Environmental Assessment of Cage Farming of Marine Finfish

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The intensive grow-out of marine finfish in cages has the potential to contribute organic matter to the surrounding environment and may affect the benthic fauna underlying these cages. Sediment biogeochemical processes may be used to detect thresholds for changes in the benthic community. With the help of experts in environmental monitoring of salmon farms in the Pacific Northwest, HSWRI has been conducting environmental monitoring at cages used for stock enhancement and commercial grow-out of marine finfish in southern California.

Cage systems in this study range in size from 14-3,000m^3, with most cages located in shallow, protected embayments and others in open-ocean. The depth under the cages ranges from 7-75m mean low low water (MLLW), with peak biomass of marine finfish ranging from 0.2-9.9mt. Sediment grabs are collected along the perimeter of the cages and then at specified distances along transects extending orthogonally from the perimeter of these cages using either a 0.025 m^2 petite ponar grab or a 0.1 m^2 van Veen grab. The sediments in each grab are photographed and then a subsample of the top 2 cm is removed and analyzed for sediment free sulfides, oxidation-reduction potential, total volatile solids (TVS), and grain size. Selected sediment samples close to the cages are also analyzed for their copper and zinc concentrations. Total organic carbon and seawater nutrients are also quantified at project specific sites. Three sediment grabs and seawater samples are also collected at a representative control site, approximately 500m from each of the cages, for comparison with the samples collected at the cage site. Dissolved oxygen, temperature, salinity, and pH were also measured at each cage system and at the reference location.

Most of the cages utilized in the stock enhancement program are located in marinas. Reference stations within these marinas indicated that they tended to be depositional and that sediments accumulated moderate amounts of organic detritus, resulting in elevated concentrations of free sediment sulfides and reduced redox potentials. In addition, marina sediments accumulate biologically significant quantities of copper and zinc. However, sediment samples collected adjacent to stock enhancement cages indicate that there is some minor organic enrichment of the sediments occurring at these cages when compared to the reference site. These differences have been restricted to less than 10m from the cage perimeter. With respect to large commercial open-ocean cages, after a year-long grow-out period of finfish, there were no detectable differences in the sediment physicochemical endpoints or seawater nutrients when compared to the reference site.

While minor organic enrichment has been observed near the cages used in the stock enhancement program, experience of experts in the Northeast Pacific suggests that the small increases in TVS and sulfide observed under these facilities would likely remediate within a few weeks or months of fallow. Due to the low sediment and seawater physicochemistry concentrations measured and the results of the analyses at the open-ocean cages, impacts to the benthic habitat or macrofauna under or around the cages resulting from the grow-out of fish in these systems were not likely to occur. The sediment and water column monitoring methods employed in these studies have provided valuable tools for assessing nutrient loading in the environment and they are currently being used in ongoing monitoring of these cage systems.

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