

Bringing Environmental Considerations into Water-use Optimization

How can the US develop sustainable hydropower?

Conventional hydropower provides the bulk of renewable energy in the US. Popular support for building dams has waned due to concerns about environmental effects. Because future growth in waterpower production depends on public trust, an important challenge will be to ensure that future hydropower meets sustainable production standards that protect aquatic ecosystems downstream.



This project seeks to define conditions that promote the long-term economic and environmental viability of waterpower. We are developing quantitative, science-based approaches to meet this challenge. The methods developed at ORNL will quantify relationships between seasonal flow releases and health of fish populations. In addition to developing an optimization framework focused on Chinook salmon, we are also contributing simplified environmental rules for use in a system-wide optimization tool being developed in collaboration with other DOE laboratories.

Linking flow and fish population health

The Natural Flow paradigm claims that riverine species evolved under highly variable flow conditions and depend on the diversity of river habitats that it creates. Our goal is to identify specific features of seasonal flow regimes that are most important to biota and develop quantifiable tools for shaping future flow regimes that support valuable downstream aquatic biota and high energy value. ORNL has developed optimization tools to understand how the timing of pulse flows can maximize fall Chinook salmon production via its effects on temperature and on prey production, particularly during floodplain inundation below New Don Pedro Dam, California. Energy objectives are represented by seasonal fluctuations in electricity value and deviations from flows optimal for turbine operation.

Ecological valuation

Our long-term goal is to bring ecological considerations into the equations used to make decisions guiding the operation of hydropower projects. To advance this goal, we will develop and apply ecological valuation methods that facilitate comparisons between energy and ecological objectives.

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