1. Summary of farm site characteristics for 2004.

Farm Site	Anoxia	Sulphides	substrate	*Capitella capitata*	Species Richness	Zinc/Copper
Center Cove	Extreme 0 m-30 m both directions	Extreme 0m, high 30 m E to EOT	Mud to sand	n/a	n/a	Zn above PEL 0-30 m both directions, EOTW; Cu same
Indian Bay	Anoxic to 100 m	Extreme 0 m, moderate to 45 m	Sandy mud	Moderate 0-15 m	Low to high 0-60 m	Below guidelines
Midsummer Island	Extreme 0 m W, moderate to EOT	Extreme 0 m W, moderate to EOT	Mostly Sand	n/a	n/a	Below guidelines
Shaw Point	Anoxic 30 m both directions	Moderate at 30 m both directions	Mud	n/a	n/a	Zn>guidelines 30m both directions; Cu below guidelines
Sir Edmund Bay	None	Low	Muddy sand	Moderate 30 m NE	Moderate 30 m NE	Zn below guidelines; Cu above guidelines at 0m
Swanson Island	None	Low	Sand	n/a	n/a	Below guidelines

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