Urbanization, Flow Regime, and Salmon Populations in the Puget Sound Basin

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One of the challenges facing stakeholder groups involved in salmon recovery planning and implementation under the federal Endangered Species Act as well as the State of Washington's Salmon Recovery Act and Watershed Planning Act has been measuring and mitigating the impacts of land and water development on salmon populations. Our paper will discuss the linkage of a currently available hydrologic model (HSPF) and a salmon population model (EDT) that quantify shifts in stream flow regime and in turn the direct and indirect effects of flow change on salmon populations. These shifts are investigated in the contest of a Puget Sound landscape shifting from pristine, undisturbed conditions through the spectrum of land uses ranging from industrial forestry, to agricultural/rural, suburban and finally to highly urbanized uses.

HSPF has been tested and applied extensively in the Puget Sound basin to simulate and analyze the impacts urbanization on stream flow regime and to design mitigation of those impacts. Likewise, EDT has recently received extensive use to assess current salmon populations and guide habitat restoration to achieve Viable Salmon Populations (VSP). In this pilot project, these two tools have been closely linked and applied to study the impact of two key aspects of human population growth in this region, land cover change and water extraction and use. The study quantifies the effects of these two drivers on two focal salmon populations, Chinook (*Onchorhynchus tshawytscha)* and coho (*O. kisutch)* in two tributary stream basins of the greater Stillaguamish River watershed, Pilchuck Creek and Church Creek.

Results of our pilot study provided two types of insights, first regarding the effects of urbanization on the focal salmon populations, and second regarding the power of our modeling tools and the knowledge base available to apply them. Examples of the first type include insights into the relative vulnerability of the two species with respect to urbanization, the role of "stream corridor" versus "upland" basin disturbances on fish populations, and comparative effects of base flow reductions caused by water extraction and consumptive use versus peak flow increases associated with conversion of forest to less pervious and impervious cover.

In the second category, challenges in simulating the effects of forest practices on flow regime, limitations of the "ecological model" to fully utilize the dynamic output available from the hydrologic model, and strong assumptions necessary to estimate essential inputs to the ecological model, all point toward needed improvements to our knowledge base and modeling tools as we move toward restoration and recovery of salmon populations.

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