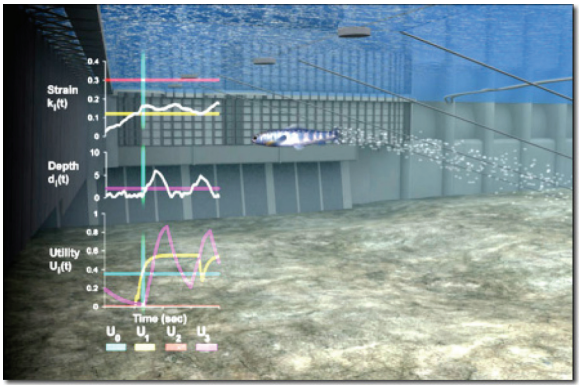
System-Wide Water SWWRP Resources Program

Numerical Fish Modeling



Description: In an agent modeling framework, the integrity of individual organisms is maintained as they respond to simulated environmental challenges via behavioral rules. Presently, Individual-Based Models (IBMs) are inherently incompatible with engineering models (e.g., watershed, water quality and computational fluid dynamics models) that represent the physical domain of an ecosystem as interconnected cells or nodes. The ideal approach for forecasting the response of these high value species to changes in their environment is to integrate engineering models (that optimally describe the physical and chemical environment) with IBM models (that optimally describe the response of individual organisms) to take advantage of the strengths of each approach.

Application: This method was used to understand how outmigrating juvenile salmon navigate through complex hydraulic patterns at dams and in natural rivers. It will be used in the near future to help design bypass systems whose total value is many $100Ms. Interest in this work has been expressed by U.S. Army Corps of Engineers Districts and the scientific communities associated with high-profile Corps activities and large-scale ecosystem restoration projects such as Louisiana Coastal Area, Chesapeake Bay, Puget Sound, Columbia River, Everglades, and Upper Mississippi River System.

Benefits: The integrated approach:

- More accurately forecasts responses of highly mobile aquatic biota to water resources management activities than standard approaches.
- Builds upon existing capabilities i.e., hydraulic and water quality forecasting.
- Improves forecast resolution and accuracy and therefore reduces reliance on expensive post-build monitoring and adaptive management.
- Improves scientific understanding of the response of aquatic biota to the physical and chemical environment.

Future Capabilities: The prototype application presently being performed in the Pacific Northwest will be generalized for application to other highly mobile coastal, and marine species (e.g., fish, shrimp, and crabs) whose response cannot presently be adequately forecast.

Points of Contact: John M. Nestler, Ph.D., Environmental Laboratory, U.S. Army Engineer Research and Development Center, CEERD-EP-W, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, (601) 634-2720, John.M.Nestler@usace.army.mil;

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R. Andrew Goodwin, Ph.D., Environmental Laboratory, U.S. Army Engineer Research and Development Center, CENWP-EC-HD, 333 SW 1st Ave, PO Box 2946, Portland, OR 97208, (503) 808-4872, rag12@cornell.edu.

Additional information may be found at: http://el.erdc.usace.army.mil/emrrp/nfs/.

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