



Air, Water and Aquatic Environments Science Program



Rocky Mountain Research Station

Focus: Reservoirs and Fish

Research

Technology Transfer

Science Application



Key Findings:

- Reservoir managers must balance the needs of water users and aquatic ecosystems.
- A suite of physical, ecological, and fish bioenergetic models is being developed to predict aquatic ecosystem and fish population response to alternative water management scenarios.
- Understanding the links between fish populations and reservoir operations can help managers improve conditions for aquatic biota in regulated rivers.



Challenge

Reservoir operators and aquatic resource planners need information to minimize harmful effects of reservoirs and to provide environmental conditions that are consistent with river and reservoir management objectives. Computer models provide scientists and resource managers a way to examine ecosystem responses to management actions. Scientists at the Rocky Mountain Research Station, the University of Idaho, the University of Western Australia, and the U.S. Bureau of Reclamation are partnering to develop a mechanistic modeling approach for describing effects of reservoir operations on fish and other biota in regulated rivers and reservoirs.

Context

This study is being conducted in the Deadwood Reservoir and River in central Idaho. The Deadwood Reservoir is used to augment flows for out-migrating salmon and for irrigation. Since threatened bull trout reside in the Deadwood River and Reservoir, resource managers must balance water delivery needs for irrigation and salmon with bull trout ecological requirements. A team of hydrologists, geomorphologists, and biologists is integrating disciplines to describe how reservoir operations affect bull trout.

Actions

- We are linking reservoir operations to bull trout production mechanistically through the integration of physical, ecological, and bioenergetic models.
1. Detailed hydrological, water quality, and ecological models are used to describe the relationship between reservoir operations and physical, chemical, and biological conditions in the reservoir and river. Data on weather conditions and water temperature, flow, and dissolved oxygen are acquired continuously using meteorological and limnological monitoring stations. These data can be translated into real-time predictions of reservoir conditions using the models ELCOM and CAEDYM. Highly detailed maps of riverbed topography have been created using state-of-the-art green lidar data. River hydrodynamic models are used to describe temperature, flow, solutes, and sediment in the downstream river channel.
 2. Reservoir operations may affect fish survival, growth, or behavior of individuals, and individual-level effects combine to create population-level responses. Limiting factors and energetic constraints to bull trout in the reservoir and the river are determined using foodweb and bull trout bioenergetic models. The foodweb model uses stable isotope tracers to track energy flow from algae to bull trout. Foodweb and fish bioenergetic models rely on information provided by the physical and ecological models.
 3. Different scenarios of reservoir operations are simulated using the linked hydrodynamic, ecological, and bioenergetic models to predict effects on bull trout. These models will allow us to predict fish population responses to a variety of water releases.

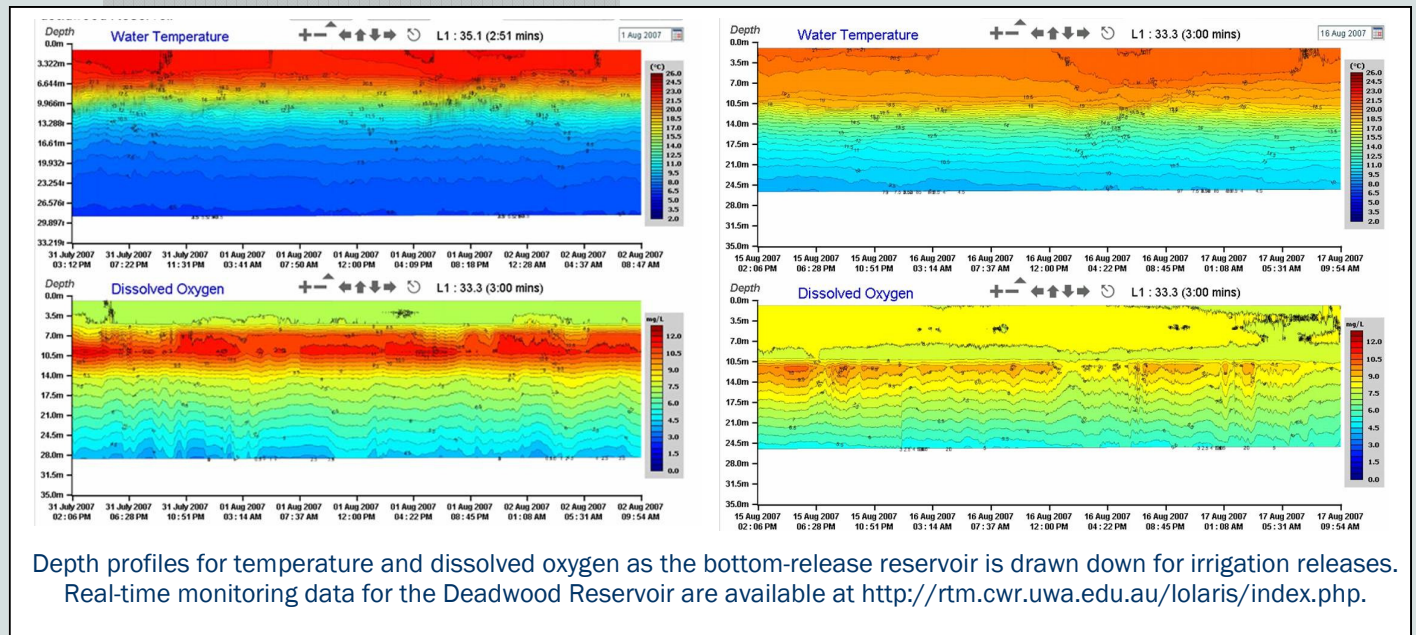
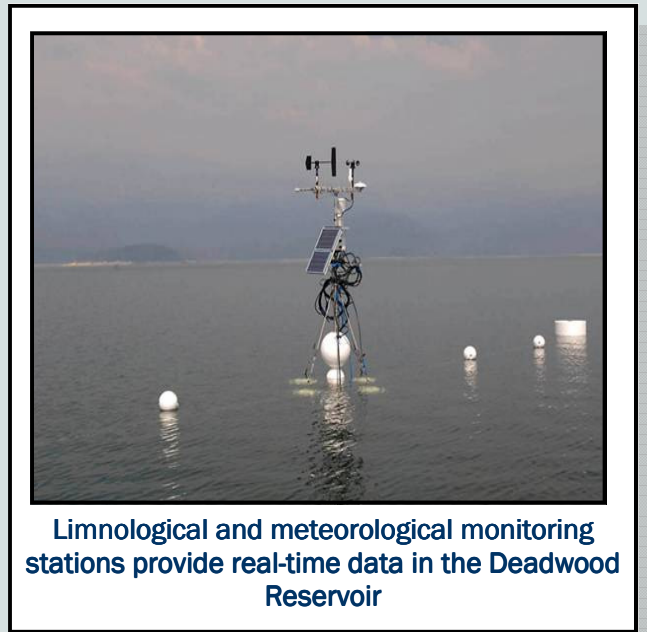
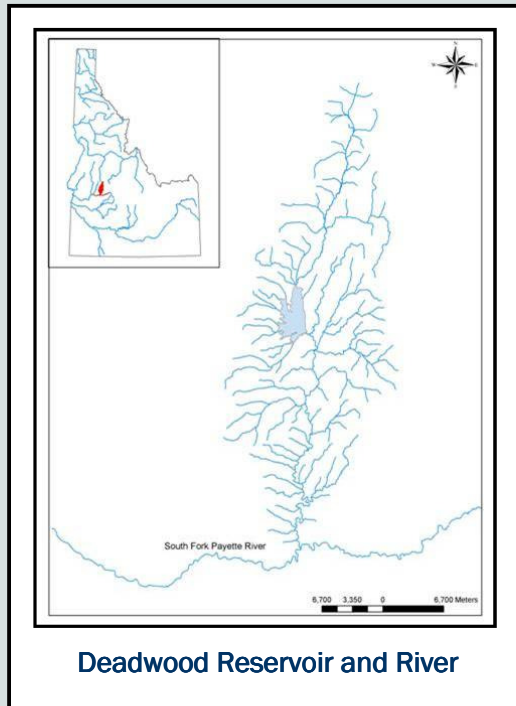
Results

In this project, multiple models will be integrated to describe links between reservoir operations, physical conditions, foodweb effects, and fish population response in a reservoir and downstream river. The process provides a mechanistic linkage from reservoir operations to fish production, and allows for prediction of effects to fish under various scenarios of reservoir operations and background conditions. This suite of models provides an innovative, science-based management tool for managers who are tasked with balancing water delivery needs with concerns for fish populations and aquatic ecosystems.



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Reservoirs and Fish



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