

# Salmon Carcass Deployment: A Potential Pathway for PCB Contamination

Salmon carcass planting throughout the Pacific Northwest has become an important component in salmonid habitat restoration that is supported by local, state, and federal agencies. Several authors have shown the benefits of decaying salmon carcasses to the stream environment (Bilby et al. 1996; Cederholm et al. 1999; Cederholm et al. unpublished data; Helfield and Naiman 2001). Cederholm et al. (1999) stated salmonids are a major source of marine-derived nutrients to the aquatic and terrestrial landscape. Bilby et al. (1996) found that many aquatic invertebrates and streamside plants were enriched with marine-derived nutrients from coho salmon (*Oncorhynchus kisutch*) carcasses. However, none of the authors discuss the potential of recontamination of the environment with polychlorinated biphenyls (PCBs) or other persistent organic pollutants such as polybrominated diphenyl ether (PBDE; fire retardants) and dichlorodiphenyl-trichloroethane (DDT) from planting salmon carcasses.

I could not find any published reports which evaluate the influence of salmon carcass deployment on pollutant reintroduction to stream ecosystems. However, PCB concentrations in the water column (O'Toole; Trent University, Peterborough, Ontario, unpublished data), and in the sediment (Krummel et al. 2003) have increased following natural spawning. O'Toole (unpublished data) found an increase in PCB concentrations in the water column of the Credit River from post-spawned Chinook salmon (*O. tshawytscha*). Krummel et al. (2003) found that PCBs concentrations in the sediment of Alaskan lakes increased seven-fold upon the return of adult sockeye salmon (*O. nerka*). Puget Sound Ambient Monitoring Program (PSAMP 2000) data show that coho and Chinook salmon in the Pacific Northwest are contaminated with PCBs. These data suggest that PCB concentrations in rivers and streams in the Pacific Northwest may increase following carcass deployment.

Carcass deployment also may distribute PCBs to the terrestrial ecosystem. Decaying salmon carcasses are an important component of the terrestrial food web. Willson and Halupka (1995) indicate that over 20 mammalian and avian species combined are direct consumers of salmonid carcasses. The consumption of salmon carcasses contaminated with PCBs may be impacting survival rates of species that feed on salmon carcasses. Bowerman et al. (1995) indicated that

bald eagles (*Haliaeetus leucocephalus*) birth rates and adult mortality in the Great Lakes region still may be impacted by consuming post-spawned salmon carcasses contaminated with PCBs. Buck et al. (1999) indicated that bald eagles from the lower Columbia River also were experiencing lower birth rates than bald eagles in other Northwest locations in association with PCB-contaminated prey sources. It is important to note in the two studies mentioned above, other environmental contaminants, may also contribute to the lower birth rates of bald eagles.

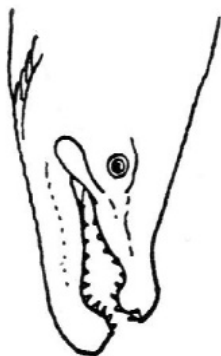
The carcass distribution program could be reintroducing PCBs and other persistent organic pollutants back into the environment at unknown levels. Currently, fish in the carcass distribution program are tested for disease and viruses but not contaminants. No research to date is occurring to determine if the PCBs in salmon carcasses are having an impact on other Pacific Northwest fish and wildlife species that feed on these carcasses. Testing thousands of carcasses that are planted into streams and rivers each year would be cost prohibitive and time consuming. However, I believe it is worth the time and effort to at least sample a sub-set of carcasses. Other alternatives such as organic pellets or seeding the streams and rivers could be an effective means of delivering marine-derived nutrients to the ecosystem, but may not be as efficient as carcass deployment and may pose other unknown risks. Some may argue that naturally-spawning fish are already contaminated, so what difference does it make whether we plant contaminated carcasses or not? I would argue that many of the salmon deployment projects are located in streams with very few returning salmon and therefore would potentially have extremely low concentrations of PCBs and other persistent organic pollutants.

Managers and scientists need to determine whether the benefits of marine-derived nutrients outweigh the detrimental impacts associated with PCBs. Planting carcasses will most likely result in the introduction of PCBs (or the increase of PCBs, for streams that already have naturally-spawning salmon), along with other toxic chemicals, into the environment where they might not currently be found. Although contamination would still occur by the die-off of natural spawners if the carcass deployment programs were discontinued, natural spawners also would still provide marine-derived nutrients to the ecosystem, albeit not at historic levels. Technological

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PCB  
DDT  
PBDE



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advances may be able to duplicate the marine-derived nutrients without the increased risk of contamination, or less contaminated stocks such as those from the coast of Washington (Missildine, in press) could be used for carcass deployment.

This is a very serious question that I believe has been overlooked and needs immediate attention. I recommend that we, as scientists and managers, start a dialogue to determine where we go from here, especially with the recent discovery of PBDEs (fire retardants) in salmon from the Puget Sound (O'Neill, Washington Department of Fish and Wildlife, Olympia, pers. comm.). 

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