Assessing the Tidal Influence of Methylmercury Movement in the Penobscot Watershed: A Coupled Modeling Approach to Identify Contaminated Fish Habitats for Nine Diadromous Species

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Abstract

The Penobscot River Watershed is an important ecological and cultural region in Maine, USA, supporting a range of fish species, including many diadromous species. However, decades of industrial activity have resulted in high levels of mercury contamination in the river, which could be affecting fish populations. The goal of this research is to develop an integrated model of diadromous fish habitat suitability and mercury contamination in the Penobscot Watershed, with the aim of identifying areas of potential habitat for native species where high concentrations of methylmercury are present.

The first research task will focus on modeling the movement of contaminated sediment and the concentration of methylmercury for the Penobscot Watershed. This will be achieved using the sediment transport module of Delft3D to develop a hydrodynamic model. This model will estimate the geographic location and concentrations of methylmercury and describe the tidal influence as it relates to movement of the contaminate throughout the watershed. By understanding the movement and concentration of methylmercury, we can better understand how it may be affecting fish populations and identify areas of potential concern.

For the second research, suitability indices will be developed for fish habitat in the Penobscot Watershed. This task will involve a comprehensive literature review, as well as utilizing available data and existing suitability indices for similar species in other regions. Indices will be developed for nine diadromous fish species found in the Penobscot Watershed (alewives *Alosa psuedoharengus*, American eels *Anguilla rostrata*, American shad *A. sapidissima*, Atlantic salmon *Salmo salar*, Atlantic sturgeon *Acipenser oxyrinchus*, shortnose sturgeon *Acipenser brevirostrum*, blueback herring *A. aestivalis*, rainbow smelt *Osmerus mordax*, and striped bass *Morone saxatillis*), and will include separate indices for spawning and juvenile habitats. These indices will then be used in to identify areas of potential high fish habitat suitability within the Penobscot River.

For the third research task, a coupled model approach will be applied to the Penobscot River using the models developed in the first two research tasks. The fish habitat suitability indices and the mercury contamination model will be applied to the study area using existing observations of hydrodynamic and ecological data for the region. Using the outputs of the hydrodynamic model developed as inputs for the habitat suitability model, the geographic location and range of fish habitat with high concentrations of methylmercury can be identified. Integration of the models, can identify areas where contaminated habitats may be adversely affecting the restoration and recovery of fish populations.

In summary, this research aims to develop an integrated model of fish habitat suitability and mercury contamination for the Penobscot River. The overall objective is to understand the tidal influence on the movement of methylmercury throughout the watershed, understanf the geographic location and range of fish habitat wihtin the Penobscot River, and identify contaminated habitats that could be affecting the recovery of native fish populations.