US Army Corps of Engineers®
Engineer Research and Development Center

Fish Surrogate Model

Problem

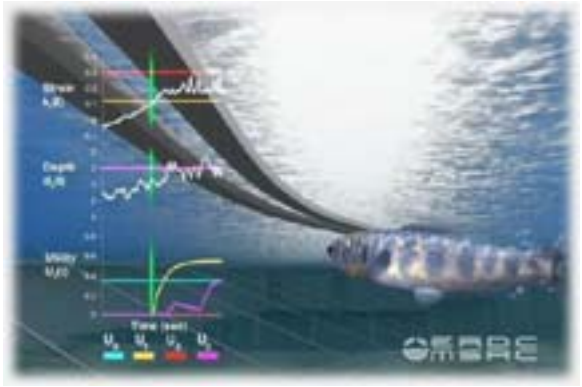
The passage of juvenile salmon around hydropower dams is an important environmental issue. Better methods are needed to ensure that more fish reach the ocean to mature and return as adults. Although U.S. Army Corps of Engineers hydropower dams have been incorporating more fish-friendly features, including fish ladders, the mortality rates of juvenile salmon are still high. It was discovered that although the salmon can sense natural obstacles or changes in the water such as logs or boulders, man-made obstacles generate signals different from those in nature and confuse the fish, causing them to swim in directions that may lead them to harm.

Description

As a part of the System-Wide Water Resources Program (SWWRP), the Corps is using supercomputers to explore the forebay of a dam to "see" a virtual world of computer-simulated water, fish, and structure. The technology uses an Eulerian-Lagrangian-Agent Method to decode movement rules and forecast response by the fish to hydrodynamic patterns and fish bypass systems at a hydropower dam. Scientists can use the numerical fish surrogate to forecast how juvenile salmon may respond to structures added to their natural environment both before the structures are built and in existing structures and dam operations to determine how they can be modified to lessen their impact.

Expected Products

Under the sponsorship of SWWRP and the U.S. Army Engineer Districts of Walla Walla and Portland, the Corps has developed an analysis and modeling technology called the numerical fish surrogate. This technology is used to mathematically decode the three-dimensional movement behavior patterns of individual fish responding to hydrodynamics, water quality, and other stimuli in the aquatic environment. The technology couples a fish swim path selection model to a three-dimensional computational fluid dynamics model. Complex movement behavior patterns are translated into a mathematical description of behavior.



Potential Users

Using the numerical fish surrogate technology, design engineers can forecast the impact of future structures and dam operations on the movement and passage response of juvenile salmon in a virtual reality environment. Designers can also conduct detailed studies of existing structures and dam operations to determine ways they can be modified to lessen their impact on the migration of salmon.

Projected Benefits

The numerical fish surrogate is improving the abilities of researchers to understand the complex underlying dynamics of fish movement behavior that impact the overall success of water resource management. This capability provides valuable engineering design guidance on how management actions can be better integrated into the environment of the fish. Structures can be modified or eliminated in the early stages of project planning, reducing cost and dramatically minimizing the environmental impact on migrating fish populations.

Program Manager

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