COLORADO WATER

Newsletter of the Water Center at Colorado State University

AUGUST 2003

Water science benefits from Colorado State's new and remodeled aquatic habitat research facilities

See page 8

From left: Chris Myrick, Department of Fishery and Wildlife Biology, graduate student Ashley Ficke and summer intern Cloelle Sausville-Giddings are investigating various types of fish ladders and whether they allow fish to move upstream. Results will be used to develop design criteria for fish passage structures.

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Colorado Water Resources Research Institute
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WATER ITEMS AND ISSUES . . .

CORRECTION: In the June, 2003 issue of Colorado Water, we identified Joel Schneekloth's affiliation as Montezuma County, CSU Cooperative Extension. Joel's correct affiliation is:

Joel Schneekloth
Extension Water Resource Specialist
U.S. Central Great Plains Research Station
CSU Cooperative Extension
Akron, Colorado.

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Editor: Shirley Miller
Writer: Marian Flanagan

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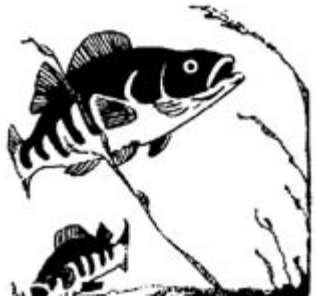
EDITORIAL

WATER AND FISH

Editorial by Robert C. Ward, Director

The impact of human activity on aquatic ecosystems has been at the core of a number of water conflicts over the past 30 years. There is a tension in the human condition that seeks security and comfort regarding domestic water supply, while at the same time seeking protection of the natural flow conditions in our rivers and streams.

An example of such conflict occurred when a 2001 drought in the Klamath River Basin in Oregon and California, combined with Federal legal requirements regarding water use, resulted in a scarcity of water both for agricultural use and for maintenance of water levels necessary to sustain threatened and endangered fish populations. Farmers experienced reductions in water available for irrigation that caused severe economic consequences in the Basin. There are numerous other examples of the tension between human and ecosystem water needs; for example, Rio Grande silvery minnow in the Rio Grande Basin and humpback chub in the Colorado River Basin.



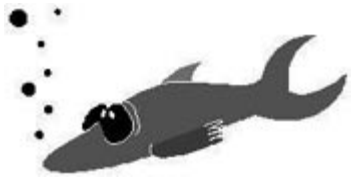
As society attempts to reconcile water use by humans and the ecosystem, there is a growing need to understand how the various components of an ecosystem interact with water resources. The Colorado Water Resources Research Institute (CWRRI) funded a three-year study of the life cycle of the brassy minnow on Colorado's eastern plains. The study, under the direction of Professor Kurt Fausch, is described in a refereed journal article on the CWRRI website at http://cwrri.colostate.edu/. As this study demonstrates, human understanding of the interface between threatened and endangered species and water resources, while increasing, is in need of additional study. The relationship between water and fish in western rivers is complex and quite dynamic.

To support enhanced studies of Colorado's threatened and endangered aquatic species, Colorado State University's Department of Fishery and Wildlife Biology has recently remodeled the Larval Fish Laboratory and created two new laboratories (Fish Physiological Ecology Laboratory, housed in the new Foothills Fishery Laboratory Building, and the Conservation Genetics Laboratory). These facilities, capable of studying aquatic organisms and their complex relationships to water, are described on page 8 in this issue of *Colorado Water*. Information developed by these new facilities may be key to resolving water-related conflicts in western aquatic ecosystems.

To illustrate, as new understanding of fish needs for water is obtained (in terms of quantity, location, and variation desired), it becomes feasible to examine ways to introduce this knowledge into the decision-making processes of water managers. Water managers, with new, information technology-based management tools, are then able to examine options for supplying water for fish needs while not damaging water rights.

Where tweaking of the water delivery system to meet fish needs is not feasible without damaging water rights, other options for obtaining water for environmental needs must be examined (e.g., purchasing water for instream flow maintenance in critical stretches of river systems).

It remains to be seen how much of the water needs for fish can be 'obtained' by a better understanding of fish requirements combined with advanced decision support systems employed by water managers. This is an exciting new frontier for water research and one where the interdisciplinary nature of the solution is requiring new research alliances and collaborations. CWRRI, with the cooperation of innovative and dynamic researchers, is at the forefront of creating interdisciplinary approaches to reducing water



Colorado Water Resources Research Institute
FY 2004 Request for Proposals
CLOSING DATE: SEPTEMBER 26, 2003

Proposals are invited for the Colorado Water Resources Research Institute FY 2004 water research program.

The Colorado Water Resources Research Institute (CWRRI) is established under the federal Water Resources Research Act, as amended, and is authorized by the Colorado legislature, most recently in 1997, under H.B. 1218. At the federal level, CWRRI is one of 54 water institutes administered by the U.S. Geological Survey in the Department of Interior. Under Section 104(b) of the Water Resources Research Act, CWRRI is to '…plan, conduct, or otherwise arrange for competent research…' that fosters the entry of new scientists into water resources fields, the preliminary exploration of new ideas that address water problems or expand understanding of water and water-related phenomena, and disseminates research results to water managers and the public. The research program is open to faculty in any institution of higher education in Colorado that has 'demonstrated capabilities for research, information dissemination, and graduate training … to resolve State and regional water and related land problems.'

Research Topics: For the FY 2004 competition, the CWRRI Advisory Committee for Water Research Policy has identified the following seven needs for new water knowledge as top priority.

- Development of scientifically sound and transparent tools for determining augmentation flows for well pumping in the South Platte Basin.
- What options does Colorado have to 'drought-proof' its urban landscapes? Are shifts to less water-demanding urban landscapes acceptable to Colorado citizens?
- Development of Colorado-based crop coefficients for use in the Penman class of evapotranspiration equations.
- What are the anticipated economic impacts on Colorado's agriculture associated with changes to augmentation flow requirements in light of the Empire Lodge decision and Senate Bill 73?
- What are the 'best' ways to mitigate the impact of excess salinity on irrigated agriculture in the Lower Arkansas Valley while avoiding negative impacts on other water users on the river?
- How cost effective are the BMPs employed to satisfy non-point source TMDL requirements in Colorado?
- With treated wastewater return flows constituting a large percentage of river flows at certain times of the year, what are appropriate nutrient criteria for Colorado rivers and lakes?

Funds Available: The CWRRI Request for Proposals is partially supported by the U.S. Geological Survey. It is anticipated that approximately $50,000 in federal funds will be available for this competition. The federal funds must be matched 2:1 by *non-federal* funds (resulting in a total of approximately $150,000 for this competition). Matching funds come from the university submitting the proposal and/or from local and/or state agencies via agreements arranged during preparation of the proposal. CWRRI research funds are awarded through a competitive process guided by the CWRRI Advisory Committee on Water Research Policy. Proposals that contain matching funds from Colorado water and water-related organizations are strongly encouraged. *Final CWRRI awards are contingent upon Congressional approval of FY 2004 funding for the national water institute program.*

Proposal Review Process: All proposals are due in the CWRRI offices by September 26, 2003. Proposals will be peer reviewed before final review and ranking by the CWRRI Advisory Committee for Water Research Policy. The general criteria used for proposal evaluation include: (1) scientific merit; (2) responsiveness to RFP; (3) qualifications of investigators; (4) originality of approach; (5) budget; and (6) extent to which Colorado water managers and users are collaborating. Proposal reviews should be completed by December 2003 with March 1, 2004, start dates. [Once projects are selected for funding by the Advisory Committee, CWRRI submits a formal funding request to the U.S. Geological Survey, including each accepted proposal.]

Eligibility: The competition is open to regular, full-time faculty at Colorado's research universities.

Project Duration: Awards will be made for one year beginning March 1, 2004. Multiple-year projects will be considered; however, funding for additional years must be obtained through the annual CWRRI research competition.

Proposal Submission: Please submit your proposal in Word format, not in Acrobat, as submitting your proposal online at the NIWR website may require some reformatting and/or page renumbering. Proposals, in both hard and electronic copy, are to be submitted by 5:00pm, September 26, 2003, to:

Director
Colorado Water Resources Research Institute
E-102 Engineering Building
Colorado State University
Fort Collins, Colorado 80523

Send electronic copy via e-mail, if you wish, to: Shirley.Miller@Colostate.edu

Proposal Preparation Guidelines: For a copy of the USGS proposal guidelines, contact Robert Ward or Shirley Miller at the above email address.

Questions: If there are questions about the solicitation, contact Shirley Miller or Robert Ward by phone at (970) 491-6308 or by e-mail at: Shirley.Miller@Colostate.edu.

PROJECTS FUNDED IN NIWR/USGS NATIONAL COMPETITIVE GRANTS PROGRAM

The six proposals listed below were recommended for funding under the fiscal year 2003 National Institutes for Water Resources/U.S. Geological Survey National Competitive Grants Program. Abstracts of these proposals are available at **http://water.usgs.gov/wrri/2003.html**. The selection panel had a difficult task in selecting these six proposals out of the 76 proposals received. Only $993,500 in federal funds was available this year, contrasted with the total of over $11 million requested by the 76 proposals. Many excellent proposals could not be funded.

Title: ***An Assessment of New Advances in Low Streamflow Estimation and Characterization***, by: Chuck Kroll, SUNY, College of Environmental Sciences and Forestry, Syracuse. Collaborators: Kenneth Eng, National Research Program, Eastern Region, U.S. Geological Survey. Institute: New York State Water Resources Institute, Cornell University. Federal Funds: $154,058 (3 years).

Title: ***A Regional Approach to Conceptualizing Fractured-Rock Aquifer Systems for Groundwater Management***, by: Stephen B. Mabee, University of Massachusetts. Collaborators: Massachusetts-Rhode Island District and Bedrock Regional Aquifer Systematics Study (BRASS) program, U.S. Geological Survey. Institute: Water Resources Research Center, University of Massachusetts. Federal Funds: $92,839 (3 years).

Title: ***Dynamics of Point and Non-Point Source Fecal Pollution from an Urban Watershed in Southern California***, by: Stanley B. Grant, University of California, Irvine; and Patricia Holden, University of California, Santa Barbara. Collaborator: California District Office in San Diego, U.S. Geological Survey. Institute: Center for Water Resources, University of California. Federal Funds: $159,054 (3 years).

Title: ***Bridging the Gap Between Plankton Dynamics and Spatial Variability in Water Quality in the Guadalupe Estuary (Texas): The Importance of Freshwater Pulses***, by: Stephen E. Davis and Daniel L. Roelke, The Texas A&M University. Institute: Texas Water Resources Institute, The Texas A&M University. Federal Funds: $233,953 (3 years).

Title: ***Distribution and Toxicity of Sediment-Associated Pesticides in the Sacramento River Watershed***, by: Donald P. Weston, University of California and Michel J. Lydy, Southern Illinois University in Carbondale. Collaborator: Chris Ingersoll, Columbia Environmental Research Laboratory, U.S. Geological Survey. Institute: Center for Water Resources, University of California. Federal Funds: $199,927 (2 years).

Title: ***Photochemistry of Antibiotics and Estrogens in Surface Waters: Persistence and Potency***, by: Kristopher McNeill, William A. Arnold, and Deborah L. Swackhamer, University of Minnesota. Collaborators: Kathy Lee, Minnesota District Office, and Paul Capel, National Water Quality Assessment Program, U.S. Geological Survey. Institute: Water Resources Center, University of Minnesota. Federal Funds: $134,070 (2 years).

USDA/CSREES GRANT FUNDS THREE Ph.D STUDENTS

A USDA grant to Colorado State University provides funding for three additional Ph.D Fellows to conduct research on water management issues critical to Colorado agriculture in the Western United States. The Cooperative State Research, Education, and Extension Service (CSREES) awarded the $207,000 grant to Jim Loftis, Civil Engineering Department, CSU and Jessica Davis, Soil and Crop Sciences Department, CSU. The doctoral fellowships carry a stipend of $22,000 per year for three years plus a travel allowance to attend two national technical conferences.

Alisa Wade

Alisa Wade will begin her doctoral work at CSU Fall Semester, 2003, studying in the Forest, Rangeland, and Watershed Stewardship Department. Alisa's research interests are in landscape ecology, focusing on how public land management actions impact watershed health. She plans to use geographic information systems (GIS) to assess how various suites of management options impact watershed ecology. Alisa has master's degrees in environmental policy (M.P.A., San Jose State University, 1995) and environmental planning (M.C.P., UC Berkeley, 2000). Alisa has worked for the City of San Jose's Environmental Services Department and the Marin Conservation Corps, and she served as Executive Director for Colorado's Legacy Land Trust. Most recently she worked as an environmental consultant for ENSR, Inc., serving as a project lead working with the Bureau of Land Management to design a land use plan for over 14 million acres in Nevada.

Curtis Cooper was born in Colorado, where he has lived the majority of his life. Curtis received his Master of Science Degree from Colorado State University in Watershed Science, examining the in-reservoir salt concentrations in the South Platte River Basin, with Dr. John Stednick. After graduation, Curtis was a consultant for several years, specializing on urban impacts on agricultural water in the Colorado Front Range. In the past year, Curtis has returned to Colorado State University where he is working on his Ph.D. with Dr. Grant Cardon in the Soil and Crop Sciences Department. Since receiving the National Needs Fellowship in Natural Resources, Curtis has expanded his knowledge of agricultural water use and is continuing to learn about soil and water chemistry and irrigation. Curtis is currently conducting research and assisting on the interdepartmental and interagency examination of the Salinity and Waterlogging issues in the Arkansas River Valley under the specific guidance of Dr. Timothy Gates in Civil Engineering.

Travis Schmidt is a Ph.D Candidate in the Fishery and Wildlife Sciences Department studying ecotoxicology in Dr. Will Clements' laboratory. His work complements research on global climate change as it affects ultraviolet radiation, dissolved organic carbon, and heavy-metal interaction with stream benthic communities. Travis's research career began while an undergraduate studying at The Pennsylvania State University and volunteering in a wetland ecology/ecotoxicology laboratory. After graduating in 1998, he held positions at The University of Notre Dame and The Ohio State University working in the

Curtis Cooper

fields of exotic species invasion and fisheries management/recruitment. In 1999, Travis began his masters education at Virginia Technological Institute, focusing on integrative bioassessment techniques to delineate acid mine drainage-impacted watersheds for restoration by the Army Corps of Engineers. He also utilized these data to look at how bioassessment techniques could be used as descriptors of stream benthic communities.

After completing his Masters Degree in 2001, Travis worked at Status Consulting in Boulder, Colorado and ELM Consulting LLC in Chicago, Illinois. His work included a Natural Resource Damage Assessment (NRDA) of the Clark Fork Reservoir, Montana, developing and participating in integrative Super Fund/NRDA/ERA investigations of a primary lead smelter, a World War I /II munitions facility on a national wildlife refuge and an oil refinery.

Travis Schmidt is washing the contents of a Hess Sampler after he collected a macroinvertebrate sample from the streambed at West Tennessee Creek. Picture credit: Bob Zuellig.

Most recently he worked on a mercury-contaminated trophy fishery in the Upper Peninsula of Michigan and developed/implemented remedial strategies to remove methyl mercury without dredging and destroying the trophy fishery.

Congressional Update/Environment -- Senate Appropriations/Endangered Species Act

On July 16, in a joint news release, Senators Pete Domenici (R-NM) and Jeff Bingaman (D-NM) stated that the Senate Appropriations Committee's Energy and Water Development Subcommittee, which Domenici chairs, approved an amendment to the FY 2004 Energy and Water Bill (S. 14424) about the Rio Grande silvery minnow and Endangered Species Act (ESA). The news release states, "The amendment was written in response to an opinion by a three-judge panel of the 10th Circuit Court of Appeals that supported a …[d]istrict judge decree that under the ESA, the silvery minnow's water requirements have higher priority…than any other user of Rio Grande and San Juan-Chama Diversion water." It adds, "The amendment statutory determines that silvery minnow habitat recovery requirements… have been -- and are continuing to be – met through the reasonable and prudent alternatives in the 2003 Biological Opinion issued by the U.S. Fish and Wildlife Service. It would prohibit the use of San Juan-Chama Diversion Project water to meet ESA requirements on the Rio Grande; and, allow for the federal purchase of privately held water if there is a willing seller." (WSW #1519)

Senator Domenici said, "This is a fair, common-sense amendment that will uphold the rights of people, while still protecting and fostering the fish. It should protect our cities, farmers, tribes and other water users from the full brunt of the 10th Circuit panel decision. It is specifically written to avoid mooting or otherwise interfering with the state's potential appeal to the full panel of the 10th Circuit." Senator Bingaman declared, "This language will help preserve San Juan-Chama water for the purpose that it was intended and provide certainty for Middle Rio Grande water users. At the same time, it should avoid an unproductive fight over the Endangered Species Act by making it clear that compliance with the…biological opinion is required and that all recovery efforts will continue. We will also continue working with all parties to resolve these issues for the long-term."

Source: *Western States Water newsletter* / July 18, 2003

RESEARCH

NEW AND REMODELED FACILITIES ENHANCE AQUATIC HABITAT RESEARCH AND TEACHING CAPABILITIES

This issue of Colorado Water describes Colorado State University's new and remodeled facilities and research and teaching capabilities in the fields of fishery biology, aquatic habitat, and endangered species conservation.

The new Foothills Fishery Laboratory (FFL) arose out of the acute need for a flexible, multi-purpose laboratory where Department of Fishery and Wildlife Biology (FWB) faculty could conduct laboratory experiments under controlled conditions. Prior to the decision to construct the FFL, wet lab space in the department was very limited. In 2000, the Colorado State University administration embarked on a course of action that would ultimately result in the approval, design, and construction of the FFL. An initial budget of $500,000 was allocated for design and construction of the facility, but following several iterations of the design process, the budget was raised to roughly $750,000. The FFL houses Dr. Chris Myrick's Fish Physiological Ecology Laboratory and provides space for other FWB investigators to conduct laboratory experiments.

The remodeled **Larval Fish Laboratory** (LFL) at Colorado State University has been a principal source of technical information for state and federal agencies on native and non-native fishes in the Upper Colorado River since 1978. The LFL is a nationally recognized center for the study of early life history of fishes.

The new **Conservation Genetics Lab**, located in the newly renovated lower level of CSU's Wagar Building, is adjacent to the Larval Fish Laboratory. Both units work closely together. Assistant Professor Marlis R. Douglas and Senior Research Scientist Michael E. Douglas direct the lab.

New Fish Physiological Ecology Laboratory Provides Multi-Purpose Facilities

by Chris Myrick
Department of Fishery and Wildlife Biology

Facility Concept

The capabilities and requirements that were built into the FFL are largely based on Dr. Chris Myrick's experience with similar facilities at the University of California, Davis. Additional design suggestions were provided by FWB faculty as well as Colorado Division of Wildlife personnel. The core concept behind the design of the FFL was that it should provide the infrastructure to support a wide variety of laboratory research projects in the fish physiology, fish ecology, fisheries management, and fish culture arenas. This concept was brought into reality by designing a building with a large amount of multi-use space, dual water supplies, temperature controls, monitoring capabilities, and water treatment facilities.

Current Status

Construction of the Foothills Fishery building was completed in December 2002. Installation of fish tanks and ancillary systems began during the spring 2003 semester. The laboratory sections of two courses, FW402 (Fish Culture), and FW405/680 (Fish Physiology) were taught in the building during that semester. These sections served two purposes: first, students were able to get hands-on instruction in the design and construction of aquaculture facilities and physiological experiments at the same time that they learned key aquaculture and physiological concepts; and secondly, the courses allowed us to begin testing the various building systems, a process that continues to this date.

Research Projects

There are now two research projects active in the Foothills Fishery Laboratory. The first, a pilot study on sand shiner swimming ability, is designed to develop better fish passage structures for plains fishes in Colorado. Investigators are measuring the fishes' swimming performance and also determining whether various types of fish ladder (pool-and-weir, inclined ramp, etc.) allow them to move upstream. This information will then be used to develop design criteria for fish passage structures. The principal investigator on this project is Dr. Christopher Myrick. He is assisted by graduate student Ashley Ficke and a summer intern in the Water REU program, Cloelle Sausville-Giddings.

The second project is underway in the new building is a study on the effects of low water temperature on the growth and survival of Colorado River cutthroat trout fry, in the presence and absence of competition from brook trout fry. This study is being conducted by Dr. Kurt Fausch, his Ph.D. student Mark Coleman, and his assistant Matt Hopken.

Professor Kurt Fausch and graduate student Mark Coleman examine the experimental approaches to study water temperature effects on growth and survival of Colorado River cutthroat trout

Facility Information

Location: The FFL is located just north of the large metal hay barns along Rampart Road, on the CSU Foothills Campus. Relative to the existing ponds and pole barn, the new facility is located to the south, on the other side of the bridge crossing over the Pleasant Valley canal.

Structure: The FFL is a 40' × 100' steel-frame building. The interior is divided into 3 sections, a 40' × 80' open "wet laboratory", a 20' × 20' "dry laboratory" and a mechanical room. A 15'-wide roll-up door provides vehicle access to the wet laboratory, and pedestrian access to both laboratories is provided by 4 exterior doors. The wet lab portion will be heated by a pair of gas-fired unit space heaters. Ventilation will be provided by large exhaust fans. The dry lab is heated and cooled by a wall-mounted environmental conditioning unit. There is limited storage in the dry lab/mechanical section of the building.

Facility Capabilities

FEATURE	FFL IMPORTANCE
-- 150 gallons per minute of College Lake water -- 70 gallons per minute of well water	The dual water supplies provide the FFL with the flexibility to approximate west slope (College Lake water) or east slope (well water) water chemistry. College Lake water comes indirectly from the west slope via Horsetooth Reservoir and shares chemical characteristics such as low hardness. The well water at the FFL has characteristics (e.g. high hardness) more typical of east slope drainages. The dual water supply makes the FFL an ideal site for conducting laboratory studies in which water chemistry is important, such as limiting factors or culture techniques research. An additional benefit of the dual water supply is redundancy. If one water supply is compromised, the second can be used to support any fish at the facility until the problems with the primary supply are fixed.

[1] Ashley Ficke's MS research will be an expanded version of the summer project, looking at multiple plains fish species (e.g., minnows, darters, dace) and different fish ladder designs. Ashley is the recipient of the 2003 Water Center fellowship.

[2] Cloelle is a junior at Smith College (MA), majoring in civil engineering. She is one of the students selected for the 2003 Water REU program at CSU, sponsored by the National Science Foundation.

-- Base heating and chilling capacity	The FFL includes a boiler capable of producing 25 gallons per minute of 40°C water and a chiller capable of producing 25 gallons per minute of 5°C water. The ability to deliver relatively large volumes of heated and chilled water will allow researchers to simulate most of the wide range of thermal conditions found in Colorado waters. The volume of heated and/or chilled water available will allow researchers to hold fish at constant temperatures under *flow-through* conditions, minimizing the likelihood of confounding factors such as changes in metabolite concentrations. If temperatures below 5°C are needed, the available supply of 5°C water will reduce the size of any additional chilling units. The initial facility specifications called for a water heating and chilling system capable of delivering 50 gallons per minute of both 40 and 5°C water. We scaled back on this requirement, but are designing the facility with future expansion in mind, should the funds become available.
-- Water treatment -- Mechanical filtration -- Ozone disinfection -- UV sterilization	A major concern of any modern fisheries facility is the ability to prevent the unwanted transfer of organisms across system boundaries. The FFL's water treatment system is designed to minimize the unwanted entry or exit of organisms. All College Lake water entering the facility passes through 2 mechanical filters (basket strainer and bead filter). Ozone is then injected into the water as a disinfectant; and water passes through a UV sterilizer before being diverted to the heater, chiller, or ambient temperature holding tank. Effluent from the facility passes through a drum filter to remove large particulate matter. The effluent is collected in a holding tank before ozone is injected as a disinfectant. The water is then returned to College Lake or to a ditch just north of the original pole barn. The sludge that is collected in the drum filter is sent to the sanitary sewer.
-- Wet lab features	The "wet lab" portion of the facility is a 40' × 60' open room with a 60' trench drain running down the midline of the floor. The floor slopes gently towards the trench drain, which is valved to direct effluent to the sanitary sewer or to the facility's water treatment system. Water and air supply pipes and are suspended from a unistrut system 8' above the facility floor. Electrical outlets will be present along facility walls and along the unistrut system. Twelve 8' × 1' fluorescent fixtures will provide the base amount of lighting. If stronger lighting and/or photoperiod control are needed for a particular study (e.g., for a study on spawning timing), enclosures housing timer controlled lights can be easily added. The open design of the wet lab means that researchers set-up systems that are finely tailored to the needs of their study, rather than relying on a fixed system of tanks and raceways. This does represent an additional materials cost for these studies, but the end result will be increased data accuracy and precision.
-- Dry lab features	The dry lab includes telecommunications ports (high-speed Ethernet and telephone), lab benches, storage, and a utility sink. The laboratory is home to a number of analytical instruments, including high resolution oxygen analyzers, centrifuges, spectrophotometers, and respirometers and tolerance/preference chambers.
-- Alarm/monitoring systems	A Johnson Controls monitoring/alarm system is included in the FFL design. The core system will monitor a number of critical variables, including: facility power, pump function, chiller and heater function, and head tank temperature. The Johnson Controls system is expandable, so future sensors (e.g., security, building temperature, etc.) can be added at a later date.

CSU's Larval Fish Laboratory Celebrates 25th Anniversary in Remodeled Facilities

by Kevin Bestgen

This year the Larval Fish Laboratory (LFL) at Colorado State University celebrates its 25th anniversary in newly remodeled facilities. Established in 1978, LFL is unique among North American fishery research laboratories, focusing its expertise on reproduction and ecology of early-life-history stages of rare native fish species.

Research is the primary function of the LFL, and it collaborates with local, state, and federal agencies and nongovernmental organizations responsible for aquatic resource management. Most of the LFL's activities are concentrated in the Upper Colorado River Basin, where it has participated in the Recovery Program for Endangered Fishes in the Upper Colorado River Basin for over 20 years.

In its 25-year history, the LFL's significant research

contributed to understanding the natural history and ecology of native fishes in Colorado and the West, which has facilitated efforts to conserve them.

The LFL, which is funded exclusively by grants, contracts, and service fees, has collaborated with scientists in over 20 local, state, and federal agencies, other universities, and non-govern-mental organizations responsible for aquatic research and resource management. Some of the most important
research areas include:

- *Early life history stages of fishes* -- Much effort remains concentrated on early life history stages of fishes in projects that span the range of taxonomy, propagation, and ecology.

- *Long-term distribution and abundance of fishes* -- Currently there are several field or data analysis projects designed to monitor long-term distribution and abundance of fishes. One of these studies is designed to estimate abundance of endangered Colorado pikeminnow *Ptychocheilus lucius* in about 500 miles of river in the Upper Colorado River Basin. Data gathered in monitoring studies will be used to detect changes in status of fishes in response to management actions.

Curator Darrel Snyder holds samples of endangered larval fish collected from the Colorado River Basin.

- *Removing non-native predator fishes* -- Investigations of effects of removing non-native predator fishes from the Yampa River will contribute to recovery of endangered and native fish species there.

- *Effects of hydropower-related flow fluctuations in the Green River* -- Over-winter survival studies will

- *Assessing the effects of major hydroelectric facilities* -- Since 1990, original research and service work has contributed to assessing the effects of hydroelectric facilities including Glen Canyon Dam (Colorado River), Flaming Gorge Dam (Green River), and the complex of dams and reservoirs in the Gunnison River. LFL scientists now contribute to interdisciplinary teams responsible for re-operation of these dams for management and recovery of aquatic resources.

- *Effects of electrofishing* -- The LFL has also developed research and technical expertise on effects of electrofishing on fish.

- *Effects of water quality and habitat on endangered species* -- Integrated laboratory and field toxicology studies continue to guide important decisions regarding effects of water quality and habitat on endangered fishes.

- *Fish entrainment and screen exclusion rates* -- Field studies that estimate fish entrainment and laboratory studies that evaluate screen exclusion rates will guide management decisions designed to enhance the health of aquatic communities.

- *Endangered Rio Grande silvery minnow swimming performance and fish passage design* -- A more recent emphasis involved assessing swimming performance of endangered Rio Grande silvery minnow (*Hybognathus amarus)*, research designed to guide decisions about fish passage design.

Research Associate and Assistant Curator Sean Seal examines morphological features of a fish specimen in the Larval Fish Lab.

provide important information on effects of hydropower-related flow fluctuations in the Green River.

- *Relative importance of natural and anthropogenic stressors* -- Computer simulation-based investigations of recruitment processes and fish bioenergetics have produced information that managers use to assess the relative importance of natural and anthropogenic stressors on natural populations of fish.

- *Distribution and status of Rio Grande chub and suckermouth minnow* -- LFL also recently completed studies on the distribution and status of Rio Grande chub (*Gila pandora)* in the Rio Grande Basin and suckermouth minnow (*Phenacobius mirabilis)* in eastern plains streams and furthered understanding about the effects of drought on those two species.

- *Genetics of suckermouth minnow, Rio Grande chub, and hybridization in catostomids* -- Dr. Michael Douglas and personnel in the Conservation Genetics Laboratory have completed recent studies on genetics of suckermouth minnow, Rio Grande chub, and hybridization in catostomids of the Yampa River Basin.

Personnel

The LFL currently has 15 people employed in a variety of capacities, including Senior-level Research Scientists and Research Associates Dr. Kevin Bestgen (Director), Dr. Michael Douglas, Darrel Snyder and John Hawkins. The recent addition of Dr. Douglas to the staff, in cooperation with the Conservation Genetics Laboratory, Fishery and Wildlife Biology, has further enhanced the lab's capabilities. There are also six junior-level research associates and a variety of technicians and work-study students.

Special Resources

The LFL has special resources for research, education, and service activities housed in its remodeled laboratory (Room 33 Wagar Building). The new space houses a depository for preserved fish eggs, larvae, and early juveniles collected from various locations throughout North America. The LFL Collection consists of an estimated 80,000 lots of fish, nearly 4 million specimens, most of which are early life stages and some of which were collected over 40 years ago. Holdings represent over 200 North American freshwater and anadromous species from across the continent, including most of the larval and small fish collected and preserved from the Upper Colorado River Basin (UCRB) since 1976. The latter account for over 95 percent of holdings and include several threatened and endangered species. Extensive literature holdings and illustrations of freshwater and anadromous fish eggs, larvae, and adults assist with research activities. Reports and publications resulting from research activities are available at the LFL website **http://www.cnr.colostate.edu/lfl/**.

Post-doctoral Fellow Matthew Kwiatkowski tests mito-hondrial DNA in the Conservation Genetics Laboratory.

Conservation Genetics Laboratory

by Marlis Douglas

The Conservation Genetics Laboratory (CGL) was established in the Fishery and Wildlife Biology Department (FWB) during autumn, 2001 when Drs. Marlis R. and Michael E. Douglas came to CSU from Arizona State University. The formation of the CGL now allows FWB to address from a molecular genetics standpoint research questions that pertain to biodiversity, systematics, ecology and conservation.

As its name implies, CGL applies cutting-edge molecular genetic techniques developed in the last decade to address broad questions that have application to conservation and management. The focus of the lab goes beyond applied conservation and straddles a variety of disciplines. Genetic data, for example, are used to reconstruct phylogenies of study groups (i.e. their evolutionary histories) so as to clarify patterns of

differentiation among and between geographic populations of the same species (i.e. their degree of variability, level of isolation, amount of population structure and its degree of fragmentation). Genetic data are also used to analyze the demographic structure of populations, particularly with regard to levels of inbreeding, paternity, population expansion and decline, etc. These data are also routinely integrated with ecological, morphological, and environmental data to obtain a landscape perspective on the manner in which organisms interface with their environment. Depending upon the evolutionary rates of the genetic markers evaluated, these tools allow a perspective on species and populations that can reflect ongoing or recent events (such as migration or reproduction), or even events long past in the evolutionary history of the study group (i.e., its proliferation following an historical bottleneck where population numbers were drastically reduced). The GLC thus employs a rigorous conceptual framework to address applied questions in aquatic resource management, and to provide sound scientific guidance to a variety of collaborators (such as academic institutions, state and federal agencies, and non-governmental organizations).

Modern molecular methodologies allow for the non-lethal sampling of organisms, and thus are particularly suitable to address questions involving T/E (threatened and endangered) species, or those with secretive and elusive lifestyles (such as large mammalian carnivores). With regard to fishes, DNA can be easily isolated from a fin clip, stored in ethanol, and eventually amplified for analysis. Thus, collection of tissue samples in the field has become very easy. Given this, molecular genetic approaches can now be easily integrated into ongoing monitoring or other ecological research activities, and are becoming another accessible and easily applied tool for investigators and research managers.

Resources & Facilities:
The Conservation Genetics Lab is located in the basement of Wagar Hall, adjacent to the LFL. It is equipped with instrumentation to carry out a broad spectrum of molecular genetics work, to include extraction of DNA, PCR amplification of target genes, sequence analysis, SNP (Single Nucleotide Polymorphism) or SSCP (Single Strand Confirmational Polymorphism) screening, and microsatellite analysis. The core instrument of the CGL is an ABI Prism 3100 Genetic Analyzer, an automated sequencer equipped with 16 capillaries that analyses fluorescent-labeled DNA molecules. This device enables the CGL to generate DNA sequence and fragment data rapidly and in a digital format that allows for easy access and analysis.

Additional resources include a computer room, and a molecular cloning lab that facilitates the development of genomic libraries and microsatellite loci, as well as a morphometrics lab for analysis of the phenotype. The latter is equipped with hard- and software for digitizing and analyzing images, and allows for the geometric morphometric analyses of body shape variation.

Personnel
The CGL is co-directed by Drs. Marlis R. and Michael E. Douglas. Their research has focused for the last 15 years on biodiversity, conservation and ecology of Southwestern desert biota, with particular emphasis on fishes. Their research has been published in a variety of peer-reviewed journals and they maintain ongoing research projects on the native Colorado River ichthyofauna. Since joining CSU, they have also become involved with East Slope species, both aquatic and terrestrial.

The CGL research team consists of a postdoctoral fellow, and graduate and undergraduate students that are actively involved in molecular analysis. The CGL also engages in inter-departmental activities, with a particular emphasis on cross-disciplinary approaches to research problems.

Research Projects
A variety of research projects are ongoing in the CGL, involving both aquatic and terrestrial organisms. These focus on conservation and management of rare and endangered species, biodiversity assessment, phylogenetic evaluations, and analysis of population structure and reproductive ecology.

Three projects were recently completed for the Colorado Division of Wildlife (CDOW). One assessed genetic diversity and population structure of Suckermouth Minnow (*Phenacobius mirabilis*), a native cyprinid fish that exists in remnant populations in the Arkansas and South Platte rivers. CDOW was interested in assessing the genetic variability of populations prior to establishing a broodstock in a hatchery and using progeny of this stock for possible supplementation of existing populations. A similar project evaluated genetic population structure of Rio Grande Chub (*Gila pandora*) from the Rio Grande, Conejos River and Closed Basin of Colorado. Again, genetic data was required to assist in the management of this species and to provide an initial perspective on establishment of hatchery broodstock.

A third CDOW project assessed the extent and magnitude of hybridization between native Flannelmouth Sucker (*Catostomus latipinnis*), Bluehead Sucker (*Pantosteus discobolus*) and introduced White Sucker (*C. commersonii*) in the Yampa River. The CGL developed a cutting-edge molecular genetic method to screen many hundreds of sucker samples for evidence of hybridization.

A fourth, ongoing project (funded by USGS) evaluates genetic interrelationships among populations of the endangered Humpback Chub (*Gila cypha*) in the Colorado River Basin. Here, the CGL employs mitochondrial and nuclear DNA sequence data, as well as microsatellite polymorphisms to assess population structure, genetic divergence and levels of population fragmentation across populations in the Colorado River Basin. These data will also provide insights into population history, and allow calculation of parameters such as effective population size (i.e., size of the breeding population) that will assist in the adaptive management and recovery of this species.

Colorado State University Agricultural Experiment Station

ROOT EXUDATES AS BIOCHEMICAL FACTORIES

by Jorge Vivanco
Department of Horticulture and Landscape Architecture
Colorado State University

Scientists have speculated for decades that spotted knapweed is able to spread over large areas because of a secret weapon - an ability to release a chemical that kills surrounding plants. Until now, they have never been able to put their thumb on the phenomenon, but recently a Colorado State University horticulture professor identified and isolated the chemical for the first time. What's more, they are using the chemical as a completely natural and environmentally friendly herbicide to kill other weeds.

The discovery and isolation of the chemical, called catechin, within spotted knapweed may revolutionize the war against weeds for homeowners and farmers. "For years, scientists have talked about spotted knapweed releasing this chemical, but they couldn't find it in the soil because it was almost impossible to separate from all the other compounds that naturally occur in soil," said Jorge Vivanco, assistant professor of horticultural biotechnology at Colorado State. "We looked for it in the plant. Spotted knapweed releases catechin into the soil through its roots…"

Now that catechin has been identified and isolated, and scientists can capture the chemical in the Department of Horticulture's laboratory, Vivanco and a team of researchers at Colorado State are investigating a wealth of applications for the chemical.

Source: Dell Rae Moellenberg
Colorado State AgNews

The roots of higher plants comprise a metabolically active and largely unexplored biological frontier. One of their unique features is their ability to synthesize and exude a wide array of chemicals such as secondary metabolites into the rhizosphere, with the potential to affect the interaction between plants and soil-borne microbes (Vivanco et al. 2002). The chemicals released into the soil by roots are broadly referred to as root exudates. Of the total photosynthates produced by a plant, nearly half are allocated to support the growth and metabolism of the root system. In turn, half of these are actively deposited into the soil by the root system. We are studying the potential of a compound exuded from the roots of allelopathic and invasive weeds as herbicides (Bais et al. 2002, 2003).

Conventional weed control relies on frequent applications of chemical herbicides, which may contribute to soil/water pollution, and pose risks to human health. As an alternative, strategies that utilize endogenous plant allelopathy could reduce our reliance on synthetic herbicides.

Preliminary Results

The Asian native *Centaurea maculosa* L. (spotted knapweed) is one of the most economically destructive exotic invaders of western North America. It rapidly displaces native vegetation and improved pasture species with the help of phytotoxic root exudates (Callaway et al., 2000). Although allelopathy (secretion of phytotoxic chemicals) has been suggested as the main displacing mechanism, until recently there has been little if any success in characterizing the responsible allelochemical. Our laboratory has determined that an exudate of *C. maculosa* roots is phytotoxic. The active fraction of the exudate was found to be composed of racemic catechin, a 50:50 mixture of (+)-catechin (A) and (-)-catechin (B). Although (+)-catechin is widespread throughout the plant kingdom, both (-)-catechin

and the racemic form have only rarely been isolated. Further, we found that the phytotoxicity and germination-inhibiting action of the exudate was entirely due to B, while A was found to have antimicrobial properties (Figure 1). (-)-Catechin (B) was toxic to several weeds, soybean, sugar beet and the model plant species *Arabidopsis thaliana*, but did not affect seedlings of *C. maculosa*.

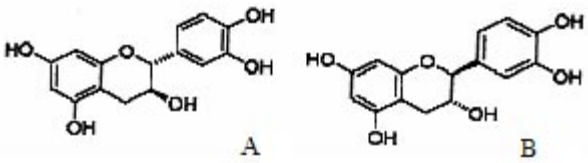


Figure 1. Chemical structures of (+)-2r,3s)-catechin (a) and (-)-(2s,3r)-catechin (b).

We have also recently undertaken preliminary greenhouse studies, which show that (-)-catechin is phytotoxic when sprayed on foliage of susceptible plants. In these studies, (-)-catechin significantly reduced the height of some weed species at 0.02 lb ai/ac and significantly reduced the height of all four broadleaf weeds at 0.16 lb ai/ac. The two most sensitive weeds were lambsquarters and hairy nightshade, while barnyardgrass showed only moderate reductions in plant height.

Rationale and Significance of our work

Conventional weed control relies on frequent applications of chemical herbicides, which may contribute to soil/water pollution, and pose risks to human health. As an alternative, strategies that utilize endogenous plant allelopathy could reduce our reliance on synthetic herbicides. Our finding that (-)-catechin secreted by *C. maculosa* roots has phytotoxic activity holds promise for such applications. A new type of allelochemical-based herbicide (CALLISTO™) derived from *Callistemon citrinus* and developed by Syngenta has recently (and rapidly) been approved by the US Environmental Protection Agency (**www.syngenta.com**). The active ingredient in CALLISTO™ is mesotrione, a synthetic relative of a natural herbicide produced by this plant. This is the first commercial herbicide developed from plant natural products. Scientific and commercial successes like CALLISTO™ validate the scientific merit and significance of this approach.

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Tapping Aquifer Could Cost $65 Million
Denver Water Board Considers Drilling Wells as 'Insurance'

Denver Water could tap aquifers for emergency water supplies, but such a program would cost the giant utility $65 million, according to a preliminary report. The Denver Water Board is expected to debate whether to create such a backup water system in September. "This system would act as an insurance policy in case of some catastrophic failure of our system," said David Little, a Denver Water planner. "The water would only be used in a dire emergency . . . if Dillon Reservoir were drained or if the Roberts Tunnel (which delivers water from the Western Slope) collapses." If approved, Little estimated the underground water plan could take 10 to 30 years to develop.

Rocky Mountain News / July 22, 2003

Colorado State University Cooperative Extension

4-H SPORTFISHING PROGRAM INTRODUCES YOUTH TO AQUATIC ECOLOGY

by Mark Cronquist
Extension Agent, 4-H Youth/Natural Resources
State Coordinator, 4-H Sportfishing Program

For many of us, some of our fondest memories are of days spent as youngsters fishing or dreaming of the next time we could go "wet a line." The 4-H Sportfishing project offers young people and the teen and adult volunteers who work with them in 4-H the opportunity to develop their skills and knowledge about fishing and gives them a wide range of ways to increase their enjoyment of this life-long recreational activity.

Colorado 4-H had a big hand in the development of the curricula available for this project through the 4-H Cooperative Curriculum System, a national collaboration of state Extension Services dedicated to providing high-quality experientially-based curriculum products to 4-H and other nonformal youth development organizations. In 1998, a ten-member team from Colorado attended a national 4-H Sportfishing Training Workshop in Washington State. The extension agents and fisheries professionals who participated in this workshop felt conventional 4-H manuals and a Helper's Guide (leader's manual) had to be developed if youth were going to get the most from this exciting activity. Colorado's team served as the original design team for the Sportfishing curricula which was introduced to the national 4-H organization in October 2001.

The three-level manuals for members and the Helper's Guide provide hands-on activities and background information to educate youth about four disciplines in Sportfishing.

- **Angling Skills** teaches about variety of fishing rods, reels and other basic equipment for fishing and what is used for different kinds of fishing. Members can learn how to use spinning, bait casting and fly fishing equipment, just to name a few.

- **Tackle Crafting** is the discipline all youth enjoy. Kids learn to make lures and jigs, to tie artificial flies and fabricate other tackle items they can use. As their abilities increase, they may even decide to make a custom fishing rod.

- "What if that fish I caught is two inches under the size limit? It's the biggest fish I ever caught. Who's gonna know if I keep it." **People and Fish** teaches youngsters about the decision-making skills and personal ethics needed as sportfishing enthusiasts.

Kim Fabrizius, Gunnison County Extension Director and State 4-H Sportfishing Team member, coaches a member in the Tackle Crafting skill of fly tying.

- **Aquatic Ecology** is the basis for true expertise in sportfishing. Water quality, non-living factors (i.e., temperature, etc.) in the water and living factors (i.e., plant growth, etc.) are tied together to teach about the aquatic habitat they'll be fishing. Kids love "Water Safaris", where they collect aquatic organisms, identify them, and learn how they interact to affect fishing.

The 4-H Sportfishing project continues to grow in Colorado. It is used in camping programs, has been used in after-school and day camp activities and is a wonderful year round project for kids throughout the state. If you would like more information about the Colorado 4-H Sportfishing program or want to become involved, contact your county office of Colorado State University Cooperative Extension. What a great opportunity: have a great time and learn while you're doing it. That's 4-H Sportfishing!

WEST NILE VIRUS

Northeastern Colorado's first horse death of 2003 caused by West Nile was confirmed, and a Fort Morgan mosquito pool has tested positive for the virus. The horse, from Yuma County, became ill on July 3 and died three days later, the Northeast Colorado Health Department (NCHD) reported. Three other horses tested positive for the virus across the state Monday in Weld, Adams and Fremont Counties and are still alive. West Nile virus can cause an inflammation of the brain and is transmitted by mosquitoes that can infect people and animals. To protect both horses and companion animals, state officials urge owners to control mosquito populations by eliminating standing pools of water and keeping animals inside during the morning and evening when bugs are more likely to feed. Although both humans and animals have died from the disease, most infections do not cause any illness. Experts say when unvaccinated horses exhibit clinical signs such as elevated temperature, stumbling, lack of coordination, or partial paralysis one of three most likely will die. Weld County contracts with Colorado Mosquito Control to monitor and kill mosquitoes in populated areas in and around 19 cities and towns. The company's workers are finding more mosquito-breeding sites than expected. For more information on West Nile virus in Colorado and Weld County, visit **www.fightthebitecolorado.com** or **www.co.weld.co.us** Fort Collins is moving ahead with a plan to combat West Nile virus by placing a bacterial agent that kills mosquitoes in storm drain catch basins. The city could begin applications of Bacillus sphaericus, a "larvicide" that contains a protein that destroys mosquito larvae as early as next week.

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Greeley Tribune / July 15, 2003, *Fort Morgan Times* / July 15, 2003, *The Fort Collins Coloradoan* / July 25, 2003

MEETING BRIEFS

COLORADO WATER WORKSHOP'S 2003 THEME: DROUGHT, WATER ALLOCATION AND SUPPLY LIMITS

Western water scarcity in the face of increasing demand has been a recurring topic of discussion at previous editions of the Colorado Water Workshop, held annually on the campus of Western State College in Gunnison, Colorado. With certain areas of Colorado and other western states still affected by the drought, the 2003 workshop, held July 23 to 25, focused entirely on issues related to water allocation and use when drought imposes even greater limits on normally scarce water supplies. Under the theme of "In Hard Times: Collaboration or Contention?" water managers, consultants, representatives of environmental organizations, and government officials presented various perspectives on how the West can cope with the combined opposing stresses of increasing demands and decreasing supply.

George Sibley, Conference Coordinator, Kent Holsinger, Colorado Dept. of Natural Resources, John McClow, Attorney, and Wendy McDermott, High Country Citizens Alliance, discuss the Black Canyon Water Right.

The first day of the workshop provided an overview of various strategies for coping with severe water shortages. Doug Kenney of the CU Natural Resources Law Center presented a summary of the Colorado General Assembly's activity during the 2003 session in response to the drought. The action that prompted most of the discussion on this day was the $2 billion bond issue referendum, which will appear on the November ballot. The highlight of the first day's program was a special presentation by Colorado Governor Bill Owens in support of this referendum. He emphasized that the most important outcome of the referendum would be the funding of smaller projects to enhance water supplies, largely through increased storage. Other legislative initiatives addressed included a State Water Supply Initiative directed by the Colorado Water Conservation Board (CWCB), to evaluate and identify projects eligible for support from the bond issue, and a special study of the proposed Big Straw Project.

Colorado Supreme Court Justice Greg Hobbs provides perspective on Colorado water law.

The legislative action emphasizing increased storage prompted responses from other speakers on the first-day program. Dan Luecke, environmental consultant, presented an analysis commissioned by the Sustainable Water Caucus of the feasibility of new water storage projects. He concluded that new storage projects are less efficient economically in meeting increased demand for water and suggested alternative strategies such as conservation, cooperative arrangements between cities and farmers, expansion of existing facilities, and better overall management of existing supplies. These arguments were echoed by John Keys III, Commissioner of Reclamation, who presented a summary of Reclamation's Water 2025 initiative, which emphasizes conservation and better management of existing supplies to meet future water demand in the West.

The second day of the program started with an update on the recent agreement that quantifies the federal reserved water right for the Black Canyon of the Gunnison between the CWCB and the National Park Service. The remainder of the morning program was devoted to further review of 2003 legislation, particularly those elements that produced institutional changes in water administration. This review was prefaced by a presentation from Colorado Supreme Court Justice Greg Hobbs on the historical evolution of water law in Colorado, with particular emphasis on the influence the drought has on water law.

The afternoon program of the second day was devoted entirely to presentations illustrating the value of collaboration among existing, sometimes even competing, water interests in producing solutions to problems resulting from limited water supplies. Presentations were made by representatives of a diverse array of government agencies, water suppliers, conservancy districts, and conservation districts.

The general session on the morning of the final day was devoted to a review of the Colorado River Compact in light of the current extended drought. David Getches, Dean of the CU Natural Resources Law Center, presented an overview of the Law of the River in relation to historic development within the basin, the various competing demands, and the changes in supply-demand balance over time. His presentation was followed by speakers representing four different interests within the basin, each providing an overview of various water supply issues. Paul Davidson, Bureau of Reclamation, provided an overview of historic basin streamflows and projections of future supplies based on various assumptions. Gerald Zimmerman, Executive Director of the Colorado River Board of California, presented a summary of the proposed quantification settlement agreement between the Department of Interior and the state of California. A review of current conflicts between Navajo Nation reserved water rights and the Law of the River, along with suggestions for their resolution, was given by Stanley Pollack, Water Rights Counsel of the Navajo Nation. Scott Balcomb, Colorado's Commissioner to the Upper Colorado River Commission, presented an overview of Colorado's interests in relation to the other upper basin states and the lower basin. The workshop concluded with a luncheon presentation by Rita Schmidt-Sudman, Director, Water Education Foundation, on California's water wars.

Rita Schmidt-Sudman of the Water Education Foundation addresses California's water wars.

INSTITUTE FOR K-12 TEACHERS SPOTLIGHTS WESTERN WATER HISTORY

The West of John Wesley Powell was the topic of conversation and study this June at a Colorado Endowment for the Humanities Teacher Institute and Public Program held on the CSU campus. The five-day Institute, developed especially for K-12 teachers, focused on the Colorado River, geology of the western landscape, Native American ethnology and linguistics, and western water history. The Institute was directed by Clay S. Jenkinson, one of the nation's leading public humanities scholars, and participated in by other distinguished environmental and water historians.

Topping off the week was a free public program, Water in the West: Multiple Visions 1866-2003 at the Morgan Library featuring a Chautauqua presentation of John Wesley Powell by Clay Jenkinson and a humanities-style discussion of water in the West. Discussion panelists included Colorado State Supreme Court Justice Greg Hobbs, Reclamation historian Brit Storey, and environmental historian Mark Fiege. Added events included a reception, a tour of the Library's Water Resources Archive, and an exhibit, Moving Waters: The Colorado River and the West.

Denny Hodgson, NCWCD Operations & Maintenance Working Foreman, discusses the Colorado-Big Thompson Project delivery system. Hodgson accompanied institute students to a spot above the Big Thompson Canyon where C-BT water can be sent north to Horsetooth Reservoir, directly into the Big Thompson River or through a City of Loveland hydrogeneration plant.

Children were not left out of the evening's activities. Storyteller Beverly Brayden told water stories to youngsters while the Museum of Nature and Science challenged an older group to some fun scientific experiments….all water related of course!

CWRRI
CSM water news

International Ground-Water Modeling Center
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MODFLOW and More 2003: Understanding through Modeling
An International Ground Water Modeling Conference and Workshops
September 17-19, 2003

Ice-Breaker Evening of September 16
International Ground Water Modeling Center (IGWMC)
Colorado School of Mines
Golden, Colorado USA

The MODFLOW conference series **unites cutting-edge developments and practical applications** of ground water models in all aspects of hydrology. The conference series focuses on MODFLOW, presently the most widely used ground-water model in the world, to foster communication among conference participants. MODFLOW, developed by the US Geological Survey, has become an international standard for ground-water modeling. The March/April 2003 Issue of the journal Ground Water, featuring 15 papers from the 'MODFLOW 2001 and Other Modeling Odysseys' conference, displays the typical breadth of the conference. The conference includes keynote speakers on diverse topics, contributed oral and poster presentations, publication of papers in a comprehensive proceedings document, exhibits, and short courses. The conference brings together model users and developers to exchange ideas on the latest innovations in model applications, discuss the capabilities and limitations of currently available codes, and explore directions for future developments. **For specific times and titles of all presentations, after August 1, see website at: http://typhoon.mines.edu/events/modflow2003/modflow2003.shtml)**

WEDNESDAY, Sept. 17	THURSDAY, Sept. 18	FRIDAY, Sept. 19
FEATURED PRESENTATIONS (AM & PM) **Arlen Harbaugh, Michael McDonald, Chunmiao Zheng, Suzanne Paschke, Prabhakar Clement, David Hyndman**	**FEATURED PRESENTATIONS (AM & PM)** **Jaime Gomez-Hernandez, Mary Hill, David Steward, David Lerner, Theo Olsthoorn, John Doherty, Sorab Panday**	**FEATURED PRESENTATIONS (AM & PM)** **Rien van Genuchten, John McCray, William Woessner, Donald Sweetkind, Mary Anderson, Frank Schwartz**
TECHNICAL SESSIONS (AM & PM) * MODFLOW limitations and directions for future development * Surface-water/ground-water interaction modeling * MODFLOW-2000, latest developments and related issues * Connections to MODFLOW for simulating processes not included in MODFLOW * Contaminant transport / bioremediation / coupled flow and reactive transport	**TECHNICAL SESSIONS (AM & PM)** * Typical problems encountered in modeling and their solutions * Code testing/performance and case studies * Sociology of groundwater modeling, decision making, conflict resolution, education * Estimating recharge * Uncertainty reduction and quantification * Fracture flow modeling * Variable density modeling	**TECHNICAL SESSIONS (AM & PM)** * Model calibration and parameter estimation * Constraining ground-water models using hydrogeologic information * Unsaturated zone and multiphase modeling * Ground-water management and remediation design optimization * Advances and applications of database management and geographic information systems (GIS)
Ground Water Modeling System (GMS) presentation at lunch	**Ground Water Vistas presentation at lunch**	**Visual MODFLOW GUI presentation at lunch**
TECHNICAL SESSIONS	**AUDIENCE / PANEL DISCUSSION COMPLEXITY vs. SIMPLICITY**	TECHNICAL SESSIONS
SOFTWARE DEMOS **Wine, Beer, and Hors D'oeuvres**	**POSTER SESSION** **Wine, Beer, and Hors D'oeuvres**	**CLOSING**

Panel Discussion (Thursday afternoon): Complexity or Simplicity? Should Ground-Water Models Strive to include Field Complexity or Maintain Simplicity?

The Colorado School of Mines Center for Experimental Study of Subsurface Environmental Processes (**http://cesep.mines.edu**) will be dedicated at 1:30 p.m. on Tues. Sept. 16th in the Green Center, Petroleum Hall. After the ceremony, leading ground-water researchers will deliver keynote lectures. Conference attendees are invited to the dedication and lectures, which will be followed by the ice breaker at 5 p.m..

Registration: The Conference registration fee is $595 (US), which includes the conference proceedings, evening receptions, lunches, and breaks. A reduced fee will apply for students registered for a degree. Address questions about the conference to IGWMC. Opportunities exist for exhibit/information booths as well as for corporate support of conference events.

Short Course Schedule

International Ground-Water Modeling Center

Course Title	Instructors	Dates
Before the conference:		
Calibration and Uncertainty of Groundwater and Other Models	Mary Hill, John Doherty, & Claire Tiedeman	Sept.10-12
MODFLOW: Introduction to Numerical Modeling	Eileen Poeter	Sept.13-16
Polishing Your Ground-Water Modeling Skills	Peter Andersen & Robert Greenwald	Sept.14-16
UCODE: Universal Inversion Code for Automated Calibration	Eileen Poeter	Sept.15-16
Advanced Modeling of Water Flow & Solute Transport in the Vadose Zone	Rien van Genuchten & Jirka Simunek	Sept.15-16
After the conference:		
Evaluating Predictions of Multiple Conceptual Models	David Anderson	Sept.20
Subsurface Multiphase Fluid Flow and Remediation Modeling	John McCray	Sept.19-21
PHREEQC Modeling: The Basics	Geoffrey Thyne	Sept.19-21
Model Calibration and Predictive Uncertainty Analysis Using Pest	John Doherty	Sept.19-21

John McCray, Associate Professor of Hydrogeology, Department of Geology and Geological Engineering, Colorado School of Mines will teach a short course on multiphase fluid flow and remediation modeling using the codes TOUGH2 and TMVOC this fall. The course will be held at the International Ground Water Modeling Center in Golden, Colorado September 19-21 (Friday through Sunday noon), 2003. An academic discount for students will be offered that is not described on the web page. For details on the course, please see the following link**: http://typhoon.mines.edu/short-course/multi.htm.**

Mesa State College Water News

Gigi Richard is again organizing a Water Seminar -- **Western Water: A limited resource--Are we facing insurmountable problems or creative solutions?** at Mesa State College this fall. The seminars will be held Wednesday afternoons at 4pm in the Saccomanno Lecture Hall (SL 110) at Mesa State. The seminar is a 1-credit class (GEOL 396 sec 002), but will be open to the public. Topics tentatively include:

Dividing the Waters - Western Colo Rivers - Where does the water go?
- A divided example - The Dolores River
- Trans-mountain diversions

Drought - Is it over yet? What do we do now?
- What's up with the weather?
- Municipal and agency response
- Impacts on agriculture and fish

Instream Flows - Any water left for the river? Does the river have a right?
- What are instream flows?
- Case Study: Black Canyon of the Gunnison
- Collaboration in action: the Pathfinder Project

For information contact: Gigi A. Richard, Ph.D, Assistant Professor of Geology, Department of Physical and Environmental Sciences, Mesa State College, 1100 North Ave., Grand Junction, CO 81501. E-mail: grichard@mesastate.edu, office: +1-970-248-1689.

CWRRI

CU water news

JIM HEANEY ACCEPTS POSITION AT UNIVERSITY OF FLORIDA

Dr. James P. Heaney, University of Colorado Professor, Department of Civil, Environmental and Architectural Engineering, has accepted the position of Chair, Department of Environmental Engineering Sciences at the University of Florida effective September 12, 2003.

Dr. Heaney is an internationally prominent scholar in the field of urban water infrastructure systems. He received his Ph.D. from Northwestern University. He was at the University of Florida from 1968-1991, holding the positions of Professor of Environmental Engineering Sciences and Director of the Florida Water Resources Research Center. In 1991, he joined the University of Colorado, Boulder, as Professor of Civil, Environmental and Architectural Engineering. He held the position of Chairman of Civil, Environmental and Architectural Engineering at Colorado from 1991-1994.

Dr. Heaney has earned many honors and awards. His research and teaching at the University of Colorado focused on developing simulation of optimization techniques to evaluate innovative urban water infrastructure systems including water supply, wastewater, and stormwater. He won the New York Water Environment Federation Best paper award in 1991 and the Association of Environmental Engineering Professors Montgomery Watson Award in 1996. Heaney, a member of the National Academies' Panel Evaluating Restoration Alternatives for the Everglades, has served as Associate Editor of several journals including the Water Resources Bulletin, the International Journal of Environmental Engineering and Policy and Urban Water. He is a Diplomate of the American Academy of Environmental Engineering and Chair of the Urban Water Resources Research Council of the American Society of Civil Engineers.

Source: Dr. Pramod Khargonekar, UF Dean of the College of Engineering

University of Colorado at Denver
Continuing Engineering Education Program
Fall 2003 Professional Development

Western Water Rights and Water Engineering is designed for people interested in water resources. This three week, 16-hour course is designed for people interested in water resources. This course will emphasize Colorado water rights, but examples from other western states will be included. Students will acquire valuable information in each of the following areas:

*The development of the water rights doctrine
*Water Institutions in Colorado
*Water rights changes, transfers, administration, and plans for augmentation
*The implications of the above factors for water resource management.

The course will be taught from a professional engineering point of view, not a legal perspective. The course is scheduled Tuesday and Thursday evenings, October 21 through November 6, 2003, from 5:30 p.m. to 8:10 p.m. on the Auraria campus in downtown Denver. The course fee is $495.

The Fundamentals of Engineering (FE) Examination Refresher Course is designed for those who need a review before taking the National Fundamentals of Engineering (FE) Examination, this course offers 44 hours of instruction. Each of the eleven sessions covers a different examination subject area, and each is conducted by a different instructor. The course is scheduled eleven Saturdays, July 26 through October 11, 2003, 8:30 a.m. to 12:30 p.m. on the Auraria campus in downtown Denver. The course fee is $475 and includes Lindeburg's Fundamentals of Engineering Review Manual with sample problems and solutions, and a practice exam.

The Professional Engineers' Examination Refresher Course for Civil Engineering is a review of subject matter related to the National Principles and Practices of Engineering Examination for civil engineering, with each four-hour Saturday morning session covering a separate exam subject area. The course is scheduled ten Saturdays, August 2 through October 11, 2003, 8:30 a.m. to 12:30 p.m. on the Auraria campus in downtown Denver. The course fee is $475 and includes Lindeburg's Civil Engineering Reference Manual for the PE Exam and Practice Problems for the Civil Engineering PE Exam booklet.

Call Continuing Engineering Education at 303-556-4907 or toll free 1-877-859-7304 for more information. Visit **www.cudenver.edu/engineer/cont** for course details and on-line registration forms.

RESEARCH AWARDS

A summary of research awards and projects is given below for those who would like to contact investigators. Direct inquiries to investigators c/o indicated department and university. The list includes new projects and supplements to existing awards. The new projects are highlighted in bold type.

COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO
Awards for May 27, 2003 to July 25, 2003

Primary PI	Dept.	Sponsor	Title
Waskom, Reagan	**SCS**	**CDA**	**Training & Education for Agricultural Chemicals & Groundwater**
Fausch, Kurt D.	FWB	CDWL	Tools to Increase Translocation Success in Colorado River Cutthroat Trout
Bergersen, Eric	**CFWLU**	**CDWL**	**Salmonid Disease Studies: Control of Whirling Disease Effects**
Bergersen, Eric	**CFWLU**	**CDWL**	**Whirling Disease Investigations: Quantification of Triactinomycin**
Bergersen, Eric	**CFWLU**	**CDWL**	**Pike/Trout Interactions in Colorado Reservoirs**
Bergersen, Eric	**CFWLU**	**CDWL**	**Yampa River Northern Pike Exclusion Study**
Bergersen, Eric	**CFWLU**	**CDWL**	**Zimmerman Lake Greenback Whirling Disease Project**
Bergersen, Eric	**CFWLU**	**CDWL**	**1:24,000 Scale Hydrographic Coverage for the State of Colorado**
Baron, Jill	**NREL**	**NPS**	**Monitoring Effects of Atmospheric Deposition in Loch Vale**
Cooper, David J.	**FRWS**	**NPS**	**Stream & Riparian Characterization & Analysis in Petrified Forest National Park, Arizona**
Culver, Denise R.	**FWB**	**BLM**	**Survey & Assessment of Critical Wetlands for La Plata County**
Loftis, Jim C.	**Civil Engr.**	**NPS**	**Guidance & Technical Support to Natural Resource Program Center (NRPC)**
Loftis, Jim C.	**Civil Engr.**	**NPS**	**Information Technology Support for Natural Resource Program Center**
Stohlgren, Thomas J.	**NREL**	**NPS**	**Perform Field Evaluations of Various Remote Sensing Techniques in Identifying Tamarisk**
Binkley, Daniel E.	FRWS	USGS	Structure & Function of Northern Ecosystems & Their Response to Global Change
Ward, Robert C.	CWRRI	USGS	Technology Transfer/Information Dissemination
Gates, Tim	CWRRI	USGS	Description & Interpretation of Salinization in the Lower Arkansas River Valley
Garcia, Luis	CWRRI	USGS	Enhancements to South Platte Mapping and Analysis Program (SPMAP)
Burke, Ingrid C.	FRWS	USGS	Analysis of Soil Macronutrients & N Mineralization/Nitrification in Relation to Season Prescribed Fire

FEDERAL SPONSORS: BLM-Bureau of Land Management, COE-Corps of Engineers, DOA-Dept. of the Army, DOD-Dept. of Defense, DOE-Dept. of Energy, DON-Dept. of the Navy, DOT-Dept. of Transportation, EPA-Environmental Protection Agency, HHS-PHS-Public Health Service, NASA-National Aeronautics & Space Administration, NBS-National Biological Survey, NOAA-National Oceanic & Atmospheric Admin., NPS-National Park Service, NRCS-Natural Resources Conservation Service, NSF-National Science Foundation, , USAID-US Agency for International Development, USBR-US Bureau of Reclamation, USDA/ARS-Dept. of Agriculture, Agricultural Research Service, USDA/NRS-Dept. of Agriculture, Natural Resources Service, USFS-US Forest Service, USDA-USFS-RMRS-Rocky Mountain Research Station, USFWS-US Fish & Wildlife Service.

STATE/LOCAL SPONSORS: CDA-Colorado Department of Agriculture, CDNR-Colorado Dept. of Natural Resources, CDPHE-Colorado Dept. of Public Health and the Environment, CDWL-Colorado Division of Wildlife, NCWCD-Northern Colorado Water Conservancy District. OTHER SPONSORS: AWWA-American Water Works Assn., CID-Consortium for International Development.

UNIVERSITY DEPARTMENTS, INSTITUTES AND CENTERS: Colorado State: BSPM-Bioagricultural Sciences & Pest Management, CBE-Chemical & Bioresource Engr., CFWLU-Cooperative Fish & Wildlife Unit, CSMTE-Center For Science, Mathematics & Technical Education, CIRA-Cooperative Inst. for Research in the Atmosphere, DARE-Dept. of Agric. & Resource Economics, ECE-Electrical & Computer Engineering, ERHS-Environment & Rad. Health Sciences, FWB-Fishery & Wildlife Biology, HLA-Horticulture & Landscape Architecture, NREL-Natural Resource Ecology Lab, NRRT-Nat. Resources Recreation & Tourism, RES-Rangeland Ecosystem Science, SCS-Soil & Crop Sciences. University of Colorado: ACAR-Aero-Colorado Center for Astrodynamic Research, AOS-Atmospheric & Oceanic Sciences, CADSWES-Center for Advanced Decision Support for Water and Environmental Systems, CEAE-Civil, Environmental, and Architectural Engineering, CIRES-Cooperative Institute for Research in Environmental Sciences, CRCMAST-Cooperative Research Center for Membrane Applied Science & Technology, EEB-Ecology & Environmental Biology, EPOB-Environmental, Population & Organismic Biology, IAAR-Institute for Arctic & Alpine Research, IBS-Institute of Behavioral Science, ITP-Interdisciplinary Telecommunication Program, LASP-Lab. For Atmos. And Space Physics, PAOS-Program in Atmospheric and Oceanic Sciences.

Primary PI	Dept.	Sponsor	Title
Poff, N. Leroy	Biology	NSF	Herbivory in Streams - Context-Dependent Species Interactions & Functional Redundancy
Welker, Jeffrey	NREL	NSF	Collaborative Research: Isotopic Characteristics of Precipitation …
Lee, Chun Man	Statistics	UCAR-NCAR	Statistical Research for Weather Prediction & Climate Change
Pielke, Roger A	Atmos. Sci.	NSF	Winter Precipitation, Sublimation, & Snow-Depth in the Pan-Arctic: Critical Processes & a Half Century of Change
Randall, David A	Atmos. Sci.	DOE	A Geodesic Climate Model with Quasi-Lagrangian Vertical Coordinates
Paul, Eldor A	NREL	DOE	Ecosystem Controls on C & N Sequestration Following Afforestation of Agricultural Lands
Loftis, Jim C.	Civil Engr.	NPS	Inventorying & Monitoring National Resources Status & Trends in National Park Service
Ward, Robert C.	CWRRI	USGS	State Water Institutes Program
Jacobi, William	**BSPM**	**Denver Water**	**Water Usage by Cottonwoods**
Poff, N. Leroy	Biology	USFS	Aquatic Ecosystem Responses to Streamflow Diversions
Ramirez ,Jorge A.	Civil Engr.	USFS-RMRS	Water Yields in the United States under ClimateChange
Cooper, David J.	**FRWS**	**USFS**	**Historic Range of Variability: Wetland & Riparian Ecosystems in Forest Service Region 2**
Haas, Glenn E	**FRWS**	**USDA Pacific NW Exp. Sta.**	**Assessing Regional Recreation Demand & Capacity…in Region 6 of the US Forest Service**
Loomis, John B.	**DARE**	**USFS-RMS**	**Assemble & Synthesize Updated Recreation Values**
Smith, Freeman	Geosciences	**USFS-RMS**	Mapping Snow Properties: A Multi-Scale Approach

UNIVERSITY OF COLORADO, BOULDER, COLORADO
Awards for April-May, 2003

PI	Dept.	Sponsor	Title
Webster, Peter	PAOS	USAID-US	Experimental Forecasting of Major Bangladesh Floods: Science and Applications
Dixon, E. James	IAAR	NSF	REU Supplement to: Archeology of Alaska Glaciers and Snowfields Phase II
Overeem, Irina	IAAR	NSF	Channel Switching in Fluvio-Deltaic Systems Draining Land Ice; Clyde River, Baffin-Island as a Type-Location
McKnight, Diane	IAAR	NSF	The Niwot Ridge Long Term Ecological Research Program 1998-2004: Controls on the Structure, Function and Interactions of Alpine and Subalpine Ecosystems of the Colorado Front Range
Gupta, V. K.	CIRES	NSF	Developing a "Numerical Laboratory" to Test Scaling Hypothesis for Hydrologic Extremes
Lynch, Amanda	CIRES	NSF	An Integrated Assessment of the Impacts of Climate Variability on the Alaskan North Slope Coastal Region
Small, Eric	Geometrical Sciences	NSF	The Influences of Land-Atmosphere Interactions on Variability of the North American Monsoon
Weatherhead, E.C.	CIRES	NASA	Detecting Future Trends in Ozone – Looking for Initial Signs of Recovery in TOMS and SBUV/2 Records
Miller, Gifford	**IAAR**	**NSF**	**High-Resolution Constraints on the Magnitude and Timing of Climate Change in Iceland over the Past 15 KA**
Miller, Gifford	IAAR	NSF	Collaborative Research: Laurentide Ice Sheet Dynamics; Applying Cosmogenic Exposure to Constrain Chronology and Glacial Style in the Eastern Canadian Arctic
Pfeffer, Tad	**IAAR**	**NSF**	**Seismological Investigation of Columbia Glacier Calving**
Monson, Russell	EEB	NSF	Soil Respiration and Microbial Diversity in a Subalpine Forest
Wu, Wanli	**CIRES**	**NSF**	**Integrated Analyses of the Arctic Freshwater Cycle and Its Influence on Global Climate**

PI	Dept.	Sponsor	Title
Barry, Roger	CIRES	NSF	Inuit Knowledge of Climate Change in the Eastern Canadian Arctic
Lynch, Amanda	CIRES	NSF	Collaborative Research: Land-Atmosphere Interactions in Beringia Over the Last 21 KA: An Investigation of Climate Feedback Using the Arctic Regional Climate System Model (ARCSYM)
Voemel, Holger	PAOS	NASA	Balloon Borne Sounding for the Validation of Upper Tropospheric Humidity and Temperature
Armstrong, Richard	CIRES	NASA	Validation of AMSR-E Snow Products
Steffen, Konrad	**CIRES**	**NASA**	**Validation of AMSR Sea Ice Products in the Southern Hemisphere**
Steffen, Konrad	**CIRES**	**NASA**	**Aerosol-Cloud-Climate Interactions**
Maslanik, James	CIRES	NASA	Validation of AMSR-E Polar Ocean Products Using a Combination of Observations and Modeling
Axelrad, Penina	ACAR	NASA	Investigation of GPS Bistatic Radar for Soil Moisture Remote Sensing
Stallard, Robert	**IAAR**	**NPS**	**Analysis of Rivers & River Basins within Alaska Network Parks**
Emery, William	ACAR	NASA	Infrared and Passive Microwave Radiometric Sea Surface Temperature and Their Relationships to Atmospheric Forcing
Zagona, Edith	CADSWES	DOA	Analysis and Implementation for Support for Various Water and Environmental Systems

WATER SUPPLY

While conditions are improved over much of the state compared to last year, water supplies are still below average conditions. Streams flowed at decent rates during runoff in the northern portions of the state, but runoff was generally over by the end of June, which is earlier than the mid-July average. The total volume water in the runoff has been below average. The southwest portion of the state, particularly the Rio Grande and San Juan/Dolores River basins, have not received the improvements the northern portions of the state have. These areas ended the winter with the lowest snowpack, had well below average runoff, and received less precipitation in June.

Areas of the state received precipitation in the first half of the month, but the latter half of the month turned drier. Summer rains are needed to support what will be below average stream flows the rest of the summer. Reservoir supplies were being tapped in June, whereas they are normally not needed until July.

The Surface Water Supply Index (SWSI) developed by the State Engineer's Office and the USDA Natural Resources Conservation Service is used as an indicator of mountain-based water supply conditions in the major river basins of the state. It is based on streamflow, reservoir storage, and precipitation for the summer period (May through October). During the summer period, streamflow is the primary component in all basins except the South Platte basin, where reservoir storage is given the most weight. The following SWSI values were computed for each of the seven major basins for July 1, 2003, and reflect the conditions during the month of June.

Basin	/1/03 SWSI Value	Change From Previous Month	Change From Previous Year
South Platte	+0.4	+1.3	+3.6
Arkansas	-0.9	+1.1	+0.8
Rio Grande	-3.4	-1.1	+0.5
Gunnison	-2.4	-2.0	+1.5
Colorado	-1.6	-0.1	+2.5
Yampa/White	0.0	-0.8	+4.1
San Juan/Dolores	-2.6	-1.3	-1.5

SCALE								
-4	-3	-2	-1	0	+1	+2	+3	+4

NSF FUNDS $1.7 MILLION PROJECT FOR INTERDISCIPLINARY RESEARCH ON BIOCOMPLEXITY

Modeling Complex Interactions of Overlapping River and Road Networks in a Changing Landscape

This interdisciplinary research project (hydrologists, biologists, civil engineers, geographers, economists) coordinated among several universities (Colorado State, Utah State, the University of Pennsylvania, and the University of Puerto Rico) will compare the hydrology, geomorphology, visitor behavior, and food web structure at river segments with and without river-road junctions to determine the influence that roads and visitor access have on biotic systems. The study has policy relevance in terms of the level of road development that is allowed in currently unroaded watersheds. Puerto Rico's Caribbean National Forest case study watershed offers both roaded and unroaded riverine environments.

The project will integrate field studies and statistical analyses along with GIS data into a simulation model of three adjacent watersheds with land uses that range from high-density urban to pristine tropical rain forests. The integrated model will then be tested in a fourth watershed that contains the same mix of land uses found in the adjacent watersheds. Northeastern Puerto Rico is a good natural laboratory due to rapid spreading of urbanization and sub-urbanization, with an associated hierarchy of road networks that modifies the natural landscape and places people closer to natural resources. Being in a coastal environment in proximity to rain forests, there is a steep land rent gradient that compresses the transitions from one land use to another. Similarly, the topographic steepness results in numerous, distinct transitions from one biological community to another in a short distance.

The project is four years in duration and is funded at $1.7 million. Co-Principal Investigators at Colorado State University include John Loomis, Department of Agricultural and Resource Economics; Jorge Ramirez, Civil Engineering Department; Melinda Laituri and Ellen Wohl, Earth Resources Department; and Alan Covich, formerly of Fishery and Wildlife Biology and now Director of the Institute of Ecology, University of Georgia.

PUBLICATIONS

USGS WATER YEAR 2002 Colorado Water Resources Data Report

Starting this year, the U.S. Geological Survey's annual Colorado Water Resources Data report will be released as an online report. The annual report for water year 2002 is available at the following URLs:

Volume 1 **http://pubs.water.usgs.gov/wdrco021** Volume 2 **http://pubs.water.usgs.gov/wdrco022**

Each volume is a PDF file. Individual or multiple pages can easily be printed from these files. Data pages will contain links to real-time and historical online data. Also available at **http://water.usgs.gov/pubs/wdr/** are the WY 1995-2001 Colorado Water Resources Data reports.

Ground Water Atlas of Colorado, by Ralf Topper, Karen L. Spray, William H. Bellis, Judith L. Hamilton, and Peter E. Barkmann. 2003. Special Publication 53 of the Colorado Geological Survey, Division of Minerals and Geology, Department of Natural Resources, Denver, Colorado. This publication is intended to be a comprehensive reference of the state's ground water resources; summarizing the location, geography, geology, water quality, and hydrologic characteristics of its major aquifers. The information presented herein was collected, compiled, and analyzed by the Colorado Geological Survey. The atlas draws heavily on the well permit database established and maintained by the Colorado Division of Water Resources. The atlas also draws on the research of other scientists, especially the work of the U.S. Geological Survey. The information is presented in a graphical format supported by descriptive narratives and tables to better facilitate the reader's understanding. Chapters 1-3 give an introduction to ground water and its geological, hydrological, and legal context. Specific discussions of the hydrologic characteristics of the major aquifers and aquifer systems in Colorado are presented in Chapters 4-7. A glossary is included as Appendix A to aid the reader's understanding of specific water terminology.

FACULTY PROFILE

Plant Biochemist, Jorge Vivanco "Thinks Outside the Box"

by Marian Flanagan

Dr. Jorge M. Vivanco is an Assistant Professor of Horticulture and Biotechnology at Colorado State University's Department of Horticulture and Landscape Architecture. Dr. Vivanco grew up in Lima, the son of a plant biologist, who worked for the Peruvian agricultural research service. Vivanco inherited his father's interest in plants and earned his Bachelors Degree in Plant Science at Universidad National Agrarian La Molina in Peru in 1994. Vivanco earned an additional degree there as well, as an Engineer-Agronomist in 1995. Later that same year, Vivanco came to the United States and attended The Pennsylvania State University, where he earned his Ph.D. in Plant Pathology-Biotechnology in 1999. His focus of research was the biochemistry of roots. Vivanco completed his post-doctoral work at Rutgers University doing research on antimicrobial proteins.

Three years ago, Dr. Vivanco came to CSU. While looking for a new area of research, he began to focus on what happens outside of plants' roots; a novel approach to the expansion of his work. In 2000, Vivanco received the highly competitive and prestigious National Science Foundation's Faculty Early Career Development Award. In 2002, Vivanco received the Charles A. and Anne Morrow Lindbergh Foundation Award -- an impressive award that recognizes significant contribution by an individual toward Lindbergh's vision of balance between technological advancement and environmental preservation. Ecology is abstract thinking, and Vivanco does it well. He has received considerable funding for his research through the National Science Foundation, the Colorado Agricultural Experiment Station, the San Luis Valley Research Center Committee, USDA, EPA and The Charles A. and Anne Morrow Lindbergh Foundation.

When asked, "How do you challenge yourself?" Vivanco said he is pretty focused on what he does, and then he commented on how lucky he is. Why is he so lucky? He is, he exclaimed, "Having so much fun doing what I do, that it is - no longer for me - work!"

In recent research, Vivanco has found that spotted knapweed (an invasive plant) secretes a natural herbicide in the soil and has isolated this chemical. He has since isolated three more chemicals in other invasive species besides spotted knapweed. He collaborated with members of CSU's Weed Science Program and the Chemistry department to develop a natural herbicide, which a company has actually licensed. This chemical has generated much interest, and this natural herbicide will likely be available commercially in a year or two.

Vivanco is presently working on an Integrated Pest Management Plan in collaboration with colleagues in the Weed Science Program and the Forestry, Rangeland and Watershed Department that is funded by a USDA Grant. They are working on finding which native plants have developed natural resistance to the natural herbicides of invasive species that can be useful in revegetation of denuded areas.

Jorge Vivanco's lab experiments isolate root exudates to better understand the biosynthetic potential of plant roots.

Regarding his teaching, Vivanco believes that being a scientist in the 21st century is about getting information "out there." "Scientific research should be made available to everyone, and the only way to do that is to publish," he said. Vivanco believes that everything a student or post doc does in the lab should be written up and should be publishable in scientific journals. He has seen his group of research scientists and students grow a lot, with two graduated masters students, one Ph.D. student, and six post-docs. According to Vivanco, what is great about his group is that they are friends and a sharing community. He tries to teach them that they can get more done if they ask for help and join forces to share their expertise. He is developing an interdisciplinary collaboration among his students, encouraging their involvement with people in other universities and countries.

As for himself, Vivanco has adopted the English phrase "Burn the Midnight Oil" as his philosophy of life.

For an inside look at Dr. Vivanco's lab see his website at: **http://lamar.colostate.edu/~jvivanco/**

WATER NEWS DIGEST

by Marian Flanagan

ANNOUNCEMENT

Gibson to manage SLV water district

Mike Gibson will be the new manager for the San Luis Valley Water Conservancy District, effective Aug. 1. Gibson will replace the current manager, Carol Redding, who is retiring. A native of Derby, England, Gibson did his undergraduate work at University of London's Royal School of Mines. He worked for a couple of years in West Africa and in 1969, he was accepted to graduate school at Stanford University where he earned master's degrees in mineral economics and business administration. Gibson moved to the San Luis Valley with his wife, Gigi, in September 1999.

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The Pueblo Chieftain / July 16, 2003

CONSERVATION/ WATER RESTRICTIONS

Aurora eases watering rules

The Aurora City Council unanimously approved a measure to scale back the city's strict watering restrictions after hearing that, by the winter, the city's 12 reservoirs will be at least 64 percent more full than their lowest level this year. Aurora's homeowners may water their lawns an hour longer beginning July 1, and come September, they may plant new grass, following a record drought that savaged their lawns. The reservoirs bottomed out at 28 percent of total capacity over the dry winter. Utilities Director Peter Binney projected that even with relaxed restrictions and increased demand, the reservoirs will have at least 42 percent of capacity when winter begins. That estimate does not include next year's snowmelt. A run on new sod was predicted in September as people replace lawns ruined by the drought. Binney foresees future revenue for a water system that has sold $1.2 million less due to conservation measures. Assuming normal weather over the next three months, Binney predicted that the city should be able to make up the revenue difference by September.

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Rocky Mountain News / June 27, 2003

No water penalty with reservoirs at 86 percent

The Denver Water Board agreed to phase out its drought surcharges in June because reservoirs were filling faster than expected. Board members said they would consider a new rate plan that would impose higher basic rates as water consumption increases. In July, Denver Water loosened outdoor watering restrictions, giving homeowners and businesses three days of watering each week instead of two. Runoff from unexpected Spring snows had pushed reservoirs back up to 86 percent of capacity, with some, such as Lake Dillon, at 99 percent full. Some board members had advocated that the agency drop all mandatory watering rules and go back to voluntary restrictions but in the end, the call for ongoing mandatory conservation won out. Denver water use has jumped dramatically because of hot, dry weather. Although water use on July 15 hit 359 million gallons, well over the average daily goal of 197 million gallons a day, Denver Water spokeswoman Trina McGuire Collier said, "That's still much less than the 500 million gallons a day people used to consume before the drought hit." The number of reported violations had spiked as well.

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Rocky Mountain News / June 26, 2003, July 15, 2003

Study: Low costs hinder conservation

Two University of New Mexico professors believe that people won't truly value water in the arid West until it costs more. "Our thinking hasn't really caught up with the economic good," said associate economics professor Janie Chermak. Western cities and utilities looking for ways to save water have boosted rates and added surcharges to discourage waste. "Water rates, however, haven't increased much since the 1950s, and the low cost provides little incentive to conserve," said UNM economics professor David Brookshire. Brookshire said, "There's no reason why the price of water couldn't go up and go down just as electric and gas bills go up and down."

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Rocky Mountain News /Associated Press / July 7, 2003

Water parks making every drop count

It didn't take a drought to inspire Water World to sell soft drinks in chilled bottles and to serve ice only on request. The water park, which is celebrating its 25th anniversary, accounts for nearly every drop and ice cube. "By not using ice cubes, the park saves about 30,000 gallons of water per year," said Joann Saitta, spokeswoman for Hyland Hills Park and Recreation District, which operates Water World. The park uses drought-tolerant plants and artificial turf, bans midday watering and irrigates with recycled water. Splash water is returned to attractions, and water conservation measures save the park an estimated 15 million gallons of water a year. Meanwhile, Six Flags Elitch Gardens has also taken steps to save water over the past two seasons. According to marketing director Tracy Durham, the park's ponds, water misters and a waterfall will remain dry for the second season in a row, while the park recycles water where it can. Last summer, the park donated some 880,000 gallons of water to Denver and surrounding areas for reuse.

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Associated Press / Rocky Mountain News / July 11, 2003

They fought the lawn, but ... the lawn waned- now they're irked with homeowners group
As the July sun continues to torture green grass in Colorado, a controversy brewed in Highlands Ranch. In July, the Highlands Ranch Community Association sent letters to about 100 residents, chastising them for having dying lawns. The residents had 14 days to correct the problem and, if they didn't, they could face $25 daily fines or be forced to resod. The letters outraged some residents, who started what they called a grass-roots effort to end covenant control run amok. "They're requiring us to abuse a resource we should be conserving, said Highlands Ranch resident Troy Hall, a homeowner who received a letter." It appeared that the Highlands Ranch Community Association is the only one in the area going after residents with dying lawns. Highlands Ranch Community Association board member Richard Mutzebaugh said that it's tough to keep lawns green at this time of year, and the community association should consider that before it reprimands residents. "We have to be a little more lenient," he said.

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Rocky Mountain News / July 16, 2003

DROUGHT, FIRE AND FLOOD

Efforts to slow floodwaters ineffective?
A government hydrologist warned that because of the Hayman fire, typical foothills rains can generate deadly force. Bob Jarrett, a forensic hydrologist with the U.S. Geological Survey said, "The efforts of emergency management agencies to impede rainwater runoff may have little real effect in protecting lives and property from flooding. A rainstorm in a burned area can produce 300 times the runoff that the same storm would produce in a forest that had not been burned," he explained. The following is what Jarrett said makes runoff in burned areas different: "A fire that burned as hot as Hayman vaporizes the oils and sap in the pine trees. This sticky mist later drifts to the ground where it bonds with the soil and hardens, forming a waxy, water-repellent coating on the ground. This layer is known as hydrophobic soil and almost no water is absorbed in such conditions," Jarrett said. As an extreme example, he described the effects of a large storm on the 1996 Buffalo Creek Fire. "About a month after this fire, which rivaled Hayman in intensity if not in size, there was an unusual storm that dumped up to 5 1/2 inches of rain over areas of the Buffalo Creek Fire in one hour," Jarrett said. Jarrett and his colleagues studied the flash flooding the storm produced and estimated the runoff flow at a rate of 18,000 cubic feet per second.

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Douglas County News Press / July 02, 2003

Flood plans are critical
More people lose their lives each year in floods than in any other natural disaster. Experts stress that it is critical to devise a plan that can be put into action the minute a flood becomes a possibility. Jamie Moore of the Douglas County Emergency Services Division said that people should stay in their houses during a flood unless water is coming in; in which case, they should immediately move to higher ground. Moore emphasized that the most important thing is to never drive through moving water, because that is how the majority of flood fatalities occur. Bob Jarrett, a hydrologist with the U.S. Geological Survey, said that people should pay close attention to what is happening upstream from them when hiking. "It can be perfect weather… but upstream, a tremendous storm can swell creeks and drainages and send water toward unsuspecting hikers with unexpected speed," he said. The county emergency preparedness guide states, "People should be especially aware at night as potential flood conditions can be harder to identify." And you should never camp next to a stream for the night.

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Douglas County News Press / July 02, 2003

Thirsty tamarisk also a fire hazard
The noxious, water-guzzling tamarisk shrub has been targeted for destruction by lawmakers and land managers because it is choking out nearly 2 million acres of native plants and trees. Tamarisk, along with the deep leaf litter that collects around it, is highly flammable because it contains volatile resins that increase fire behavior. It is a feathery, pink-flowered shrub that can grow to the size of a tree, and it burns so hot during a fire that it can kill giant cottonwoods in its midst. Afterward, a tamarisk taproot, that can reach up to 50 feet, quickly begins sending up new shoots. The end result is a thicker-than-ever stand of tamarisk that completely chokes out any other native vegetation. Tamarisk, also known as salt cedar, is generally found along lower-elevation rivers and wetlands. It has been the focus of increasing attention since the drought hit Colorado and more lower-elevation fires are expected. Recent moisture has caused other fire-fodder vegetation such as cheat grass to grow waist-high, which has increased the potential for fast-moving blazes that could reach riverbanks. Tamarisk was a factor in a blaze that burned and damaged two homes and forced hundreds of evacuations along the Rio Grande near Albuquerque last week. It also helped to spread fires that burned along the Colorado River and destroyed campgrounds near Moab last year. Tamarisk soaks up an estimated 2 million to 4.5 million acre-feet of water per year in Western states - as much water as Colorado supplies to California annually. In March, Gov. Bill Owens ordered the Department of Natural Resources to coordinate efforts to wipe out the plant in Colorado within the next decade. U.S. Rep. Scott McInnis and Sen. Ben Nighthorse Campbell have introduced legislation to provide funding for tamarisk eradication efforts. McInnis' bill would earmark $1 million for study and development of a long-term plan to wipe out tamarisk. Campbell is proposing to make $2 million available for actual eradication of the plant, which spreads prolifically and is very tough to kill.

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Denver Post Western Slope Bureau / July 13, 2003

Reclamation head nixes Lake Powell drain plan
Bureau of Reclamation Commissioner John Keys convened the fourth of eight "Water 2025" regional conferences on Western water problems in Salt Lake City. Again, advocates of draining Lake Powell and allowing the Colorado River to run freely through southern Utah pitched their idea to Keys, but he dismissed it, declaring, "That's never going to happen." The advocates argued that four years of drought have left the huge reservoir on the Utah-Arizona border only about half full. John Weisheit, director of the Moab group Living Rivers, said Lake Powell could be sucked dry in 8 years, if the drought continues. Weisheit claimed that huge quantities of water are wasted through evaporation and seepage. Keys dismissed that claim as the "cost of doing business" and said it would be irresponsible to drain Lake Powell or Lake Mead, the two largest Colorado River reservoirs, citing that without them, the 23 million people who depend on the lower Colorado River Basin would have had only 40 percent of their normal water supplies last year.

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Fort Collins Coloradoan / July 17, 2002

ENDANGERED SPECIES

What happened to Warren Lakes?
"Warren Lakes," which sits atop Smuggler Mountain, is home to one of the highest peat bogs in Colorado. Its protection is a critical reason the Forest Service acquired the land, according to Forest Service hydrologist Andrea Holland-Sears, who conducted a major study of the area when the federal agency made the land purchase. Peat can include more than 160 species of specialized plants that grow in dense clumps around ponds in swamps, bogs or fens. "The fen at Warren Lakes is rare because most fens in Colorado are 3,000 years or younger and this one was much older," Holland-Sears said. Together, the pale-green to deep-red plants that make up a peat bog can hold 20 times their weight in water. When the plants die and are compressed, they form organic peat, which is a commodity harvested for fuel, mulch, or packing material to ship plants and live aquatic animals. Now that the Forest Service owns Warren Lakes, designs to preserve its ecological beauty are under way. The Forest Service anointed Aspen Center for Environmental Studies Director, Tom Cardamone, as the volunteer project coordinator to help restore Warren Lakes predominantly into a wetlands area, where fire risk and human encroachment would be reduced and the land restored to its natural state. The land is prime elk-calving habitat and the wetlands provide habitat for ducks, herons, fish and other riparian life. Also, Forest Service biologists are hopeful that the fen might provide quality habitat for tiger salamanders and endangered boreal toads.

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Aspen Daily News / June 28, 2003

Scientists aim to rid rivers of foreign fish
As part of a $116 million species restoration project, the U.S. Fish and Wildlife Service is trying to save four native fish species from extinction. The Colorado pikeminnow, humpback chub, razorback sucker and bonytail, frolicked for millennia in the wild river system that once was the Colorado Basin. But dams, reservoirs and dramatic changes in river flows, have sent the fish populations crashing. The agency has built fish ladders around dams, bred thousands of the rare fish at hatcheries and restored crucial riverside habitat. The federal government's latest strategy is to slash the populations of northern pike in Colorado and Utah in hopes of easing the pressure on the endangered ones. The predatory northern pike, an invader from east of the Mississippi, is overwhelming Western waterways, swallowing whole the young endangered fish and out-competing them for food and habitat. Wildlife officials say these non-native predators are erasing the local species.

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Rocky Mountain News / June 30, 2003

Water flow increased to help fish
The U.S. Bureau of Reclamation increased the flow from Navajo Reservoir into the San Juan River from 800 cubic feet per second to 900 cfs in an effort to help the habitat of the Colorado pikeminnow and the razorback sucker. The increased flows also meet recommendations made by the San Juan River Basin Recovery Implementation Program, which oversees recovery efforts for these endangered fish. Reclamation Water Management Team Leader Pat Page said, "One of the things we're trying to do is maintain a target base flow for endangered fish through the designated critical habitat, which is basically from Farmington to Lake Powell in Utah." Page said that water from the reservoir is needed to supplement changing conditions downstream and the decreased flow from the Animas River. "From the time water is released from the reservoir to when it reaches Mexican Hat (Utah), almost half of it is depleted," Page said. The depletion in the San Juan River is due to dry winds, high temperatures, increased evaporation and less return flow from irrigation.

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Durango Herald / July 8, 2003

RECREATION

Cities hope to find gold through pursuing whitewater tourism
Recreational water users in Colorado have established themselves as players in the state's long-standing system for allocating water rights. A dozen new cities across the state, including Fort Collins, are hoping to attract serious tourism dollars by building whitewater parks aimed at rafters and kayakers. Officials in Golden say their Clear Creek Whitewater Park helps pump more than $2 million into the local economy annually by attracting thousands of kayakers and onlookers. Millions more in sales-tax revenue have been realized

in Vail and Breckenridge. Fort Collins officials and local organizations have long talked about building a kayaking park on the Cache la Poudre River near the North College Bridge. City officials hope a Great Outdoor Colorado (GOCO) grant will help launch the project in the next few years.

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Fort Collins Coloradoan / July 7, 2003

Arkansas River access funds sought in proposed appropriations bill

Sen. Ben Nighthorse Campbell, R-Colo., announced that $20 million in federal funds is targeted for a variety of Colorado projects in 2004. Of that, $500,000 would go toward obtaining parcels of land within the Arkansas Headwaters Recreation Area as part of the federal government's proposed 2004 Interior Appropriations Bill. "We have identified a number of tracts that would enhance recreational opportunities - both boating and fishing - by providing access in areas that were not available before," said Ken Smith, Bureau of Land Management spokesperson in Canon City. "Many of the tracts would allow river users to scout ahead on areas of the river to see where dangerous rapids are and look for things like low bridges, so that would enhance safety on the river," Smith explained.

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The Pueblo Chieftain / July 16, 2003

RESEARCH AND TECHNOLOGY

Selenium task force to feel pinch of budget cuts

Funding cuts at the U.S. Bureau of Reclamation may mean trouble for the Gunnison Basin Selenium Task Force. The budget for the National Irrigation Water Quality Program, which focuses on drain water contamination and its effects on endangered species and migratory birds, was nearly halved and technical expertise may no longer be available to the task force. The task force was formed to help bring selenium levels in the Gunnison River Basin into compliance with a 5 parts per billion (ppb) requirement set by the Colorado Water Quality Control Commission in 1997. Selenium has been shown to be more poisonous than mercury or arsenic in high concentrations. A study by the U.S. Fish and Wildlife Service conducted from 1991-93 shows 64 percent of water samples taken from the Gunnison River and 50 percent of samples from the Colorado River exceed the U.S. Environmental Protection Agency selenium criterion of 5 ppb. Also, selenium levels between 16 ppb and 25 ppb were measured at the mouth of the Uncompahgre River. Selenium is commonly found in marine sedimentary deposits like the Mancos shale found around the valley. Bureau of Reclamation team leader Mike Baker said "…the $2.6 million budget for the NIWQP was cut by $1.25 million." The $750,000 in write-in funding for the Uncompahgre Valley Water Users' Association to line a ditch lateral near Dry Cedar Creek was also cut by approximately 10 percent. "They have put in a decade of work to understand the (selenium) problem, and now they are stepping back," said task force facilitator Randy See. The replacement of 8.5 miles of open ditch irrigation laterals with 7.5 miles of pipe reduced the selenium load at the outflow site in the Montrose Arroyo by 28 percent, or 194 pounds per year, according to a report by David Butler of the U.S. Geological Survey. The piping also reduced the salt load by 1,980 tons per year. "It's a pretty clear cause and effect. If you can reduce the percolation, you can reduce these loads," said See. "I think it is unfair for the water users . . . if we can't continue the lining and piping of the ditches," he said. Ditch piping can help conserve water as well as reducing selenium and salt loads.

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Montrose Daily Press / July 02, 2003

Colorado science jobs on the line / Planned federal cuts in research could put 190 out of work

Congress is considering deep cuts in federal research funds that would cause an estimated 190 Colorado scientists to lose their jobs. About $14 million in cuts to the National Oceanic and Atmospheric Administration projects in Colorado, and additional cuts to the National Institute of Standards and Technology (NIST), were contained in an appropriations bill being considered by the House of Representatives. If approved as expected, they still must be considered by the U.S. Senate. "Obviously, it has me gravely concerned," said Susan Avery, director of the University of Colorado's Cooperative Institute for Research in the Environmental Sciences. "These are cuts that could be very detrimental to our research programs." The cuts are contained in a $38.6 billion appropriations package for the Commerce, Justice and State departments and the federal judiciary. NIST would lose about 300 jobs nationwide, including about 60 in Boulder, said Rep. Mark Udall, who tried unsuccessfully to reverse the cuts on the House floor. Avery said the cuts would affect research at both the University of Colorado and Colorado State University, including climate modeling programs and research into weather phenomenon such as El Niño and La Niña. If approved by the House, the bill would move to the Senate, where state researchers hope the cuts will be reversed by Sen. Ben Nighthorse Campbell, an Ignacio Republican and a member of the Appropriations Committee.

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Rocky Mountain News / July 23, 2003

WATER HISTORY

Anasazi reservoirs no empty notion / Research appears to have solved longtime mystery

In a new book, Water for the Anasazi, Boulder civil engineer Kenneth R. Wright summarized his research team's eight-year study of four suspected Anasazi reservoirs at Mesa Verde. Since 1995, Wright's team of engineers, hydrologists, geologists, soil scientists, archaeologists and pollen analysts gathered enough evidence to convince park officials that Mummy Lake and three other small dirt structures were once reservoirs, built and operated between A.D. 750 and 1180. The four reservoirs were used to harvest storm runoff

and to capture spring snowmelt. In response to the team's findings, park officials replaced the Mummy Lake sign and renamed the site "Far View Reservoir" in 1999. Two more suspected reservoirs still await testing at the national park, west of Durango. The Public Works Historical Society will publish "Water for the Anasazi" next month. Wright was been invited to lecture on the topic at the Library of Congress in October. Wright and his wife, photographer and former state legislator Ruth Wright, also discussed the Mesa Verde project on July 23 at the Colorado Water Workshop in Gunnison.

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Rocky Mountain News / July 25, 2003

WATER POLICY

Farmers to temporarily loan, lease water rights

Gov. Bill Owens signed a law in early June to create statewide water banks. The law is intended to make it easier for farmers and ranchers to temporarily loan, lease or exchange their water rights without losing rights to their land. Before the drought, it was common for cities to lease excess water rights to farmers. However, in March Fort Collins agreed to pay nearly $1 million in a deal that allows about 400 farmers to lease their water rights to the city for a year. The agreement, with two irrigation companies, means farmers will earn up to $40,000 each for a lease that has nothing to do with their crops. "You could realize more income out of renting your water," said Gary Simpson, president of North Poudre Irrigation Co. A wet spring and March blizzard left some farmers with unexpected irrigation water. JoAnn Baland, 71, who farms near Wellington, said she leased her water rights to Fort Collins after the drought sent crop yields plummeting last year and forced her to sell nearly all her cattle for lack of feed. She sold the rights reluctantly, because she thinks sending water to cities signals the end of agriculture along the fast-grown Front Range. "We're like dinosaurs," said Baland. "We're a dying breed."

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Aurora Sentinel / July 2, 2003

Farmers may face water cut / Imperial Valley wastes ration, U.S. panel finds

The Bureau of Reclamation said Thursday that farmers in California's Imperial Valley are wasting Colorado River water and should receive less from the drought-stricken waterway next year. The bureau's unprecedented examination found that some 400 farmers in California's southeastern corner, who use most of the State's supply from the Colorado River, should lose 275,000 acre-feet of water, or 9 percent of their current allotment. Barring an appeal, the bureau's findings would become permanent next month. Imperial County pours about 1 trillion gallons (about 70 percent of the state's share) of Colorado River water across sun-baked fields to produce $1 billion worth of food every year. The major crop is alfalfa, a thirsty, low-value crop used to feed livestock. The region's farmers, who were among the first to stake a claim to the Colorado, literally flood their fields to allow water to percolate to the roots and to flush salt from the desert soil. One third of the valley's water winds up in the Salton Sea, which would quickly become too salty for fish and birds if it were not for runoff from the farms. The bureau has the authority to take Colorado River water away from anybody found to be wasting it in Arizona, Nevada and California. Interior Secretary Gale Norton had tried to reduce Imperial's share of the Colorado River by 10 percent earlier this year. Imperial's water board challenged Norton in federal court in San Diego and won in March, when a judge found that DOI had acted improperly and then ordered it to conduct a review as outlined in federal regulations.

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Denver Post / July 4, 2003

Council: Fluoridate / Foes vow ballot initiative or lawsuit

Fluoridation lives, but opponents are vowing a continued fight. The City Council has voted to continue fluoridating Fort Collins water, and several members said they trusted the opinions of local and national health experts. But opponents of water fluoridation argued their freedom of choice was being trumped. The council's 4-3 vote is a victory for those who agree that water fluoridation poses little health risk and is a cost-effective way to prevent cavities. In voting, the council affirmed the consensus report of the Fluoride Technical Study Group, a group that in February concluded that fluoridation prevents cavities and poses little risk to the public. The vote came after the testimony of more than 30 people -- most of them asking that fluoride be removed. It was just the first round in what opponents say now is a battle to end the city's 36-year-old fluoride policy aimed at fighting cavities. For more than two years, the city has grappled with the contentious issue of whether to continue fluoridating Fort Collins Utilities water with liquid hydrofluorosilicic acid, or HFS. Clean Water Advocates, a recently registered nonprofit group opposed to water fluoridation, is raising funds for a ballot initiative and has not ruled out filing a lawsuit to end fluoridation.

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Fort Collins Coloradoan / July 16, 2003

WATER QUALITY

City's water squeaky clean

The City of Durango's water is clean - very clean. "We've never had a violation in my 25 years here," said Mike Amato, superintendent of the water-treatment plant. The city's water comes primarily from the Florida River, with additional water from the Animas River during the summer months. The city spent $1.2 million for upgrades to the plant between January and June because of last year's fires. The concern by the city's Public Works Department was that runoff from the denuded slopes would foul the treatment plant's

machinery. Amato said the upgrades had nothing to do with the recent water-quality report. "Still, the upgrades will come in handy if the water is ever clouded by runoff," Amato said. "There has not been any impact from runoff this year ... yet," he said. About 17,000 people use drinking water from the plant each day.

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Durango Herald / July 2, 2003

Groups discuss uses for Colorado River

The Colorado Water Quality Control Commission met in Glenwood Springs on Monday to hear testimony from water agencies and others who have proposed changes to water-quality standards, classifications and designations in the Colorado River Basin. The changes that would more accurately affect recreational and other river uses should be in place early next year. The commission considers such changes every five years. Colorado River Water Conservation District Chief Engineer Dave Merritt said, "Aquatic life, agriculture and water supply are included in developing the regulations, along with changes to reflect actual recreational use of streams, creeks and reservoirs." The new regulations will address maximum pollutant levels in such waters. Copies of the proposed regulations are on the commission's Web site: **www.cdphe.state.co.us/op/wqcc/wqcchom.asp**

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The Grand Junction Daily Sentinel / July 15, 2003

Appeals court upholds reduction in arsenic level in drinking water

A federal appeals court has upheld the Environmental Protection Agency's requirement that water agencies significantly reduce arsenic levels in drinking water. The new EPA standard reduces the maximum amount of arsenic allowed in drinking water from 50 parts per billion, a level that had been in effect since 1942, to 10 parts per billion. "This is a big victory for public health and for all Americans who want safe drinking water," said National Resource Defense Council attorney Eric Olson.

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The Fort Collins Coloradoan / June 21, 2003

WATER RIGHTS

Water Trust gets grant to buy and protect water rights

The Colorado Conservation Trust made a $60,000 grant to the Colorado Water Trust to help protect native populations of cutthroat trout in the Colorado and Rio Grande River Basins. Will Shafroth, executive director of the trust said, "The funding is the first significant grant the CWT has received that will allow it to begin negotiating deals with water users on the open market." The end result could be more water in streams and a healthy river ecosystem with adequate stream flows for native fish.

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Rocky Mountain News / July 8, 2003

WATER SUPPLY AND DEVELOPMENT

Mountain towns know it's do or dry

In decades to come, Denver Water and the Loveland-based Northern Colorado Conservancy District will move billions of gallons of water across the mountains - water they've owned for years but never needed. According to a report by the state demographer, Colorado's population will hit 7.15 million by 2030. Meanwhile, Grand County's water needs are expected to quadruple; Summit County's water use is expected to more than double; and nearly two dozen fast-growing communities will face water shortages. Western Slope and Eastern Slope water experts have been meeting for months, studying water supplies and trying to determine how everyone's needs can be met. Last month, a new group of politicos and water providers formed in Grand County to examine whether water needs and development - among other things - are on a collision course. "There have been preliminary discussions about whether to cut back (development)," said Bruce Hutchins, manager of the Grand County Water and Sanitation District. "Theoretically, we have enough water for future growth, but that would mean at times we will dry up the stream. So we've turned the issue over to the town of Winter Park. The people will have to decide whether they want water for people or whether they want water in the stream," Hutchins said. David Little, a planner at Denver Water, said all parties understand what's at stake, including the health of the tourism economy which depends on the state's natural beauty. "We're going to try to help the counties solve their water needs," Little said. "Everyone's trying to finesse this issue in a way that does the least environmental damage."

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Rocky Mountain News / June 21, 2003

Storms, snow melt boost Colorado-Big Thompson quota

The Northern Colorado Water Conservancy District increased the Colorado-Big Thompson quota to 50 percent, giving Northern Colorado an additional 31,000 acre-feet of water this year. This means if a water user has 100 acre-feet of Colorado-Big Thompson water, they will have access to 50 acre-feet. The president of the board, Mike Applegate, said, "We are now in a position to increase this year's deliveries without jeopardizing next year's." The board's original April decision of 40 percent was the lowest quota ever.

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Greeley Tribune / July 14, 2003

MEETINGS and CALLS FOR PAPERS

THE 14TH ANNUAL
SOUTH PLATTE FORUM
PLANNING FOR UNCERTAINTY
Oct. 22-23, 2003
Raintree Plaza, Longmont, Colorado

SOUTH PLATTE FORUM

Keynote Speakers

Ken Salazar, Colorado State Attorney General
Dave Robbins, Hill & Robbins, PC
Rod Kuharich, Colorado Water Conservation Board
Robert Ward, Colorado Water Resources Research Institute

RURAL ECONOMICS - THIRSTING FOR WATER
Rick Dykstra, Progressive 15; Eric Schuck, Colorado State University; Alan Foutz, Colorado Farm Bureau

WE'RE ALL TAPPED OUT
Sharon Harris, Green CO; Leslie Parker, Denver Water; Dick Parachini, Colo. Dept. of Public Health & Environment

CRISPY CRITTERS - PAST, PRESENT & FUTURE
Kurt Fausch and Kevin Bestgen, Colorado State University; Boris Kondratieff, Colorado State University; Ellen Wohl, Colorado State University

PLANNING FOR AN UNCERTAIN FUTURE IN THE SOUTH PLATTE
Don Ament, Colorado State Agriculture Commissioner; Peter Binney, City of Aurora; David Merritt, USDA Stream Systems Technology Center

JUST HOW ABRASIVE IS GRAVEL?
Melissa Young, Colorado Rock Products; Glenn Rodriquez, US Environmental Protection Agency; Margaret Langworthy, US Corps of Engineers

WILL YOU TAKE A RAIN CHECK FROM THE WATER BANK?
Leroy Mauch, Lower Arkansas River Conservancy District; James Broderick, Southeast Colorado Water Conservancy District

AND MORE…
Julie McKenna, Brandeberry & McKenna Public Affairs - State Legislative Update
Nolan Doesken, Assistant State Climatologist - Climate Update

For additional information, CONTACT:
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Website: **http://southplatte.jjbrown.com**

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Denver Water
No. Colorado Water Conservancy District
US Bureau of Reclamation
US Environmental Protection Agency
US Fish and Wildlife Service

COLORADO WATERSHED ASSEMBLY ANNUAL MEETING
September 11-12, 2003
Ramada Inn in Glenwood Springs, Colorado

A great combination of technical sessions and workshops are planned for this year. Also, the Annual BBQ will be hosted by the Colorado River Water Conservation District at Confluence Park. Registration is $75.00 for the meeting (BBQ included). Rooms are available at the Ramada Inn for a discounted rate of $69.00 per night. Some scholarships are available to help pay for the meeting. For more information contact Marc Alston at alston.marc@epamail.epa.gov or Chuck Wanner at cwanner@frontier.net. If you would like to arrange accommodations for a booth or display, contact Bonnie Pierce at 970/484-3678 or E-mail her at bonnie@treeswaterpeople.org. Download Registration Form at **http://www.coloradowater.org/cwa_2003_conference.htm**.

COLORADO WATER CONGRESS WORKSHOPS

The following workshops are planned for Fall - 2003: They will all be held in the Colorado Water Congress Conference Room, 1580 Logan Street, Suite 400, Denver, Colorado.

Initiatives - What You Should Know
Water Quality
Groundwater
Legislative Process - Advocacy
News Media Relations
Wetlands
Federal Environmental Laws
Water Financing
Ethics
An Advance Course in Water Law by the Veterans (or the School of Hard Knocks in Water Law)

The Colorado Water Law Seminar is scheduled for September 8 - 9, 2003. Program and Registration will be posted on the CWC Website when available at **http://www.cowatercongress.org**.

Colorado Water Congress - Summer Convention -- August 21-22, 2003
Steamboat Grand Resort Hotel & Conference Center, Steamboat Springs, Colorado
The **2004 46th Annual Convention** will be January 29-30, 2004

Monitoring Science & Technology Symposium
Denver, Colorado – September 20-24, 2004
Unifying Knowledge for Sustainability in the Western Hemisphere

Come to the one monitoring symposium that puts it all together. Senior policy makers, resource managers and scientists from many organizations and a wide range of disciplines will address critical needs for unified information and knowledge. The symposium is designed to facilitate how this information and knowledge is obtained to support monitoring for ecosystem sustainability and to assure a sound, defensible foundation for sustainable economic development.

This symposium engages you in discussions of technological advances and knowledge needs across institutions and disciplines to make monitoring of ecosystem sustainability both effective and efficient. You will participate both within and outside of your disciplinary area since the focus of the symposium emphasizes working across disciplinary boundaries. You will be challenged to think outside the box to advance monitoring science through cross-disciplinary presentations and discussion.

As organizations and governmental institutions increasingly engage in monitoring and inventory activities, it has become clear that much value is lost when these activities fail to embody common information or common protocols. Interoperability is a common thread running through the symposium. You can also expect to learn of the results of innovative monitoring approaches and technology applications. The symposium focuses on Western Hemisphere interests and activities, providing you an opportunity to meet and collaborate with like-minded colleagues from North, Central and South America as well as from other regions.

Monitoring Science & Technology Symposium - Denver, CO -- 1115 Grant St. Ste. 308 - Denver, CO 80203

Phone:(303) 830-6850 Email:info@monitoringsymposium.com http://www.monitoringsymposium.com

CALENDAR

Aug. 21-22	COLORADO WATER CONGRESS Summer Convention, Steamboat Springs, CO. Contact: Dick MacRavey, Executive Director, at Phone 303/837-0812, FAX 303/837-1607, E-mail macravey@cowatercongress.org. Website: **www.cowatercongress.org**.
Sept. 16-19	RIVERBANK FILTRATION CONFERENCE -- Riverbank Filtration: The Time is NOW!, Cincinnati, OH. See information at the website **http://www.NWRI-USA.org**.
Sept. 17-20	SUSTAINABILITY ISSUES OF ARIZONA'S REGIONAL WATERSHEDS, Mesa, AZ. Contact: Dr. Pete Kroopnick at Phone 602/567-3850, FAX 602/567-4001, or E-mail PKroopnick@brwncald.com or Julie Rutkowski, Symposium Committee Chair, at 602/771-4411 or rutkowski.julie@ev.state.az.us. Website: **http://www.azhydrosoc.org**.
Sept. 22-23	10TH ANNUAL WESTERN WATER LAW CONFERENCE, Denver, CO. For information see website at **http://www.cle.com** or call (800)873-7130.
Oct. 12-15	10TH ANNUAL CONFERENCE ON TAILINGS AND MINE WASTE, Vail, CO. Contact: Linda Hinshaw, Coordinator, Dept. of Civil Engr., CSU, Phone 970/491-6081, FAX 970/491-3584, E-mail lhinshaw@engr.colostate.edu.
Oct. 22-23	14th ANNUAL SOUTH PLATTE FORUM, PLANNING FOR UNCERTAINTY, Longmont, CO. Contact Jennifer Brown at (970) 213-1618, jennifer@jjbrown.com. Website: **http://southplatte.jjbrown.com/**.
Oct. 29-30	GETTING IT DONE: THE ROLE OF TMDL IMPLEMENTATION IN WATERSHED RESTORATION, Stevenson, WA. Contact: Kelly Newell at 509/335-5531, E-mail watercenter@wsu.edu. Website: **http://www.swwrc.wsu.edu/conference2003.**
Nov. 3-7	7TH BIENNIAL CONFERENCE, INTEGRATING SCIENCE AND MANAGEMENT ON THE COLORADO PLATEAU, NORTHERN ARIZONA UNIVERSITY, FLAGSTAFF, AZ. Contact: David Mattson, Phone 928/556-7466 x245, David.Mattson@nau.edu; David Fiss, Phone 928/523-7087, David.Fiss@nau.edu. Website: **http://www.usgs.nau.edu/conf2003/**.
Nov. 4-8	NALMS 2003: PROTECTING OUR LAKES' LEGACY, 23rd International Symposium, Mashantucket, Ct. Co-Chairs: Amy Smagula, Phone 603/271-2248, E-mail asmagula@des.state.nh.us; Neil Kamman, Phone 802/241-3795, E-mail neilk@dec.anr.state.vt.us.
Nov. 16-18	116TH ANNUAL MEETING, NATIONAL ASSOCIATION OF STATE UNIVERSITIES AND LAND-GRANT COLLEGES, New Orleans, LA. Contact NASULGC at Phone 202/478-6050, FAX 202/478-6046, E-mail am03@nasulgc.org, Website at **http://www.nasulgc.org/am2003**.

7th National Mitigation & Conservation Banking Conference
March 3-5, 2004, New Orleans, LA.

Practice & Policy & New Emerging Markets is the conference theme for 2004. Interactive sessions at the nation's hands-on conference for mitigation and conservation banking will range from how-to sessions to panels on new markets such as water quality trading, stormwater credits, carbon sequestration and NOx credits. Technical banking issues, wetlands science, alternatives to banking, and the newest information on legislation and industry events will be discussed. And a continuation of last year's *Regulators' Forum* facilitated by the Corps of Engineers. CALL FOR PAPERS deadline is September 12, 2003. For more information, visit www.mitigationbankingconference.com.

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