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FORT COLLINS SCIENCE CENTER

Aquatic Systems and Technology Applications

Capabilities

Land and water management agencies are responsible for restoring and conserving our nation's natural resources. However, they face increasing, often competing demands for those resources, which can result in alteration or loss of critical riverine, riparian, wetland, and terrestrial habitats. Land and resource managers may be in federal, state, or local government, but all have the same need for quantitative, objective, science-based information that helps them plan, manage, and conserve the natural resources within their purview.

The Aquatic Systems and Technology Applications Branch (ASTA) of the Fort Collins Science Center (FORT) encompasses a wide variety of studies, investigations, and activities that are related to providing tools and capabilities for natural resource managers. ASTA's mission is to provide managers with credible science-based information on the interrelationships among the physical, chemical, aquatic, and biological natural resources in river basins for resource management decision-making.

Branch goals are to:

- develop and apply specific models and analysis tools for resource management issues,
- identify habitat and biological linkages in river corridor environments,
- design and evaluate specific water quality improvement features,
- define economic measures for natural resource benefits,
- investigate altered flow regime effects on native fish populations,
- characterize sediment transport effects in river corridor environments, and
- utilize advanced technology to evaluate landscape-scale changes in river basins.

Selected Projects

Five major project areas support the ASTA mission and goals for resource management: (1) river and stream modeling and decision support systems, (2) western freshwater and anadromous fish, (3) lake and wetland ecosystems: constructed wetlands, (4) fish disease and sediment transport modeling, and (5) technology applications in support of Department of the Interior agencies. Representative projects from each area are described below.

River and Stream Modeling and Decision Support Systems

This project focuses on developing one- and two-dimensional aquatic habitat models, refining hydrodynamic models for habitat issues, building computer tools for habitat research, providing science-based information for regulated river systems, and developing planning and assessment models to evaluate water management strategies. Changes in river flows cause temporal and spatial variability in habitat for aquatic organisms. Visual representations of this variability provide resource managers with more explicit information on what is required to maintain or improve river conditions for target species, for example, in the Upper Yellowstone River in Montana and the Klamath River Basin, Oregon and California. Decision support systems provide a central location for data, provide institutional memory for resource managers, and allow "gaming" with river systems to optimize or improve certain resource variables.

Western Freshwater and Anadromous Fish

Project scientists investigate and examine fish community relationships in lakes and rivers, using both traditional and new technologies. Spatial scales range from small streams to large reservoirs. Methods employed in this project range from standard gill netting and electrofishing to sophisticated hydroacoustic sonar, geographic information systems (GIS), tracking telemetry, and other remote sensing techniques. Both recreational and special status species research are a part of this work. For example, studies being conducted on the Colorado River and associated reservoirs will benefit restoration efforts for endangered fish species and assist the Bureau of Reclamation in developing water project operating plans. In other work, investigations of predator-prey interactions utilize laboratory testing, underwater videography, and stable isotope analysis.

U.S. Department of the Interior
U.S. Geological Survey

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Lake and Wetland Ecosystems: Constructed Wetlands

In the arid West, loss of critical wetland and riparian habitat due to depletion of water resources has severe impacts on biodiversity. Often the only water available for restoring wetland or riparian habitat is of impaired quality. Using constructed wetlands as low-cost, low-maintenance, socially attractive treatment systems provides an opportunity to reuse impaired source water while enhancing wildlife habitat. ASTA scientists are applying an ecosystem perspective to understanding water treatment functions, evaluating the habitat created, and developing cost-effective techniques for operation and maintenance of these wetlands. Research is designed to understand water treatment functions within constructed wetlands, evaluate wildlife habitat, improve the integration of habitat value and treatment function, develop cost-effective techniques for habitat management, and apply new techniques to the restoration of degraded natural riparian and wetland ecosystems. Technical assistance in design, operation, and maintenance of constructed wetlands is provided to client agencies in many western states.

Fish Disease and Sediment Transport Modeling

The goal of this project is to link sediment/river channel interactions with changes in physical habitat important to fish populations. ASTA scientists are determining sediment limiting factors for *Tubifex* species, an intermediate host for whirling disease, using statistical routines developed at FORT to predict spatial distribution of sediment size classes with one-, two-, and three-dimensional hydraulic models. The studies of sediment and channel interaction develop predictions for channel maintenance flows, flows to remove (or not remove) sand and fines, and flows to predict spawning gravel movement. For example, ASTA scientists are using sedi ment transport modeling to identify specific places in river channels modified by construction activities that could be redesigned to reduce the area and suitability of sediment deposits for *Tubifex* species to survive.

Technology Applications in Support of Department of the Interior (DOI) Agencies

The Technology Applications Project Team (TAT) conducts applied research and development to help DOI agencies and international conservation organizations better understand and manage natural resources. TAT's cadre of highly skilled information technology specialists and ecologists work for sister DOI bureaus, building Web-based applications and testing promising new technology. Major efforts in the past several years have involved converting operational programs into Web applications that vastly improve access and efficiency. For example, TAT built and maintains a suite of programs on the Web for the U.S. Fish and Wildlife Service (USFWS) that provides agency and public access to critical data such as endangered species, wetlands, and critical habitat. This program is accessed daily by hundreds of registered USFWS users and thousands of public users, processing more than three million database transactions per month. Other products under development include a comprehensive research reporting system for the National Park Service, an air quality monitoring system for the Bureau of Land Management in Wyoming, and the Southwest Information Node of the National Biological Information Infrastructure (NBII).

Staff

Branch Chief: David Hamilton, Ph.D. Ecologist: wetland ecology and management, computer applications.

Bartholow, John, M.S. Ecologist: temperature, water quality, and fish population modeling; systems analysis; training.

Bovee, Ken, M.S. Hydrologist: stream habitat analysis, hydraulic modeling, hydrology.

Boyle, Terence, Ph.D. Ecologist: biological and ecological indicators, ecotoxicology, ecological risk assessment.

Campbell, Sharon, M.S. Ecologist (Aquatic): reservoir and stream ecology, water quality.

Carpenter, Jeanette, Ph.D. Fishery Biologist: stream ecology, endangered species, introduced species, fish habitat analysis.

Douglas, Aaron, Ph.D. Economist: nonmarket valuation, riverine resources.

Flug, Marshall, Ph.D., P.E. Research Hydrologist: reservoir operations, water resource systems, environmental decision support, modeling and simulation.

Hanson, Leanne, M.S. candidate. Biologist: aquatic ecology, environmental and geospatial sciences.

Henriksen, Jim, B.S. Ecologist: stream ecology, instream flow, stream habitat analysis, hydraulic modeling, impact analysis.

Hunter, Don, Ph.D. Ecologist: ecology, international conservation, information systems.

Milhous, Bob, Ph.D., P.E. Hydrologist: hydraulic modeling, instream flow models, sediment transport, channel dynamics.

Mueller, Gordon, M.S. Research Fishery Biologist: reservoir fisheries, fish detection, telemetry, sampling equipment, hydroacoustics.

Sartoris, Jim, M.S., P.E. Research Civil Engineer: engineering limnology, water quality, aquatic ecology, wetland creation.

Terrell, James, M.S. Fish and Wildlife Biologist: modeling fish and wildlife habitat relations.

Thullen, Joan, M.B.A., B.S. Botanist: aquatic plant ecology and management, wetland creation, wetland ecology, water quality.

Waddle, Terry, Ph.D. Hydrologist: reservoir operations and water routing models, river hydraulics.

Williamson, Sam, Ph.D. Ecologist: fish population dynamics, cumulative impacts, systems analysis.

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Find information about FORT science, products, and resources at http://www.fort.usgs.gov

Learn more about the Aquatic Systems and Technology Applications Branch at http://www.fort.usgs.gov/research/500/500.asp