COLORADO WATER RESOURCES RESEARCH INSTITUTE

COLORADO WATER

Newsletter of the Water Center of Colorado State University

APRIL 1999

CWRRI's Advisory Committee for Water Resources Policy has selected projects for the restored federal FY1999 State Water Institute Program -- *See Page 14*

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"Drain Lake Powell?"
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WATER ITEMS AND ISSUES . . .

COLORADO WATER

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EDITORIAL

DOES UNIVERSITY SCIENCE PRODUCE HIGH-QUALITY DATA?

by Robert C. Ward, Director

During the past few months I've encountered several expressions of concern regarding the quality of data being collected as part of university-based water research. This concern ranges from questions about the quality of data collected by graduate students to the ability of the peer review process to assure high quality data underpinning scientific conclusions. Given the tighter relationship between science and policy in western water management, the quality of the data used to draw scientific conclusions, that have immediate policy ramifications, must be above reproach. Given the lack of documentation of procedures used to collect data within university-based research projects, it is difficult to state unequivocally that the data are always above reproach.

High quality, well-documented datasets that are readily available on the internet will be recognized as extremely valuable in the future as society attempts to understand and document its long term 'footprint' on the environment.

Articles, such as appeared in EOS, the newsletter of the American Geophysical Union, August 4, 1999, highlight the reasons scientists have not been interested in documenting the quality of the data used for research purposes. Among the reasons cited by the author, Ronald Vogel, are:

"Others will publish using my data and will receive recognition for the results instead of me; Describing and documenting data is a time-consuming and costly process; I do not want everyone and anyone asking me for my data. I do not have time to respond to all those requests. I am in the business of research, not data distribution. I fulfilled the obligation to my funding agency by publishing the results of the research. The data are mine and I can do with them as I please.

What counts toward my professional standing is the publication of research results. Why should I even bother with dataset documentation?"

Vogel notes that the three most important issues related to better documentation of data are "credit in the scientific literature for data reuse, credit toward professional standing for making data available, and funding for data documentation and archive activities" so that scientists can take the time to quality-assure, format and document their data.

Thus, while many scientists recognize the need to document the quality of research data (ie provide metadata with the data), the incentives are not there. Perhaps continuing evolution of internet technology and the accompanying increased ability to share scientific data, will generate the need to develop incentives for scientists to document data as a separate and valuable product of research. The traditional eight-page refereed journal article, reporting research results, does not provide the opportunity to document and share data as a valuable, separate product of research.

CWRRI research projects that involve collecting water environment data are not immune to the issue of dataset documentation. Kurt Fausch and Kevin Bestgen, in CSU's Fishery and Wildlife Biology Department, recently received CWRRI funding for research. They describe their attitudes and approaches to data collection and documentation in an article on page 19. Tim Gates and John Labadie, in CSU's Civil Engineering Department, also recently received CWRRI funding and will describe their approach to data collection and documentation in the next issue of *Colorado Water*.

University scientists collecting water environment data must confront their attitudes and policies with respect to data quality, documentation and sharing within the context of the incentive issue. High quality, well-documented datasets that are readily available on the internet will be recognized as extremely valuable in the future as society attempts to understand and document its long term 'footprint' on the environment. CWRRI will work to develop the incentives faculty need to create data sets deemed highly valuable in future water research. CWRRI incentives may take the form of grants to establish metadata templates for a particular discipline's placement of data on the internet and grants to investigate formats in which water data, on the internet, are of most use to water managers. In the final analysis, however, universities must establish ways to give credit in the tenure and promotion review process for production of high quality, relevant, and well-documented data sets.

WATER MANAGEMENT SCIENCE AND TECHNOLOGY PROGRAM

NAMED PROGRAM OF RESEARCH AND SCHOLARLY EXCELLENCE

President Albert Yates has selected the Water Management Science and Technology Program as one of 14 programs designated as a Program of Research and Scholarly Excellence for the coming four years. Colorado State's mission, as Colorado's land-grant university, is to address the need for education, research and outreach in support of the state's agricultural industry and its natural resources, including water. As Colorado, the U.S. and the World move from a strictly 'development' focus on water resources to one more guided by 'sustainability,' Colorado State can provide much of the science, technology, information and education that will be needed to support this transition. Colorado State houses 22 departments that apply their expertise to solving water problems. This extensive water-related expertise at Colorado State has resulted in the development of over 150 senior and graduate-level courses that address water issues.

Of the more than 100 Colorado State faculty who apply their disciplines to water, 15 work as Water Management Science and Technology Program 'Core Faculty' within the Water Center. Each has excelled in bringing his/her water expertise (discipline) to 'real world' water management in an individual and/or collaborative manner. Members of the Water Center Core Faculty are:

Steve Abt, Environmental river mechanics
Jill Baron, Ecosystem function
Will Clements, Aquatic toxicology
Deanna Durnford, Groundwater models
Kurt Fausch, Water flows needed for fish sustainability
Marshall Frasier, Economics of water management
David Freeman, Sociology of water management organizations
Luis Garcia, Integrated decision support technology
Tim Gates, River models
Neil Grigg, water resources planning/management
Jim Loftis, Water quality
Dan Smith, Agricultural water needs/management
Freeman Smith, Water Resources planning/management
John Stednick, Water quality management/monitoring
Robert Ward, Water monitoring/management

The Water Center also has developed an undergraduate water 'minor' to help guide undergraduate students into the richness and depth of this water expertise in an organized manner. Core Faculty are initiating development of a graduate-level water 'minor.' In all, this core water faculty group has guided 216 graduate students to completion over the past five years.

Colorado College Earth Week to Feature Lake Powell Debate Between Floyd Dominy and Dave Wegner

The legendary former U.S. Bureau of Reclamation Commissioner Floyd Dominy will face Dave Wegner, former director of the Bureau's Glen Canyon Environmental Studies on the controversial topic, "Drain Lake Powell" for the Timothy Linnemann Memorial Lecture at 7 p.m. on Wednesday, April 21, in Packard Hall. While serving as commissioner for the U.S. Bureau of Reclamation (USBR), Dominy completed the Glen Canyon, Flaming Gorge, and Navajo Dams for the Colorado River Storage Project during his 10-year term. He is the only USBR commissioner to serve by appointment of four U.S. presidents. Dominy is a major figure in two important books on water in the west (Marc Reisner's Cadillac Desert and John McPhee's Encounters with the Archdruid). As director of the Glen Canyon Environmental Studies program from 1983 to 1996, Dave Wegner led a team of scientists in conducting a comprehensive study of the effects of Glen Canyon Dam on the downstream ecosystem of the Colorado River through Grand Canyon National Park. His work led to the Grand Canyon Protection Act of 1992 and, in the spring of 1996, the highly publicized test-flood through the canyon aimed at restoring the riparian ecosystem of one of America's most renowned national parks. Wegner left the Bureau in 1996. He is now vice president and chief scientist of the Glen Canyon Institute, the leading voice for draining Lake Powell and restoring Glen Canyon.

All events are free and open to the public. For more information, call Diana Smith at (719) 389-6138 or
OFFICE OF COLLEGE RELATIONS, 14 East Cache La Poudre Street, Colorado Springs, Colorado 80903-3298,
Phone 719/389-6603, FAX 719/389-6256.

EGYPTIANS EXAMINE OPTIONS FOR FARMER-MANAGED LOCAL IRRIGATION ORGANIZATIONS

by David Freeman
Department of Sociology, Colorado State University

Ten Egyptian irrigation managers, farmers, and agricultural scientists were hosted by David Freeman and John Wilkins-Wells of the Department of Sociology February 14-28 at Colorado State University. They participated in a workshop focused upon issues pertaining to design and implementation of farmer-managed local irrigation organizations and federating such organizations in ways such that Egyptian farmers can assume responsibility for operations and management of branch canals as well as lower level distributaries (mesqas).

From left: David Freeman, Sociologist, Eng. Ramses Bakhom Lofty, Head, Irrigation Improvement Sector; Prof. M. Hussein Hegazi, Soil and Water Environment Institute, and Dr. Hussein El Atfy, Undersecretary for Irrigation

Many large-scale irrigation systems around the world have come to rely increasingly upon local farmer managed canal organizations to work as partners with central irrigation authorities in order to enhance water productivity, reduce financial burdens on central treasuries, enhance social justice and environmental sustainability, and secure the benefits of local farmer knowledge and capacity to adapt scarce resources to site-specific irrigation situations. The workshop emphasized organizational

From left: Farmer Mesqa Leader M. Saeed Nounou; Farmer Mesqa Leader Gamil Gawish; David Freeman; Eng. Mamdouh Metwally, Director, Irrigation Advisory Service, Mid-Egypt.

design and management policy analysis skills that will enable participants: 1) to work effectively as an interdisciplinary Ministerial Action Planning team that is expected to assist the Minister of Irrigation and Public Works in formulating and implementing irrigation policy; and 2) create the conditions within which farmer managed local organizations at the mesqa and branch canals levels can flourish with benefits both to farmers and central irrigation system management.

Among the participants were two farmer mesqa leaders, the Undersecretary for Irrigation, the General Director of the Irrigation Advisory Service, the Head of the Irrigation Improvement Sector, the Director of Operations of the Irrigation Advisory Service and the Directors for the East Delta and Mid-Egypt. Also included were two professors representing the Agricultural Extension Institute and the Soil, Water, and Environment Institute. The delegation was accompanied by Dr. Robert Cardinalli, anthropologist, who represented Winrock and USAID/Cairo as Senior Social Scientist in USAID's Environmental Policy Institutional Strengthening Program. Ramchand Oad, Professor of Chemical and Bioresources Engineering at CSU, and Max K. Lowdermilk, former CSU Sociologist and USAID administrator, assisted with the workshop.

This workshop represents a continuation of a highly valued relationship between Egyptian irrigation authorities, the Department of Sociology at CSU, and other departments such as Civil and Bioresources Engineering, Soil and Plant Sciences, and Economics at Colorado State University. In 1981, the first Egyptians came to CSU to examine the design and operation of local irrigation organizations. Over the years the policy discourse has become increasingly rich and rewarding for all parties. Ideas about the devolution of water control to farmer managed organizations that were virtually unthinkable less than 20 years ago have now become central to the strategy of the Ministry of Irrigation and Public Works. The new forms of local water organization are intimately connected with prospects for enhanced water use efficiencies, social justice in water resource distribution, environmental sustainability and public health benefits, and the practice of local rural democratic governance.

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The American Water Resources Association Requests Applications for the 1999-2000 Richard A. Herbert Memorial Scholarships

AWRA is proud to announce the availability of two $1,000 scholarships derived from proceeds of this fund for the 1999-2000 academic year. One $1,000 scholarship will be awarded to a full-time undergraduate student working toward their first undergraduate degree and is enrolled in a program related to water resources for the 1999-2000 academic year. The second $1,000 scholarship will be awarded to a full-time graduate student enrolled in a program related to water resources for the 1999-2000 academic year. In addition to the scholarships, each winner will receive a complimentary membership in AWRA for 2000.

SELECTION CRITERIA: The undergraduate scholarship will be awarded to the student most qualified by academic performance. Measures of academic performance include the cumulative grade point average, relevance of the student's curriculum to water resources, and leadership in extracurricular activities related to water resources. The graduate scholarship will be awarded to the student most qualified by academic and/or research performance. The measures of academic performance are identical to those for the undergraduate scholarship with the addition of the quality of the student's research and it's relevance to water resources. Scholarship recipients will be selected by the AWRA Student Activities Committee and announced during the summer of 1999.

APPLICATION PROCESS: Applicants should prepare a title page and a two-page summary of their academic interests and achievements, extracurricular interests, and career goals as they relate to the above selection criteria. (Summaries must be limited to two pages.) The application must also include three letters of reference (preferably from professors and/or advisors), a transcript of all college courses (undergraduate and graduate), and the applicant's full name, permanent mailing addresses, and a phone number at which she or he can be easily contacted. DEADLINE: All applications must be received by APRIL 30, 1999

MAIL APPLICATIONS TO: Ligno Tech, USA
AWRA Student Activities Committee
Attn: Stephen Dickman
100 Hwy. 51 South
Rothschild, WI 54474

QUESTIONS?...CONTACT: Stephan Dickman - Phone: 715/355-3684; FAX 715/355-3648; e-mail stdi@ltus.com

Colorado State University Agricultural Experiment Station

THE COLORADO CLIMATE CENTER 25 YEARS OF CLIMATE MONITORING AND AGRICULTURAL APPLICATIONS FOR COLORADO

by Nolan Doesken

In 1974, the Colorado Agricultural Experiment Station initiated a research program to monitor climatic conditions in Colorado and conduct research on climate and agricultural applications. This research project established the Colorado Climate Center, within the Department of Atmospheric Science, at Colorado State University as a state resource on current and historic climate information. Dr. Thomas McKee, Professor of Atmospheric Science, has been the principal investigator for the project since its inception. Nolan Doesken joined the Center in 1977 as Assistant State Climatologist.

Right: Nolan Doesken, Assistant State Climatologist, Colorado State University

Basic weather data such as temperature, humidity, precipitation, snowfall and wind, collected systematically over time, provide the essential resource for climatological studies and applications. During the early years of the project, the primary goal was assembling climatic data from all portions of Colorado. A digital climate database was developed, which has been used ever since in climate monitoring and research. These data have been used extensively by Colorado Climate Center scientists and shared with thousands of scientists, engineers, consultants, planners, students, and many others.

In the winter of 1976-77 a severe drought emerged in Colorado. In an effort to improve access to timely information on drought and other climate anomalies, the Colorado Climate Center made special arrangements with the National Weather Service to receive monthly climatic data from more than 200 weather stations representing all areas of Colorado. Using this comprehensive data source, a monthly newsletter was created to provide detailed information on recent climatic conditions, climate impacts and research results. For nearly 20 years this publication has been distributed at no charge to scientists, government agencies, Cooerative Extension personnel, teachers,and business leaders throughout Colorado. More recently, the World Wide Web has become the primary communications tool for disseminating climate information. The National Weather Service continues to provide statewide data to the Colorado Climate Center on a monthly basis.

Over the 25-year history of this research program, many topics have been investigated. A few examples include studies of climatic influences on wheat phenology, frost characteristics on the Western Slope and their effects on fruit production, hail patterns, the length and variation in growing season duration, and long-term trends and variations in temperature, precipitation,and other important climatic elements.

Water Resources and Water Management Issues. As climate monitoring has matured in Colorado, emphasis on research and applications has turned increasingly to water resources and water management issues. In 1981, the Colorado Water Availability Task Force was formed as a part of the Colorado Drought Response Plan. The Colorado Climate Center continues to be a major provider of information and expertise to that important organization. The Center also provides information to regional and national climate monitoring activities such as the Western Governors Association Drought Council.

During the 1990s, Dr. McKee developed and tested a new tool for drought monitoring called the Standardized Precipitation Index (SPI). This index is rapidly becoming the index of choice for drought monitoring across the U.S. Snowfall in Colorado is immensely important, not only because it becomes the primary source for surface water supplies as it melts during spring and early summer, but also because of the huge winter recreation

industry that it supports. In 1996, Nolan Doesken and co-author Author Judson (U. S. Forest Service, retired) completed a book, "The Snow Booklet: A Guide to the Science, Climatology and Measurement of Snow in the United States." This book has become a popular reference about snow and has been distributed nationally and internationally.

Flooding and Rainfall Patterns. The Colorado Climate Center works closely with the Colorado Department of Natural Resources on climate information related to observed and potential flooding in the state. Catastrophic flash floods struck Fort Collins, Sterling and other portions of northeast Colorado in late July 1997. The Colorado Climate Center conducted detailed studies of rainfall patterns associated with these storms. The Fort Collins storm was found to be the heaviest rainfall ever observed over an urbanized area in the history of Colorado. The Pawnee Creek storm was one of the four largest rainstorms ever documented anywhere in Colorado during the 20th Century.

The Colorado Agricultural Meteorology network (COAGMET). The demand for real-time weather data for on-farm decision making has increased dramatically in recent years. From irrigation scheduling, to fertilizer application and pest management, weather conditions affect nearly every aspect of agriculture. The Colorado Agricultural Meteorology network (COAGMET) was established to provide detailed and timely automated weather data from irrigated agricultural areas throughout Colorado. The Colorado Climate Center is one of several collaborators on this project and serves as the focal point for data retrieval, management and dissemination.

The Colorado Collaborative Rain and Hail Study (CoCo RaHS). In 1998 a new research effort, the Colorado Collaborative Rain and Hail Study (CoCo RaHS) was initiated to study detailed local rainfall and hail patterns associated with spring and summer storms. Volunteers, including students from nearly 40 schools in northern Colorado, are helping gather rain and hail data. Maps are produced and displayed on a special student-developed website. This new project is a collaborative effort of scientists, educators, business, utilities and government entities with a shared interest in the impacts and educational opportunities associated with spring and summer storms. Current plans are to expand the project to other areas of Colorado in 1999 and 2000.

The Atmospheric Science Building, Foothills Campus, Colorado State University

The Internet has become a primary means of disseminating climate information and research results. A list of project publications, much of the historic climate data for Colorado, and other climate information are available online via the Colorado Climate Center website. http://ccc.atmos.colostate.edu.

In May 1999, Dr. Tom McKee will retire as State Climatologist after serving in that position for the entire 25-year history of the Center. Dr. Roger Pielke, Professor of Atmospheric Science who has strong background in mesoscale modeling and land surface climatology, will become the new State Climatologist. Nolan Doesken will continue as Assistant State Climatologist and Odie Bliss as Program Assistant. They have each been with the Climate Center for more than 20 years.

Right: Professor Tom McKee, Department of Atmospheric Science, Colorado State University

Colorado State University Cooperative Extension COOPERATIVE EXTENSION

DENVER COUNTY COOPERATIVE EXTENSION PROMOTES BEST MANAGEMENT PRACTICES FOR LAWN AND GARDEN

Abstracted from material by Carl Wilson, Denver County Extension Educator in Horticulture

People are rediscovering the natural landscape of the West and deepening their knowledge about this unique place. This discovery isn't about physical, geographical facts, but about a deeper resonance between people and surroundings. Coloradans can join in defining a unique, Colorado regional gardening style based on adapted plants and water-efficient practices.

Denver County Cooperative Extension has information available on Home gardening, Water conservation, Green industry education, Safe pesticide use, Connecting with and understanding plants and the environment, and Training and engaging community Master Gardeners.

How to Avoid Groundwater Pollution When You Fertilize -- People striving for a picture-perfect lawn who overdo the fertilization can pollute surface and groundwater. The foremost lawn fertilization tip involves the amount applied. Don't overload your lawn's system with more nitrogen than the turf can use at one time. A form of nitrogen called nitrate easily moves with rain and irrigation water to cause pollution when applied in excess. The standard rate to spread fertilizer given on product bags equals one pound per 1,000 square feet.

Annually, 2 to 4 pounds per 1,000 square feet is recommended for bluegrass lawns. This means 2 to 4 applications timed as follows: April, late May, late August, and early October. The fourth application is only necessary for people wanting to grow extremely high-quality turf requiring lots of mowing. Skipping the April application, however, is just one of the many advantages to what is now regarded as the most important lawn fertilization application time of the year - Fall. In fact, if you only fertilize once per year, fall is the time to do it. Fall fertilization results in early spring green up without the frequent mowing seen with spring lawn fertilization. Why not get the benefits of lawn fertilization without paying the price of taking on heavy mowing chores? Fertilize in the fall (early October)!

One caution if you grow grass on a sandy soil. Sands don't hold on to fertilizers like clays. Nitrogen fertilizer easily washes through sandy soils. Fertilize sands in small amounts (at the package rate) but fertilize frequently (four times per year). Consider using slowly available nitrogen fertilizers such as sulfur coated ureas, IBDU, and natural organic fertilizers such as poultry manure products (in warmer months). These fertilizers reduce the potential for water pollution and well contamination.

Soil preparation for successful gardening -- Take advantage of opportunities to amend soils with organic material, then carefully regulate the amount of water applied for best plant growth. By doing both, you will realize the greatest results from your gardening efforts. If you leave grass clippings on the lawn when you mow, you can apply less fertilizer than if you collected them.

Who Are Denver Master Gardeners? -- Master Gardeners are community people with an interest in learning more about growing plants through classes, community service and associating with others of similar interest. Master Gardeners help people make environmental connections through information and education. For more information about the Master Gardener program or to ask a plant question of our Master Gardeners call (303) 640-5278.

Denver County Cooperative Extension is a part of Colorado State University and the U.S. Department of Agriculture. For more information about Best Management Practices for your lawn and garden, contact the Denver Cooperative Extension Office, 110 16th St., Suite #300, Denver, CO 80202, Ph 303/640-5278 (f) 303/640-5289, e-mail: denver@coop.ext.colostate.edu.

COLORADO STATE FOREST SERVICE

THE FOREST SERVICE AT COLORADO STATE

by Ron Gosnell

The following article is condensed from information provided in and with exerpts from *Political Aspects of the History of the Forestry Function of Colorado*, by Donna R. Story, December 6, 1977.

Consider; there is a Colorado natural resource agency that has no land jurisdiction, no regulatory power, and is responsible for all *forests in the State. This agency is part of Colorado State University; it's the Colorado State Forest Service (CSFS).*

Forestry in Colorado goes all the way back to the Colorado State Constitutional Convention in 1875-76.

Colorado forests are some of the most spectacular, enjoyable and revered in the United States. Opportunities here for cooperative forestry are enhanced because of forestry's ties to education and a non-regulatory land grant institution. How the forestry function came to Colorado State University (CSU) — twice — is an interesting story.

Forestry in Colorado goes all the way back to the Colorado State Constitutional Convention in 1875-76. There, on the 3rd day of the convention, Frederick J. Ebert offered a resolution to add a committee on Forest Culture. This being accepted, Ebert was appointed its chairman. Ebert had been trained as a professional forester in Germany before immigrating to the Colorado Territory. He was a respected citizen who later served on the Denver School Board and was a Regent of Colorado University.

At the convention, Ebert won approval of two sections of Article XVIII: Section 6., For the preservation of forests, and Section 7., Exempting arborial planting from land value taxation. Thus, Colorado became the first state to draft into its constitution conservation policy language. Ebert seemed to figure little in subsequent forestry matters, although there was legislation passed for fire control, and in 1881 a tax law resulted from the forestry provisions in the Constitution.

The next recognized in a line of individuals serving as State Forester was Edgar T. Ensign, a wealthy Colorado Springs banker. Though not professionally trained as a forester, forestry was his passion. Ensign initiated an effective forestry information campaign. In 1884, this influential, politically connected man published a series of articles in the Colorado Springs Gazette, entitled *Forestry inColorado*. The information was echoed in several other newspapers, which helped inspire a convention in November of that year held at the State House in Denver. There, a citizen-activist Colorado State Forestry Association (CSFA) was formed, and included a professor of botany and horticulture at the State Agriculture College (now CSU) and the editors of the Denver *Rocky Mountain News* and *Greeley Tribune* on its board.

The CSFA charter arranged for numerous Vice Presidents, one from each county! Further, all VPs were appointed by the President of CSFA. Each Vice President's duties included calling county forestry conventions to carry out CSFA objectives. From inception, CSFA was purposeful and expected results. Of course, Edgar Ensign was the first CSFA President..

CSFA drafted a bill on forestry and developed a political strategy to get it passed. The Board of Managers also prepared a Memorial to the United States Congress for the transfer of all public lands to the State. The Colorado legislator passed only half of CSFA's proposal, enacting a forestry bill April 4, 1885. The law established the position of Forest Commissioner of Colorado; however, no supporting appropriation was approved.

Edgar Ensign was appointed Forest Commissioner, and served from 1885 to at least November of 1890 (the date of his last report). During Ensign's tenure, the national counterpart of CSFA, The American Forestry Council, held

its annual meeting in Denver at CSFA's invitation. Also, CSFA lobbied the U.S. Congress to: (1) repeal the so-called preemption acts which made it easy to get lands fraudulently, and (2) amend the Timber Culture Act and remove the lumber tariff in order to prevent gross export.

All the while, Colorado politics was helping shape national forestry policy...

During the 1880s, Ensign corresponded with the Secretary of the Interior, the Commissioner of the General Land Office (which became the Bureau of Land Management or BLM), John Wesley Powell of the US Geological Survey, Bernard Fernow of the Forestry Division (later the U. S. Forest Service), Gifford Pinchot, considered the father of American forestry, and numerous representatives of various state and national forestry organizations.

Ensign was very impressed with the work of Dr. F.P. Hough, the first Chief of the Forestry Division, and came to believe that this Agriculture Department agency should administer public domain forest-lands of the Interior Department's Land Office. Later, when National Forests were finally set aside, they did go to Agriculture for administration. It can be said that Colorado influenced greatly the political aspects of United States forest policy.

While CSFA and others strongly supported national forestry developments, it was against the wishes of another powerful Coloradan, US Senator Henry M. Teller, a champion of mining interests and Secretary of the Interior in 1882-85. An organizer of the Republican Party, Teller figured powerfully in state politics. Teller wanted expansion of the Free Timber Act to include all public lands instead of narrowly defined "mineral lands."

Finally, the efforts of Ensign and others wanting forest protection paid off. On March 3, 1891 the Organic Act created the USDA Forest Service to administer all National Forests. Ironically, the Organic Act was largely a product of the Senate Committee on Public Lands, on which Senator Teller sat. Hastily added by the conference committee for the bill, a last minute provision gave the United States President authority to set aside forest reserves. The conference committee version passed without debate and it was years before Teller realized the consequences.

All the while, Colorado politics was helping shape national forestry policy, and based upon the state forestry act of 1885, locally, county commissioners and road overseers cared for forests. Edgar Ensign obtained a measure of cooperation, though most county representatives had little formal conservation training. The Forest Commissioner's job was largely one of education, coordination, and communication with the counties.

Following Ensign's resignation as Commissioner in 1890 (he never received a paycheck), no one held the job until finally in 1897 the authority of that office was made part of the office of Commissioner of a new Department of Forestry, Fish and Game. However, the next real "mover and shaker" for forestry did not arrive until CSFA President WGM Stone, who presided from 1905 until his death in 1917. Stone was a preacher, businessman, and farmer — in that order. He kept meticulous records including letters, clippings, petitions and articles, many of which were discovered in the Old Economics building at CSU, and chronologically cataloged in 1975.

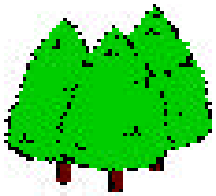
Stone accomplished three major forestry endeavors. He continued Ensign's press for a forestry school at the State Agriculture College (later CSU). He corresponded with Presidents Lory and Aylesworth, and spoke at forestry short courses. Finally, in 1909 the College offered its first four-year course in forestry. (Colorado College, a private school in Colorado Springs, offered the first four-year forestry course in Colorado in 1905.)

Second, Stone pushed for more forest reserves. In 1903, only 3 million acres of forest had been set aside, and CSFA began a campaign to have the rest of public domain forest (estimated at 13 million acres) put into forest reserves. The winning argument was for preservation of watersheds. Plentiful and high quality water was of extreme economic importance to a state dependent on irrigated agriculture.

The process of reserving a parcel of forest land took several years, because each parcel had to be surveyed. By 1914 public sentiment had begun to shift away from reserves, and CSFA's Stone again took to the press and reminded the

people of Colorado that the whole State had petitioned for the reservation of forests in 1900. Stone publicized the following list of petitioners as wholehearted supporters of forest reserves:

- The State Legislature;
- Denver City Council;
- Chambers of Commerce in Denver, Colorado Springs and Sterling;
- Seven daily Denver newspapers; 37 weekly and monthly newspapers;
- Denver Real Estate Exchange;
- Denver Gas Company;
- General William Palmer and a list of leading citizens;
- 26 corporations;
- State Boards of Agriculture and Horticulture;
- State Grange and 10 local granges;
- Longmont Farmers Association;
- State Teachers Association;
- All universities and colleges in the state; and
- Citizen petitions in 17 cities and towns.



Today, as a result of the forest reserve process, in Colorado alone the U. S. Forest Service administers over 14 million acres of National Forests.

Third, Stone pushed for new forestry legislation. The CSFA got both Republican and Democratic parties to support a plank for a new Colorado Department of Forestry in their party platforms in the fall of 1904. During the winter of 1906-07, petitions were circulated state wide for new forestry laws, the new Department, and a school of forestry at the state college. The Colorado Forestry Act of 1911 named the College's governing body, the State board of Agriculture, as the State's Board of Forestry. The Board had authority to appoint a State Forester, who was to be a professor of forestry at the college. This arrangement at the college lasted until 1933, the first time.

With the enactment and provision for development of a professionally trained forester cadre, citizen activism for forestry waned somewhat and was substituted by professional organizations' activities — the Society of American Foresters, 1900, and the National Association of State Foresters, 1920.

Duties of the State Forester between 1911 and 1933 were:

- to manage State Forest Reserves, if any;
- to collect and publish data relevant to forests and ti mber;
- to cooperate with the federal forestry function;
- to promulgate and publish rules for fire prevention;
- to study the best conditions for preserving and growing trees in Colorado;
- to give technical advice to the State Board of Land Commissioners, which was exclusively respon sible for state lands administration; and
- to act as a consulting forester for the people of the state.

Professor B.O. Longyear held the State Forester appointment from 1911 to 1915; W. J. Morrill from 1915 until 1933. Both men developed cooperative agreements with the U.S. Forest Service. In 1916 Morrill proposed the exchange of scattered state school land sections, inside National Forest boundaries, for federal lands. This was to form a single block of State Forest, thus making it easier and practical for both governments to administer their lands.

An enabling act was passed by the Colorado legislature in 1931, and the boundaries of the only Colorado State Forest were determined in 1936, encompassing 71,000 acres in Jackson County. Morrill began a seedling tree program in 1917, growing and making available to the public trees at cost for establishing windbreaks and shelterbelts. The state seedling and fire programs received a significant financial boost from the federal Clarke-McNary Act of 1924.

After 22 years of cooperative stability for the forestry function at the State College, a Great Depression-era state administrative reorganization act of 1933 ended it, temporarily. The act abolished the office of State Forester, the State Board of Forestry and 23 other state agencies. The State Board of Land Commissioners, in the Governor's Division of Conservation, was assigned forestry responsibilities of the state. In Denver, the Land Board

was content to have the seedling nursery, located at the Agriculture College, continue operation by the federally-funded Extension Forester at the College.

Professor R.E. Ford of the College's forestry department became the Extension Forester in 1937. Fortunately, he had been involved in many of the College's previous forestry endeavors prior to the reorganization act. He had helped establish the State Forest in Jackson County and arranged for the Civilian Conservation Corps to do much of the original facilities construction there. And he almost singlehandedly continued the seedling tree distribution program at a time when President Franklin Delano Roosevelt was trying to still the winds on the dusty plains with trees (the Great Shelterbelt Program).

Unofficially, the forestry function continued at the College, which during this period was called the Colorado College of Agriculture and Mechanical Arts. Years of tradition, national level contacts, the forestry curriculum, personal commitment, and the seedling program benefits could not be denied. Meanwhile, in Denver, the Land Board appointed E. J. Lee to the position of State Forest Supervisor. Lee lived at the State Forest Headquarters near Gould, at one point overseeing Colorado's largest lumbering camps and commercial timber harvesting on the State Forest.

In 1940, C.L.Terrell became assistant Extension Forester, and Ford had a valuble compatriot. In 1941 the State Board of Agriculture, in recognition of Ford's effort, appointed him "State Forester." About this time Lee went to work for the Land board in Denver. Ambitious, Lee convinced the Land Board to appoint him "State Forester." He also got the Land Board to negotiate with the U.S Forest Service for Lee to take over cooperative fire control operations and the seedling program. Thus in 1945, Colorado basically had two independent state forestry organizations.

Working out of the Denver office, Lee had no tree distribution facilities and asked Ford for help. Ford had kept the seedling program going at personal expense. After the old college facilities were eliminated through a combination of age, inadequacy, campus development and lack of College financing, Ford bought some suitable farm ground and had the CCC build a tree-growing facility. He was managing a "break-even" enterprise at the time of Lees's request. Ford and Lee disagreed, and the former classmates' friendship ended. In 1948, the Land Board saw the dilemma of Ford running an almost "personal facility," and asked the college to accept Ford's tree program and take responsibility for it, again. This the college did. Then, working together, Ford and Terrell put together a political plan to return the whole forestry function to the college.

By the early 1950's, Ford and Terell had an unexpected ally. By this time the Land Board had fired Lee, and grown weary of forestry affairs. Consumed by the matters of administering state school lands, the Land Board sought relief and lobbied for Ford and Terrell's bill when it appeared in the 1955 State Legislature. Ford and Terrell had conducted an effective grass-roots campaign, visiting every county in the state. H.B.10 passed easily in 1955, establishing the Colorado State Forest Service as a Division of Colorado A&M (which became Colorado State University in 1957). The Forestry function was with education a second time.

The State Board of Agriculture, acting once more as the state's Board of Forestry, appointed Russ Ford State Forester, again. When Ford retired in 1956, Chuck Terrell was appointed State Forester. Tom Borden, a South Dakota forester schooled in the values of education and cooperation, was recruited by Chuck and appointed State Forester in 1959. Upon Borden's retirement Jim Hubbard, a CSU forestry graduate and Borden's right-hand man, began his current State Forester appointment in 1984.

Today, the Colorado State Forest Service enjoys a long-standing institutional partnership with Colorado State University, the USDA Forest Service, and the Colorado Board of Land Commissioners. CSFS delivers forestry education and protection and management services to landowners, counties, cities and communities, and other agencies throughout the state, including the Denver-based State Department of Natural Resources. The CSFS self-funded nursery grows and distributes over 3 million seedlings every spring for conservation purposes, and its shop fabricates and manages 140 wildland fire engines which are assigned to counties and fire departments. There are 18 CSFS District offices plus the CSFS Headquarters at the Forestry Building on the CSU campus. CSFS employs 106 full-time dedicated employees and grows to a 160-person organization seasonally. CSFS is an organization that helps people enjoy the rewards from healthy forests that they care for, and water is one of the important benefits.

CWRRI

COLORADO WATER RESOURCES RESEARCH INSTITUTE

CWRRI ADVISORY BOARD SELECTS FY1999 WATER RESEARCH PROJECTS

Three water research projects were selected for funding by CWRRI's Advisory Committee on Water Research Policy (ACWRP) at its initial meeting on February 12th in Denver. Prior to the meeting, members were polled for their assessments of the highest-priority water problems in Colorado. The projects described below were chosen based on their responsiveness to the research needs expressed by the committee.

From right: ACWRP members David Robbins, Lee Sommers, Brad Young, Fred Anderson, Sara Duncan, Greg Parsons and John Porter

Description and Interpretation of Salinization In the Lower Arkansas River Valley, Colorado

In Colorado's lower Arkansas River Valley, saline high-water tables began to appear in the early part of the 20th century. Installation of subsurface drains in the l930s seemed to assuage the problems for awhile; however, water tables began to rise again in the late l970s. Investigators suggested the cause was increased diversions from the river for irrigation application and associated reduction in groundwater pumping. And indeed, in the l950s-'70s, two reservoirs began operations that have drastically changed the river. Flushing from floods was substantially reduced and controlled releases were made from the reservoirs. This allowed year-round, or at least prolonged, supplies of water to the canals on the perimeter of the valley. Seepage from these canals and lower velocity in the river have caused the river channel to widen, sediments to deposit on the bed, and the river level to rise. Also, since 1991 irrigation water supplies from snowpack and rainfall have been far above average, leading many in the area to divert more water; and with the Kansas-Colorado court ruling, groundwater pumping has diminished. There is growing evidence that the irrigated lands of the lower Arkansas are subjected to forces that are elevating the severity of waterlogging and salinization. This project will strengthen the data foundation needed to characterize salinization problems in the lower Arkansas River Valley. Principal investigators will consider soil salinity, water table depth and salinity; river level, flow and salinity; water levels, flows, and salinity in canals and drains; irrigation practices; hydraulic conductivity of surface soils; well pumping; and crop yields. The project results will include a digital spatially-referenced (ArcView™ GIS format) database. *The Principal Investigators are Timothy K. Gates and John W. Labadie, Department of Civil Engineering, Colorado State University; Co-Investigators are Grant E. Cardon, Department of Soil and Crop Sciences, Colorado State University, Israel Broner, Department of Chemical and Bioresource Engineering, Colorado State University, and James C. Valliant, Extension Irrigation Specialist, Cooperative Extension, Colorado State University.*

Distribution, Habitat and Life History of Brassy Minnow in Eastern Colorado

Results of a recent survey, compared with earlier surveys, show that ten native fish species are either rare or imperiled in the South Platte River Basin. A review also reported that almost nothing is known about the habitat and life history of most eastern Colorado plains fishes. The Colorado Division of Wildlife recently selected brassy minnow as the highest priority for study. This research project will:

♦Define the original distribution and current status of brassy minnow in the South Platte River Basin in Colorado, based on historical data and specimens and resampling of all sites where previously collected.

♦Assess effects of flow fluctuations and habitat modifications on brassy minnow populations by measuring dynamics of stream habitat, and its use by brassy minnow, in study reaches that contrast in flow regime (strong vs. moderate flow fluctuations), longitudinal position (foothills vs. plains streams), and channel form (natural stream channels vs. irrigation channels).

♦Relate basic life history characteristics of brassy minnow to flow and habitat to understand critical habitats needed for survival and reproduction.

The Principal Investigator is Kurt Fausch, Department of Fishery and Wildlife Biology, Colorado State University.

From left: Committee member Greg Parsons, Colorado Department of Public Health and Environment, and Committee Chair Brad Young, Chair of the House Committee on Agriculture, Livestock and Natural Resources.

Protocol for a State-wide Groundwater Quality Monitoring Program and Establishment of a Groundwater Quality Data Clearinghouse

The Department of Soil and Crop Science at Colorado recently pulled together existing groundwater quality data in the state as part of an effort by the Colorado Water Quality Control Commission (WQCC) to delineate aquifers meeting the "high quality" classification criteria. A key outcome of this project was the discovery of a significant lack of comprehensive groundwater quality data. Many aquifers in the state have not been sampled, at least not to the degree that would allow a scientifically defensible evaluation of their quality. Moreover, most of the databases lacked sufficient descriptive data necessary to fully compare the data to other sources, particularly sample location, sample depth, analytical methodology, and quality assurance/ quality control parameters on the data. This project's objectives are to:

♦Work with the Colorado Water Quality Control Commission to develop a protocol for a state-wide groundwater quality monitoring program.

♦Organize and execute an educational effort to put the protocol in the hands of all agencies working with ground water in the state.

♦Develop and deploy an Internet-based information source for all groundwater quality monitoring activities in the

The Principal Investigator is Grant Cardon, Department of Soil and Crop Science, Colorado State University; Co-investigators are Jessica Davis, Department of Soil and Crop Science, Jim Loftis, Department of Chemical and Bioresource Engineering, Colorado State University, and Jose Salas, Department of Civil Engineering, Colorado State University.

The Advisory Council on Water Research Policy, as provided for in CWRRI's by-laws, is comprised of: the Chair of the Senate Committee on Agriculture, Natural Resources and Energy, the Chair of the House Committee on Agriculture, Livestock and Natural Resources, the Director of the Department of Natural Resources, the Director of the Department of Public Health and Environment, the Commissioner of the Department of Agriculture; and six members of the general public "selected based on their participation in setting Colorado water policy in the legislative process and involvement in obtaining funding for such policy." The ACWRP's mandate is to address two functions: advising CWRRI regarding research to be undertaken as part of the federally supported, state-based water research program; and seeking state and local water research funding to provide the state match required. The state-based, federally supported research program, terminated three years ago, was restored in the FY1999 federal budget.

CWRRI CSM Water News

CALIBRATION AND UNCERTAINTY OF GROUND-WATER MODELS
May 10-13, 1999

COURSE DESCRIPTION — This course teaches how nonlinear regression and associated statistics can be used to dramatically improve how data is used to calibrate and test ground-water models. For example, parameters which can not be estimated accurately and uniquely with the available data and the likely utility of potential new data will be clearly and quickly identified. Parameter values that produce the best fit between simulated and observed hydraulic heads, concentrations, and soon, can be determined using nonlinear regression. Measures of prediction uncertainty are a natural consequence of regression methods. The computer code UCODE will be used to perform hands-on exercises; the computer code MODFLOWP will be described briefly. The course will run from 8:30 am to 5:30 pm each day, and will recess for lunch.

COURSE AUDIENCE — This course is designed for the hydrogeologist and environmental engineer familiar with groundwater flow modeling who would like to learn to use inversion to calibrate their models. Participants will benefit the most from this short course if they have a working knowledge of ground-water flow modeling and some knowledge of basic statistics.

COURSE MATERIALS — Attendees will receive course notes; UCODE and MODFLOWP software and associated USGS reports, including the UCODE manual; and data files for example problems.

INSTRUCTORS

Mary C. Hill is a research scientist with the U.S. Geological Survey in Boulder, Colorado. She is the author of MODFLOWP, the popular PCG2 solver for MODFLOW and MODFLOWP, articles on the numerical methods of solvers and nonlinear regression, confidence intervals, and calibration methodology, and is co-author of UCODE. She has conducted and consulted on numerous ground-water investigations involving numerical modeling nationally and internationally over the last 20 years.

Richard Cooley is a Research Hydrologist in the National Research Program of the U.S. Geological Survey. He is the author of some of the first publications on application of nonlinear regression methodology to calibration and uncertainty analysis of ground-water models. Although his primary fields of research have been numerical methods, calibration, and uncertainty analysis for ground-water models, he has published in a wide variety of topics in hydrogeology, ranging from variably saturated flow to geomorphology and recharge characteristics of desert alluvial fans.

Eileen Poeter is Director of the IGWMC and a Professor at Colorado School of Mines. She has been modeling in the academic and geohydrologic consulting arena for 23 years and teaching modeling both as semester and short courses for 16 years. Dr. Poeter is the first author of UCODE. Dr. Poeter authored over 75 articles and reports in the area of ground water with specialization in ground-water modeling, evaluation and simulation of heterogeneity, use of soft data such as geophysical data, and using inverse modeling as a tool to improve such endeavors.

Claire Tiedeman is a research scientist at the U.S. Geological Survey in Menlo park, California. She has applied parameter-estimation methods to the numerical simulation of complex ground-water flow systems characterized by fractured and porous media. She has taught parameter-estimation methods for three years, and is the co-developer of the exercises used in the course.

Fee: $1195 / $1395 after April 25 — Location: CSM, Golden, Colorado

For more information, contact:

Office of Special Programs and Continuing Education
phone: +1 303 273-3321, FAX: +1 303 273-3314, email: space@mines.edu,
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International Groundwater Modeling Center
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CWRRI CSM Water News

PROFESSOR TISSA ILLANGASEKARE ACCEPTS AMAX DISTINGUISHED CHAIR AT COLORADO SCHOOL OF MINES

Professor Tissa Illangasekare recently accepted a position at the Colorado School of Mines (CSM) as the AMAX Distinguished Chair and Professor of Environmental Sciences and Engineering and Professor of Civil Engineering. This position was created through an endowment provided to CSM by the AMAX corporation, with the expectation that the Chair will play a primary leadership role in building and refining CSM's environmental research and education emphasis within the broad natural resource exploration and production field. A distinguished chair is the highest honor that can be bestowed upon a faculty member.

Colorado School of Mines is one of the premier institutions of higher learning and research in mining and earth-related sciences and engineering in the world. Professor Illangasekare's department, Environmental Science and Engineering, has one of the largest graduate student enrollments at CSM. The department's unique faculty composition, which includes both environmental scientists and engineers, will allow him to participate and contribute to the unique multidisciplinary academic programs and research efforts that are currently underway.

Professor Illangasekare also plans to actively participate in the development of an environmental engineering specialty in the undergraduate engineering degree that is currently offered in the Division of Engineering at CSM. He plans to continue his modeling and experimental research on fate and transport of chemicals in the subsurface. Using the endowment funds and support from CSM, Professor Illangasekare plans to develop a new intermediate scale, 500-square foot laboratory that will provide a focal point for multidisciplinary research efforts. He plans to collaborate closely with faculty in other nationally and internationally recognized programs in engineering, geological engineering, petroleum and chemical engineering and geophysics. He will also continue his international collaborations with Cambridge University in England, Technical University of Denmark, Polytechnic University of Barcelona in Spain and the University of Kassel in Germany. Colorado School of Mines is also home to the International Groundwater Modeling Center (IGWMC). Professor Illangasekare plans to contribute to the efforts at this Center involving technology transfer.

Prior to joining CSM, Dr. Illangasekare was a Professor of Civil and Environmental Engineering at the University of Colorado (CU) at Boulder. He is also an Affiliate Faculty in the Department of Applied Mathematics at CU and in the Department of Civil Engineering at Colorado State. Prior to joining CU in 1986, he served on the faculties at Colorado State University (1978-1983), Louisiana State University (1983-1986) and the University of Ceylon (1971-1972).

He received a B.Sc. (honors) degree in Civil Engineering from the University of Ceylon in 1971 and a M.Eng. in Hydrology and Water Resources from the Asian Institute of Technology in 1974. In 1978, he received a Ph.D in Civil Engineering from CSU. His areas of expertise are numerical and physical modeling of flow and transport in porous and fractured media and intermediate scale testing. He is currently on the editorial board of Water Resources Research, J. of Contaminant Hydrology and J. of Hydrology. He is a registered professional engineer and a hydrologist. He also currently serves on the National Research Council's Committee on Subsurface Contamination.

CWRRI CU Water News

Conference on Water and Climate: First Announcement
Climate Variability and Water Resources in the Interior West
21-22 June — Boulder, Colorado

The NOAA's Climate Diagnostic Center and the University of Colorado's Cooperative Institute for Research in Environmental Sciences are sponsoring a conference on climate variability and water resources in the Interior West (Colorado and surrounding states). The conference is organized around an interdisciplinary group of 70 recognized authorities in the field of climate prediction, water resources, water management, and water policy for the Interior West. The purpose of the conference is to describe and analyze the current status of water science technology, management, and policy as they relate to the Interior West, and to project the main developments in these fields over the near future, especially as related to improved capability for prediction of climate variation. Contributions to the conference will be published as a printed volume in fall of 1999.

The conference will last 2 full days (21 and 22 June 1999) and will be held in Boulder at a location that will be given in the second announcement.

The conference will consist of two parts. Plenary presentations on the mornings of both days will allow the entire to hear a selection of the most widely recognized authorities describe and analyze subjects that bar upon the themes of conference. In the afternoons, each participant will attend one of four concurrent workshops that are designed to report to the main group a collective opinion from specialists about current developments and future prospects for the understanding of climate variability, water availability, and water management. The results of the workshops will be summarized in the published volume.

Topics for plenary presentations and workshops are as follows:

Plenary Presentations

1. Climate Variability: Patterns and Predictive Capability in the Interior West.
2. Water Management in the Interior West: Current Practice and Future Change.
3. Control of Hydrology by Climate Variability in the Interior West.
4. Social and Economic Changes in the Use and Distribution of Water in the Interior West.

Workshops

1. Can Climate Predictions be of Practical Use in Western Water Management?
2. How Can Useful Climate Data be Acquired, Managed, and Disseminated?
3. Has Modeling of Water Resources reached its Full Potential?
4. Social, Policy, and Institutional Issues: More of the Same, Radical Change, or Gradual Evolution.

There will be no registration fee for the conference, and lunches will be provided at no cost to the participants. Conference attendees will need to make their own arrangements for lodging, but the conference will arrange for a block of rooms to be available at one or more hotels in Boulder,

Members of the Conference Organizing Committee include William Lewis (CU-Boulder/CIRES), Roger Barry (CU-Boulder/CIRES), Henry Diaz (NOAA-CDC), Rene Reitsma (CU-Boulder), Charles Howe (CU- Boulder), Andrea Ray (NOAA-CDC), James Wescoat (CU-Boulder), and Connie Woodhouse (CU-Boulder.INSTAAR). Logistics for the conference are being handled by Diana Perfect of CU-Boulder/CIRES. Diana Perfect can be contacted by phone at 303/735-2377, by email at ***dianap@cires.colorado.edu, and by fax at 303/492-1149.***

WHY AND HOW TO COLLECT HIGH-QUALITY DATA ON PLAINS STREAM FISHES

by Kurt D. Fausch, Professor
Department of Fishery and Wildlife Biology, Colorado State University

and Kevin R. Bestgen, Director, Larval Fish Laboratory
Department of Fishery and Wildlife Biology, Colorado State University

Dr. Robert Ward invited us to write a short article on the importance of high quality data to our research on stream fishes. This is a timely issue, because we just received joint funding from CWRRI and the Colorado Division of Wildlife (CDOW) to conduct research on the life history and critical habitat requirements of the brassy minnow (Hybognathus hankinsoni), a species that has declined sufficiently to warrant listing by the State of Colorado as a threatened species. Over the last 20 years, we have worked to develop techniques and protocols for collecting high quality data on stream and river fishes under a variety of conditions in many different environments, and so were happy to have the opportunity to summarize our thinking here. We first address why it is critical that scientists who study stream fish collect-high quality data, and then describe how we go about that for a specific stream reach, in a series of seven main steps. We end by raising issues of sampling scale that are important considerations, but beyond our scope here.

Kurt Fausch, Department of Fishery & Wildlife Biology, Colorado State University

Why Collect High Quality Data?

Decisions on resource management, such as designating threatened and endangered species and allocating resources to conserve them, are based on scientific data. Often these are historical data, collected by other scientists many years before. For example, the current listing of six fishes in the South Platte basin on Colorado's eastern plains as threatened or endangered by the State of Colorado resulted from comparing a 1992-94 survey of 520 sites conducted by the CDOW (Nesler et al. 1997) with a 1978-80 survey of 177 sites conducted by David Propst for his Ph.D. dissertation research (Propst 1982; Propst and Carlson 1986), also funded by the CDOW. Fishes of the South Platte basin were relatively poorly known before Propst's sampling, which established a baseline of data to which future surveys could be compared. Earlier surveys had either sampled few sites, or were restricted only to certain subbasins, as detailed in Fausch and Bestgen (1997).

The Great Plains portion of the South Platte basin has some of the harshest aquatic habitats in the Mississippi River basin of central North America, and as a result supports fishes tolerant of environmental extremes. Thus, neither Propst nor CDOW managers had reason to suspect that fishes like brassy minnow, which evolved in a system with highly fluctuating flows, ranging from torrents of muddy snowmelt runoff to drying pools in late summer, would eventually decline throughout the basin. Nevertheless, CDOW managers reached this conclusion based on the decline in brassy minnow distribution from 22 of 177 sites (12%) sampled in 1978-80 (Propst 1982) to only 9 of 520 sites (<2%) in 1992-94 (Nesler et al. 1997), despite more than twice the sampling effort for the latter.

In such cases, it is obvious that if sampling in either period was inadequate, then a poor decision could result. For example, if later surveys detect a downward trend in distribution when in fact populations are stable, decision makers may opt for action when none is needed leading to time and money being wasted on further sampling and intensive management. Eventually, after considerable energy and funds are spent to overcome the inertia of inaccurate data, the end result is loss of credibility by scientists and management agencies. Given this, how does

one go about ensuring that data are of high quality to support decisions about the status of species?

How to Collect High-Quality Data

A common goal when sampling fishes in streams is to establish the presence or absence and relative abundance of species at a given location, or site. In few cases do we attempt to estimate absolute abundance of small fishes in plains streams, except when calibrating sampling (see below), because the depletion sampling needed to do so requires about one day per site, and often yields large numbers of small fishes that must be recorded and released (often 1,000-10,000 individuals ranging from 6-300 mm in length). Depending on the goal of the research, biologists are often as interested in establishing absence of certain rare species as in determining their presence or abundance. Following are seven main considerations for collecting high quality data at specific sites to support conclusions about species distribution and abundance.

…seven main considerations for collecting high quality data…:

- ***Appropriate gear and effort***
- ***Skill in sampling technique***
- ***Calibrate sampling methods***
- ***Record data carefully***
- ***Handle fishes with care***
- ***Preserve voucher specimens***
- ***Publish the data***

1. *Appropriate gear and effort* - Capturing mobile vertebrates like fishes requires appropriate sampling gear and sufficient technical assistance. Most streams in the South Platte basin are shallow enough to wade, so seines are the main gear of choice, supplemented by dip nets, various traps and trap nets, and electrofishing. Electrofishing gear must be specially designed for sampling plains streams due to very high conductivity (1000-2000 micromhos/cm) which renders many units ineffective. Mesh size of seines and nets is important because many fishes reproduce nearly year round, so young-of-year fishes <1 inch long are almost always present. We often use 4-mm-mesh seines and nets to maximize capture of age-1 and older fishes while minimizing drag that hampers catching larger fish. Crews of 2-10 persons are required to conduct sampling, depending on the size of the habitat and number of fish captured that must be identified and measured.

2. *Skill in sampling technique* - Like many methods used in science, capturing fish in streams requires a combination of technique and skill. For example, drastically different samples can result from seining upstream versus downstream, using long versus short seines, using seines of different mesh size, and sampling during day versus night. Because different fish species use different habitats (e.g., pools, riffles, runs, backwaters), and even microhabitats (e.g., above versus beneath rocks in riffles), all habitats must be sampled with gear and methods that are effective in order to accurately measure an entire fish assemblage or community. For example, bottom-dwelling fishes in riffles are best sampled by disturbing the stream bed upstream from a stationary seine, whereas mobile pool-dwelling fishes are best sampled using a short seine hauled rapidly downstream, or by electrofishing if the pool is too deep to wade. Some species such as catfishes are nocturnal, so establishing their presence/absence requires skillful sampling at night.

3. *Calibrate sampling methods* - Maximizing usefulness of data on stream fishes requires calibrating the method, like any scientific sampling technique. Because removal of all fish from a reach is virtually impossible by any non-destructive sampling method, investigators must usually calibrate their gear by estimating the proportion of all species and all individuals present that are sampled using a given protocol. For example, one might ask what proportion of species and individuals are captured by a standard sampling protocol consisting of 30 minutes seining through all habitats. This could be determined by blocking the ends of the section with fine-meshed nets and depleting the fishes present by seining it for four or more 30-minute periods. Fish captured in each seining pass are held in live baskets until all work is completed. Statistical estimators designed for such removal sampling methods are then used to estimate the total number of species and individuals from the pattern of depletion, from which we can then calculate the sampling efficiency of the standard protocol.

Additional seining at night, and sampling with other types of gear, can be used to determine presence and relative abundance of other species not captured by daytime seining. For example, we used methods similar to this at two sites on the Cache la Poudre River to estimate that a standard protocol of 45 minutes of electrofishing at 100-m sites captured all but the rarest species and more than half the individuals estimated to be at the sites (Fausch and Bestgen unpublished). Lohr and Fausch (1997) also calibrated sampling gear for use in the plains portion of the Purgatoire River, a tributary of the Arkansas River.

4. *Record data carefully* - It goes without saying that in any scientific endeavor, the accuracy of the conclusions rests on the care with which data are measured and recorded.

However, maintaining data quality can be difficult when your laboratory bench is a muddy bank under a hot sun, accompanied by biting insects, or a drenching thunderstorm with lightning! Appropriate gear and methods for measuring and recording data have been developed to help meet such logistic challenges. In addition, transfer of valuable data to electronic databases must be checked for accuracy, and the resulting media archived in two geographically separate locations to avoid loss from catastrophes, such as the 1997 flood.

5. *Handle fishes with care* - With declines in fishes in many basins, there is renewed concern for care of animals that are captured to ensure they are returned to the environment unharmed, or treated humanely when sacrificed for scientific research. Our protocol for all field research is reviewed and approved by the Colorado State University Animal Care and Use Committee of the Office of Regulatory Compliance before any grant funds are awarded. Scientists in our laboratories recently received approval by this committee of two formal Standard Operating Procedures (SOP), for sampling and handling stream fishes and for euthanasia of fish used in scientific research. These address appropriate sampling methods, anaesthesia to prevent fish injury, methods for holding fishes (e.g., aeration, live baskets in flowing water) and releasing them to prevent stress and mortality, and humane methods for euthanizing fish. For long-term studies where the same sites are sampled repeatedly, releasing fish in good condition is critical for answering ecological questions about how fish populations and communities change through time.

6. *Preserve voucher specimens* - Some fishes are difficult to identify in the field, and the names given to fish species are always changing, so it is imperative to retain properly labeled voucher specimens and catalog them in a permanent museum facility so that future scientists can determine the species and other characteristics of the fishes that were studied. Just as scientists and other scholars depend on libraries to store information critical to their work, so ecologists and taxonomists depend on specimen repositories to store representatives of the taxa studied by former investigators. The brassy minnow that we are about to study is an excellent case in point. Early investigators called all members of this group a different species, because the brassy minnow was not described and named until 1929 (Bailey 1954). Moreover, another superficially similar species, the plains minnow (H. placitus), is also present in the basin, although apparently much rarer than brassy minnow. Thus, the historical distribution in Colorado of both species is unknown. To solve this mystery, our research will include examining all specimens of this genus that were ever captured in Colorado, despite their being scattered among museums throughout the U.S. An important point is that voucher specimens preserved in contemporary collections will be just as important to future investigators as the specimens collected in the early 1900s are to us.

7. Publish the data - A final step to ensure that high quality data are available to foster progress in science and management is to publish them in a peer-reviewed outlet that is retrievable from most university libraries. Scientific journals are a traditional form of publication, which ensure that data and results are available to a worldwide audience. Peer review increases the quality of these publications by exposing work to critical, usually constructive, review. Despite various potential disadvantages of the peer-review system, it is still the best method of maintaining quality in science. Published work provides an important baseline from which to proceed in developing management plans and actions to recover declining species. For example, research reported by graduate students (including several unpublished theses), scientists, and professors from our department provides a useful baseline for stream fishes in the South Platte and Arkansas basins (e.g., Li 1968; Propst 1982; Miller 1984; Platania et al. 1986; Propst and Carlson 1986; Bestgen 1989; Schrader 1989; Platania 1990; Bestgen et al. 1991; Bramblett and Fausch 1991a, 1991b; Fausch and Bramblett 1991; Lohr and Fausch 1996, 1997; Fausch and Bestgen 1997; Smith and Fausch 1997; Strange et al. in press; Labbe and Fausch in review). Future efforts should also be directed at providing high-quality data via WWW sites, as Dr. Robert Ward has suggested for other types of water data.

Issues of Scale

Two more considerations for sampling to establish distribution and abundance of stream fishes are very important, but largely beyond the scope of this report. First, the optimal lengths of stream sections to sample to ensure that there is a high probability of capturing all species present in the longer reaches they represent depend on the size and complexity of habitat. Second, the spatial and temporal distribution of sampling must be considered very carefully, often with the advice of a qualified statistician. For example, surveys of geographic distribution of fishes done in different time periods must have a common geographic basis to make valid inferences about species status. Moreover, if species are patchily distributed, vary widely in abundance, or move among sites, the frequency or timing of sampling may be very important. Stream fish ecologists are currently grappling with many of these issues. Progress in science and management depends on high-quality data. Advances in theory and techniques in stream fish ecology have opened exciting new frontiers in this field, which are also beyond the scope of what we can address in this article. Scientists and students in our program will continue to strive to collect the best possible data to facilitate informed decisions about stream fishes by both managers and other scientists.

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RESEARCH AWARDS AT COLORADO UNIVERSITIES

A summary of water research awards and projects is given below for those who would like to contact investigators. Direct inquiries to investigator 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, CO 80523

Title	PI	Dept	Sponsor
Measurement of Hydrogeological Parameters for the Denver Basin Drilling Project	**Sanford, William E.**	**Earth Resources**	**Denver Museum Nat. Hist.**
Environmental Management Administration	Shaw, Robert B.	Forest Sciences	USFS-Rocky Mtn. Rsrch. Sta.
Assessment of Sediment Quality Criteria for Heavy Metals	Clements, William H.	Fish & Wildlife Biology	Wright State University
Crystalline Plyacrylamide Enhancement of Soil Water Retention & Growth of Row Crops	Cardon, Grant E.	Soil & Crop Sciences	McMahon Bioconsulting & Stockhausen Chem
Water Vapor in the Climate System	Stephens, Graeme L.	Atmospheric Science	NASA.
Storm Water Vault Model	**Abt, Steven R.**	**Civil Engineering**	
Snow Distribution & Runoff Forecasting, Kings River Basin, California	Elder, Kevin J.	Earth Resources	COE
Instrumentation for Disturbance Regimes of Hydrologically Extreme Regions	**Wohl, Ellen E.**	**Earth Resources**	**DOD**
Irrigation System Planning, Design & Rehabilitation	**Podmore, Terence H.**	**Civil Engineering**	**World Bank**
Effects of Heavy Metals in Sediments	**Clements, William H.**	**Fish & Wildlife**	**School of Mines**
Geomorphic Assessment of Lower Mississippi & Atchafalaya Rivers in Vicinity of Old River Complex	Watson, Chester C.	Civil Engineering	Louisiana Hydroelectric, Ltd.
Water Quality Control Division Riparian Classification	**Kittel, Gwen M.**	**Fish & Wildlife Biology**	**CDPHE**
Assessment of Sediment Quality Criteria for Heavy Metals	Julien, Pierre Y.	Civil Engineering	SW Research Inst.
Hydrocoverage for Colorado	**Laituri, Melinda J.**	**Earth Resources**	**CDWL**
NFWF--Riparian Classification of the Lower San Juan & North Platte Watersheds	**Kittel, Gwen M.**	**Fish & Wildlife Biology**	**BLM**
Fish Screen Efficiency Testing	**Bestgen, Kevin R.**	**Fish & Wildlife**	**Metro Wastewater Recl. Dist.**
Interdisciplinary Approaches to Identification & Mitigation of NPS Water Quality Impacts	Stednick, John D.	Earth Resources	Univ. of Wyoming
Platte River Hydraulic Model Study	Abt, Steven R.	Civil Engineering	Love & Assoc. Inc.
Ecological Effects of Reservoir Operations on Blue Mesa Reservoir	Johnson, Brett M.	Fish & Wildlife Biology	USBR
A Study of Boater Recreation at Lake Berryessa, California: Phase I	Wallace, George N.	Nat Res Recreation & Tourism	USBR
Yucca Mountain Infiltration Paper Review	**Julien, Pierre Y.**	**Civil Engineering**	**Sw Research Inst.**

UNIVERSITY OF COLORADO
BOULDER, CO 80309

Title	PI	Dept.	Sponsor
Predictability of the Coupling Ocean-Atmosphere System on Intraseasonal and Interannual Time Scales: Emphasis on Enso-Monsoon Relationships	**Webster, Peter**	**Atmospheric and Oceanic Sciences**	**NOAA**
Radarsat Data Access and Analysis Capabilities at the Navy/NOAA/Coast Guard National Ice Center	Fetterer, Florence	Coop. Inst. For Res. In Environ. Sci.	DON
Quantification of Humic Electron Transfer Reactions in Natural and Contaminated Marine Sediments	**McKnight, Diane**	**Inst. For Arctic and Alpine Research**	**DON**
Theoretical and Experimental Studies of Hydrological Properties of Rock Fractures During Active Deformation	Spetzler, Hartmut	Coop. Inst. For Res. In Environ. Sci.	DOE
Decision Support for Watershed and River System Management	**Zagona, Edith**	**Civil Engr.**	**DOI**
Upper Colorado Research, Development, and Support for Riverware	**Zagona, Edith**	**Civil Engr.**	**DOI**
Arctic Regional Sea-Ice Anomalies: A Diagnosis of Ice-Atmosphere Ocean Interactions and Linkages to Large-Scale Climate	Lynch, Amanda	Coop. Inst. For Res. In Environ. Sci.	GSFC
The Niwot Ridge Long Term Ecological Research Program 1998-2004: Controls on the Structure, Functions and Interactions of Alpine and Subalpine Ecosystems of the Colorado Front Range	**Bourgeron, Patrick**	**Inst. For Arctic and Alpine Research**	**NSF**
Treatability of Perchlorate-Containing Waters by Osmosis and Nanofiltration	**Amy, Gary**	**Civil Engr.**	**AWWA**
Effects of Sedimentation, Lithologic Change, Erosion, and Fluid Flow on the Shallow Marine Sediments of Woodlark Basin	Ge, Shemin	Geological Sciences	Texas A&M
Impact of Air-Sea Interaction on Tropical Cloud Life-Cycles and Radiative Processes	Webster, Peter	Atmospheric and Oceanic Sciences	DOE
Characterizing the Siple Coast Ice Stream Using Satellite Images, Improved Topography, and Integrated Aerogeophysical Measurements	**Scambos, Theodore**	**Coop. Inst. For Res. In Environ. Sci.**	**NASA**
Natural Organic Matter (NOM) Rejection by, and Fouling of, Nonfiltration and Ultrafiltration Membranes: Bench-Scale and Pilot-Scale Evaluations	Amy, Gary	Civil Engr.	AWWA
Sustainability of Arctic Communities: Interactions Between Global Change, Public Policies, and Ecological Processes	Walker, Marilyn	Inst. For Arctic and Alpine Research	Univ. of Alaska
Temperature Variability Since AD 1000 In the Western US from Tree Rings	**Woodhouse, Connie**	**Inst. For Arctic and Alpine Research**	**Univ. of Arizona**

*FEDERAL SPONSORS: BLM-Bureau of Land Management, COE-Corps of Engineers, DOA-Department of the Army, DOE-Department of Energy, DON-Department of the Navy, DOT-Department of Transportation, EPA-Environmental Protection Agency, 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, , USBR-US Bureau of Reclamation, USDA/ARS-Department of Agriculture, Agricultural Research Service, USDA/NRS-Department of Agriculture, Natural Resources Service, USFS-US Forest Service, USFWS-US Fish & Wildlife Service.

STATE SPONSORS: CDNR-Colorado Department of Natural Resources, NCWCD-Northern Colorado Water Conservancy District, CDWL-Colorado Division of Wildlife, CDA-Colorado Department of Agriculture, CDPHE-Colorado Department of Public Health and the Environment.

OTHER SPONSORS: CID-Consortium for International Development, AWWA-American Water Works Assn.

PUBLICATIONS

U.S. Geological Survey Publications

Contact the U.S. Geological Survey, Earth Science Information Center, Open-File, Reports Section, Box 25286, Mail Stop 517, Denver Federal Center, Denver, CO 80225 or call 303/236-7476 unless another source is provided.

Summary of Floods in the United States, January 1992 Through September 1993, by C.A. Perry and L.J. Combs. USGS Water Resources Investigations Report 98-4236. 1998.

Travel Times Along Clear Creek and Selected Tributaries Upstream From Golden, Colorado, 1996-97, by Sally M. Coffin. USGS Water-Resources Investigations Report 98-4151. 1998.

Migration and Geochemical Evolution of Ground Water Affected by Uranium-Mill Effluent Near Canon City, Colorado, by Daniel T. Chafin and Edward R. Banta. USGS Water-Resources Investigations Report 98-4228. 1998.

American Water Resources Association

AWRA has a new publication — Water Resources **IMPACT**. IMPACT, a bi-monthly news magazine, focused on practical solutions to today's water resource problems. It provides timely, state-of-the-art problem-solving articles about real life everyday situations in water resource management. Readers will receive thought-provoking information on matters that touch the many varied layers of individuals involved in the study, use, management and care of the world's water resources. For information contact: American Water Resources Association, 950 Herndon Parkway, Suite 300, Herndon, VA 20170-5531. Phone 703/904-1225; FAX 703/904-1228; e-mail awrahq@aol.com.

WATER SUPPLY

SWSI values in all basins show th estate to be in a near normal water supply situation. The South Platte basin SWSI value is slightly above normal, but has been for many years. The statewide snowpack accumulation of 85 percent of normal on March 1 is slightly below average. The Yampa/White basin has the highest snowpack, 92 percent of normal, and the San Juan Delores basin has the lowest snowpack, 74 percent of normal. Streamflows are running at typical rates. Reservoir storage is doing well, with an end of February statewide value of approximately 118% of normal. The surface Water Supply Index (SWSI) developed by this 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 snowpack , reservoir storage, and precipitation for the winter period (November through April). During the winter period snowpack 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 March 1, 1999, and reflect conditions during the month of February.

Basin	3/1/1999 SWSI Value	Change from the Previous Month	Change from the Previous Year
South Platte	1.7	+0.1	-0.4
Arkansas	0.2	-0.4	+1.0
Rio Grande	0.5	-0.4	+1.3
Gunnison	-0.2	-0.5	+0.6
Colorado	0.0	-0.2	+0.3
Yampa/White	-0.1	+1.6	+2.1
San Juan/Dolores	0.0	-0.4	+1.5

SCALE

-4	-3	-2	-1	0	+1	+2	+3	+4
Severe Drought		Moderate Drought		Near Normal Supply		Above Normal Supply		Abundant Supply

Where in Colorado are you, if the Water Quality is …..?

by John Carillo

The quality of water in Colorado varies as you move about the state. The quality is measured by many organizations including the U.S. Geological Survey. Below are six locations identified with a number and several measurements of water quality made at each location, during the month of September. Using your knowledge of flows and quality, match the water quality to the location. (Answers are given on page 28).

Locations, throughout Colorado, where water quality data was taken.

1) Cache La Poudre River at Livermore, Colorado
2) Muddy Creek near Kremling, Colorado
3) Colorado River near Dotsero, Colorado
4) East River near Crested Butte, Colorado
5) Gunnison River northeast of Montrose, Colorado
6) Colorado River near Colorado-Utah state line

Water quality data that was taken.

Location	Discharge cubic ft./s	PH	Temperature degrees C	Oxygen dissolved mg/L	Chloride dissolved mg/L	Total Dis. Solids mg/L	Nitrogen Dissolved mg/L
A	1330	8.3	17.0	9.2	28	291	0.09
B	3960	8.4	18.5	7.9	80	852	1.00
C	12	8.5	9.0	11.5	7.1	118	0.08
D	5.3	8.4	16.0	7.6	1.8	300	<0.05
E	741	8.1	12.0	8.8	0.8	105	0.08
F	96	8.4	13.5	7.6	1.0	180	0.08

Scientists Relating Frequency of El Nino to Nile Flooding

Scientists trying to unravel the mysteries of El Nino are studying floods on the Nile, using information collected by instruments introduced in the days of the Pharaohs. The annual Nile floods were vital to Egyptian agriculture, so the ancient pharaohs introduced the nilometer, a device to measure the height of the river flood. Now researchers at the Massachusetts Institute of Technology are finding those records useful in estimating the frequency of the El Nino climate phenomenon in the past. Researchers have looked at Nile flood records dating back to A.D. 650 — long after the pharaohs but still recorded using the nilometer system — to develop an estimate of past El Ninos.

El Nino, an unusual warming of the water in the eastern tropical Pacific Ocean, can have worldwide impacts on weather. Sea surface temperature records go back only to the late 1800s, so climate researchers have looked for other ways to determine when past El Ninos might have occurred. When an El Nino is underway, rain is reduced over the sources of the Nile. Studies have found that about 30 percent of the change in water flow on the Nile at Aswan can be attributed to El Nino. The study shows frequent El Ninos between about 750 and 1000 with a reduction after that, and then an increase again in the latter years of this century. It did not speculate on the reason for the correlation between the two periods.

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Washington (AP) U.S. Water News March, 1999

MEETING BRIEFS

PREPARING FOR THE 21ST CENTURY: COLORADO WATER CONGRESS ANNUAL MEETING

Preparing for the 21st Century was the emphasis of the 41st Annual CWC Convention held in Northglenn, Colorado January 27-29.

The keynote speaker for the opening General Session was Patricia Mulroy, General Manager, Las Vegas Valley Water District and Southern Nevada Water Authority, who gave an impassioned plea for Colorado's support of her state's position in lower basin negotiations. Southern Nevada now has a water supply plan that will meet projected growth through 2025, and the region is building a $2 billion water intake from Lake Mead, paid for by a local sales tax.

From left: Jason Ward, Chemical & Bioresource Engineering student, Norman A. Evans, former CWRRI Director, and Bill Brown, Attorney,

Nevada has also made a deal with the State of Arizona to bank its excess Colorado River supply in groundwater reservoirs in Arizona. The Arizona Legislature has approved the deal, but the U.S. Department of the Interior is stalling on regulations that would assure Nevada's right to retrieve the water in the future. Mulroy believes the reason may be that California is seeking approval for a new operation of the Colorado River system that would allow it a 16-year surplus water supply from Lake Mead. Tied to the new operation is a promise that California would reduce its water use down to 4.4 million acre-feet a year.

From left: Norman A. Evans, former CWRRI Director, and James Ruff, Department of Civil Engineering, Colorado State University

Also speaking in the first session were Beverly Ausfahl, President of the Colorado Education Association, the Honorable Ken Salazar, newly elected Attorney General, State of Colorado, and Greg Walcher, Governor Owens' appointee for Executive Director of the Colorado Department of Natural Resources. Salazar, former Executive Director of the Colorado Department of Natural Resources, demonstrated his familiarity with the problems facing Colorado water users and managers. Walcher has served as president and executive director of Club 20, a Western Slope organization, since 1989.

"The Generations Look at the 21st Century," General Session 2, brought together panelists including student representatives from Colorado State University; Colorado Representative

Dorothy Gotlieb; Jim Thomas, former State Senator; and Norman Evans, former CWRRI Director; who described water issues from the perspectives of their particular generations. Professor Evan Vlachos of Colorado State University summarized the panel's comments and offered observations on the future.

The CWC Education Committee met at the Annual Convention and reviewed new initiatives for CWC to consider, which included the following:

♦Renewing of the Legislative Luncheon Series, sponsored by CWC.

♦Developing a CWC web page. Committee members Matt Cook, Water Consult (Loveland), and Jasper Welch, Four Corners Management Systems, will head up this effort and have a draft website ready for the CWC summer meeting in Steamboat Springs.

♦Offering a program of annual water leadership classes, proposed as a series of six meetings scheduled every other month at different locations around the state. The meetings would last one day. Jasper Welch, Brian Werner, Northern Colorado Water Conservancy District, and Ralph Curtis, Rio Grande Water Conservation District, will develop a format for the classes.

Floyd E. Dominy, Retired Commissioner of the U.S. Bureau of Reclamation, provided an enlightening and entertaining perspective of his years with the Federal Government. Recipient of the Wayne N. Aspinall Water Leader of the Year award, presented at the luncheon, was Dick MacRavey, Executive Director of the Colorado Water Congress.

WEB PATHS

Description	Website
"**Stream Corridor Restoration: Principles, Processes, and Practices**." Prepared by a team of experts from 15 federal agencies and the private sector. Focuses on stream restoration as a means to restore and protect water quality, aquatic habitats, and similar environmental benefits.	**http://www2.hqnet.usda.gov/stream_restoration**
The Local Government Assistance Network (LGEAN), a new USEPA-funded effort, is designed to provide local governments with information on environmental management, planning, and regulatory compliance. An important feature of LGEAN allows local officials to get answers to specific questions on environmental issues. They can be sent through the web site, a given phone or FAX number. Partner organizations help answer the questions. The Water Environment Federation will provide expertise on wastewater and stormwater management.	**http://www.lgean.org**
Check the Colordo Water Workshop website in late April for information about the 1999 meeting. Download the 1999 registration form from the website at that time -- or ask to be added to the mailing list.	**http://www.waterinfo.org/workshop/html**

Answers -- Where in Colorqdo are you, if the Water Quality is ... ? (Page 26) ***1,C; 2,D; 3,A; 4,F; 5,E; 6,B***

WATER NEWS DIGEST

by Jamie Miller, Dave Bartecchi and Banning Starr

AGRICULTURE

Farmers facing water worries

Farmers are entering a time when water is scarce, populations are increasing at an alarming pace, and government legislation is forcing many out of business. The time is critical for Northern Front Range farmers to store water, start saving precious farmland from development, and start fighting bureaucracy. At least, those were a few of the solutions discussed by agriculture leaders who met in Greeley to discuss strategies for agriculture in the year 2000. Richard Hergert of Hergert Nutritional Services warned that water shortages are on the horizon if something is not done soon to protect the resource. The bad news for farmers is that they have to compete with urban areas for water, but the good news is that their property values have increased, making it profitable to sell out. Hergert emphasized that farmers are not getting support from the government. New legislation, constantly being introduced by opponents of one thing or another in agriculture, could mean thousands of dollars of changes in farming operations that are barely surviving today.

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Longmont Daily Times 1/28/99

DAM SAFETY/MAINTENANCE

Officials question process for dam upgrade; alternatives sought

Local and Congressional officials are questioning the U.S. Army Corps of Engineers plan to upgrade Cherry Creek Dam. The Corps in 1995 declared Cherry Creek Dam deficient. A National Weather Service report determined a "probable maximum flood" amount for the Cherry Creek Basin, and the Corps found that the dam now can hold only 75 percent of that maximum flood. The probable maximum flood would be caused by 29 inches of rain falling over the 380-square-mile basin in 72 hours. But many have challenged the amount, saying it's several times higher than any flood the area has ever seen. The method for calculating a probable maximum flood was determined in the mid-1980s by the Corps, the Weather Service, the Bureau of Reclamation and the Soil Conservation Service. It is an estimate of the largest flood a drainage basin might produce, based on an estimated maximum rainfall, and is used throughout the United States. If water ever did top the dam, it is expected that the dam would crumble within a few hours sending water toward Denver at 1.7 million cubic feet per second and potentially killing 10,000 people. The Corps mainly is studying three fixes for the dam so it could handle the probable maximum flood: raise it by 15 feet; raise it by nine feet and add a second spillway; or raise it by seven feet and add a dry dam upstream. Douglas County Commissioner Jim Sullivan has suggested a rebuild of the old Castlewood Dam, which Corps officials said is an option. The Corps will look at new alternatives for the project after a series of public meetings. A definite plan should be chosen by late September when the corps expects to complete an environmental impact statement for the alternatives.

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Douglas County News Press 2/16/99, *Longmont Daily* 3/15/99

Pueblo dam work may not be ready for winter water storage program

The quality of repairs at the Pueblo dam is good. New diversion tunnels are on track. But work to stabilize the concrete midsection of the dam probably won't be finished in time to save this year's winter water storage program. If the work has not progressed far enough by May 15, water held since last fall must be released to make way for potential spring floods. The contractor thinks the work can be completed by the appointed date. But the Bureau of Reclamation's engineers say the work could take until mid-June. The district last month asked for a firm decision by the bureau on the winter storage program by March 15, but agreed to extend the date in case rock bolts are installed on time. The district also discussed costs of the dam repairs. So far, only about half of the $7.7 million spent on the project has been paid to contractors, with the rest to the bureau. Much of the funding has gone to design and engineering, however, so the bureau's share of costs should decrease. The total cost of the project is estimated at $25.7 million.

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Pueblo Chieftain 3/19/99

INSTREAM FLOWS

Future of the Flow: Park Service Plan for Black Canyon worries some

Dams built in the mid-1960s have restricted midsummer flows through the Black Canyon. Previous floods had helped oxygenate streambed gravel which is essential to aquatic life. The low water created sandbars, allowing vegetation to take root, ultimately changing the canyon's look. Now, the National Park Service, concerned about the river's health, wants to partially reverse course and increase releases from the dams to restore some of the Gunnison's natural power. Park Service officials say they have proof the

proposal will be successful. Since 1991, the park service and Bureau of Reclamation have simulated natural peak flows by releasing high water from the dams every summer. The process has proven effective. Downstream water users, government agencies, and landowners fear high water releases from Aspinall Unit dams would return widespread flooding to riverside communities miles downstream. The Park Service is unsure when the proposal will become reality. Beset by water rights litigation and negotiating a formal plan with other interests on the Gunnison River, the Park Service could be in for a long wait.

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Daily Sentinel 3/21/99

Diversion may leave farms and Ute water customers dry

A federal plan to divert water from the Government Highline Canal for endangered fish survival in the Colorado River will leave some Grand Valley farmers' crops high and dry in the late summer. Those farmers have relied on water spilled out of the canal and into six washes between Grand Junction and the Utah state line as a supplemental source for their crops. 60,000 Grand Valley water customers also rely on the Colorado River intake when the district's Plateau Creek piping is out of service. This backup line will be used for most of the next three years while the Ute Water Conservancy District rebuilds and expands its Plateau Creek Pipeline. The pumping station above the dam also serves as an emergency backup for the city of Grand Junction and the Clifton Water District. The new plan would greatly affect these districts. The project will allow the canal operator, the Grand Valley Water Users Association, to bar 28,000 acre-feet annually from the 55-mile-long canal during August, September, and October. The water will be kept in the river to ensure endangered fish between Palisade and Grand Junction have enough water to survive. Farmers affected by this plan are now considering two options: buy water from an upstream reservoir; or petition to reclassify their property to be eligible for canal water. The Ute Water concerns are being weighed as the US Bureau of Reclamation plans what to do with the dam. The USBR would like to begin construction on the check dams this fall. The agency is awaiting a final ruling on the fish recovery program for the entire Colorado River basin, which may come in the next two months.

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Daily Sentinel 2/21/99, 3/02/99

SYSTEMS OPERATION AND MAINTENANCE

Yellowstone plumbing needs repairs

It will cost up to $7.5 million to repair sewage treatment systems here that spilled hundreds of thousands of gallons last year, according to a National Park Service report. In June, power failures at a pump station near Lake Lodge sent 177,000 gallons of sewage into an unused septic tank and then into Yellowstone Lake. In September and October, grease clogs in sewer lines caused nearly 50,000 gallons of sewage to overflow into the Firehole River and one of its tributaries near Old Faithful. The report lists repairing the system at Old Faithful among the Park Service's top 10 priorities nationwide. The park has water and sewage treatment systems in 23 areas. While most of the facilities work, they get no preventative or regular maintenance, according to the report.

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Rocky Mountain News 3/08/99

Dirty way to mark a clean start

The Ute Water Conservancy District broke ground at Cameo to mark the start of construction of the 48-inch line that will replace the 30-year-old, 24-inch line that brings water 14 ½ miles from the Jerry Creek reservoir to Ute Water's treatment plant. The district is pumping and treating Colorado River water while the pipeline is shut down for construction. This section of pipe should be replaced by mid-April and Ute will switch back to mountain water. Ute Water started the pipeline at Cameo because the section of pipe ruptured four times in the past year. Ute Water serves more than 60,000 people in a 240 square-mile area.

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Daily Sentinel 2/17/99

WATER CONSERVATION

Awash in water problems

Castle Rock's water delivery system hasn't kept up with growth in this community, so the Town Council will consider emergency conservation measures this summer. The council will vote on an ordinance that will ban laying sod from April 1 to Aug. 31, limit residential watering to early morning or late evening every third day, and step up monitoring of businesses that over-irrigate landscaping. The town would also provide untreated water, rather than drinking water, for builders to use in construction. Officials in the neighboring towns of Highlands Ranch and Parker as well as Denver said they do not anticipate water restrictions this year. The water system in Castle Rock was never designed to accommodate residents' watering more than once every three days, and that restriction has been enforced since last year. After a warning for the first offense, unauthorized watering costs $25 on the second offense. By the

fifth offense, it increases to $100 and the water can be shut off. Those fines would not increase under the new ordinance, but residents are angry over the promised tighter restrictions on hours and more stringent enforcement. Although town officials say they have done a good job securing water rights for newer homes, residents are angry that the infrastructure did not keep up. Castle Rock has four water projects in the works, but they have faced delays. A key well in the center of the town was delayed 60 days by fears that it would disrupt a habitat for the threatened Preble's jumping mouse. The issue has been resolved and the well could be completed by late summer. The town is planning a $2 million expansion of its water treatment plant so it can use two more wells by the end of the year. Meanwhile, a 4 million-gallon storage tank is being built in Plum Creek and should be complete next year.

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Rocky Mountain News 3/19/99

WATER QUALITY

Four Corners students help monitor waterways

Area students are getting a chance to get their feet wet monitoring water quality in Four Corners streams. The information they gather – which must meet the stringent standards of the U.S. Environmental Protection Agency – is used by the state water commission to settle water disputes among cities, environmentalists, farmers, ranchers and even mining companies in the middle of a cleanup. The program lets students perform highly specialized tests for real-world applications, and the state gets crucial data that it otherwise might not have to help settle water disputes. The program is called River Watch. Its founder, Barb Horn is an aquatic biologist who works in Durango at the Division of Wildlife. She started the program in 1990 because of budget cutbacks to such state agencies as the Department of Health, which caused a lack of water quality monitoring. Horn said that before River Watch, disputes were being settled by as little as one sample. Now, thanks to local students, sampling is done on a regular basis throughout the year by approximately 260 schools statewide.

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Pueblo Chieftain 3/04/99

County to use mag chloride for dust control

Magnesium chloride will still make its appearance this summer on dusty roads in Garfield County, despite unconfirmed fears that the substance could damage the environment, especially the watershed. The commission, with very little discussion, voted unanimously to continue mixing magnesium chloride with water to control dust on dry county roads. After the meeting, Commissioner Walt Stowe said the current benefits of dust control outweigh the known consequences. Stowe also said keeping dust particles on the road protects the road from wear and tear. The Colorado Department of Transportation has used magnesium chloride on Colorado highways for three years as a de-icing agent. Recently, officials in Basalt and Aspen have questioned the adverse effects of the naturally-occurring compound.

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The Glenwood Post 3/02/99

Turkey Creek Basin Growth Prompts Water Worries

As more people rush to live in the mountainous Turkey Creek Basin, will the Water run out? In March, scientists and volunteers ended a second round of collecting water samples as part of a three-year study in the area. The Jefferson County Mountain Ground Water Resource Study area encompasses about 47 square miles ranging in elevations from 6,000 to 10,000 feet along the US 285 corridor, including the towns of Conifer, Aspen Park and Indian Hills. After analyzing the first set of samples, taken in September, findings indicate water quality and quantity throughout the basin is generally good, although high nitrate levels, as well as uranium were found in wells in the Indian Hills area and in other isolated areas. Officials aren't overly concerned about the findings and no action is planned b the EPA. However, an environmental engineer with the U.S. Geologic Survey and project chief of the water study said residents in the basin should be aware that more people and more houses could cause the nitrate presence to spread. The issue should be addressed as far as growth is concerned.

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Denver Post 3/4/99

WATER SUPPLY/DEVELOPMENT

County recommends denial of Jackson Creek water-supply plan

Douglas County's water consultant has recommended denial of the latest water-supply plan for the proposed Jackson Creek Ranch golf resort because the plan lacks enough information to determine whether it could sustain the resort's water demands. A development application for the 1,300-acre Jackson Creek Ranch was submitted in late 1997. The plan includes two championship golf courses, 50 houses, 325 vacation cabins, a 160-unit lodge and other facilities. The water-supply plan, submitted to the county Jan. 5, calls for use

of two Denver Basin aquifers — the Arapahoe and Laramie-Fox Hills — to supply water to the resort. Surface water from Jackson Creek and potentially West Plum Creek would provide supplemental water supplies. The two aquifers initially would support the domestic demand and some of the golf-course irrigation. Surface water from the two creeks would supply the balance of the golf-course irrigation and potentially could be stored to support the entire development if the two aquifers failed to meet demand, the plan states.

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Douglas County News Press 2/24/99

Water bill dropped

Rep. Al Gagliardi warned that an innocent-sounding water redevelopment planning bill in the Colorado House poses a threat to the San Luis Valley. By pushing for a statewide plan to meet future water needs, the bill allows for a finding that would state that the Front Range needs the water for growth more than the farmers in the San Luis Valley need the water for crops. Gagliardi raised doubts about the bill's mitigation to protect a basin from which water is diverted. In this bill groups only have to consult with the local planning groups, not get their approval. Gagliardi is hesitant to let someone other than the local planning groups decide if water use in a basin has been impaired because of exportation of water. Gagliardi also questioned the bill allowing construction of pipelines and other facilities to export water after an "analysis of reasonable alternatives." The bill's sponsor, Rep. Matt Smith, R-Grand Junction, said he will drop the idea, HB1050, for this year because of a request from the Rio Grande Basin. Smith added that he probably will try for a water assessment and development bill again next year.

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The Pueblo Chieftain 3/19/99

Rural water system getting calls

Vallecito Water Co. officials say they are starting to get a steady flow of calls from people interested in reserving water taps from the proposed rural water system. The water company is in the midst of a drive to sign up 350 people near Grandview and Oxford, the first areas to be served by the system. Vallecito officials need to sign up that number in those areas to receive a $5 million U.S. Department of Agriculture loan that was committed for the project. The $17 million project, proposed by the Pine River Irrigation District through the Vallecito Water Co. it formed, would annually take 2,000 acre-feet of agricultural water from Vallecito Reservoir, pipe it to a treatment plant in Bayfield, and make it available for household and commercial use. The cost to reserve a tap is a $100 nonrefundable deposit. The remaining cost of the tap will be due about 90 days prior to construction, expected sometime next year. The cost of a tap is $3,500, but will increase to $4,500 on March 1.

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The Durango Herald 1/21/99

Vallecito Reservoir transfer closer

Lakeside residents and businesses and downstream farmers seem to have partially resolved some sticking points regarding the proposed transfer of the Vallecito Reservoir from federal ownership to the Pine River Irrigation District. The two sides edged closer to agreeing on how conservation easements might be crafted to prevent despoiling of lands around the lake while ensuring that the irrigation district would have the latitude it needed to run water-delivery and other operations. The easement could be held by the La Plata County Open Space Conservancy. Protests against the title transfer this year succeeded in stalling Congressional legislation required to effect the change. US Senators Wayne Allard and Rep. Scott McInnis have agreed to sponsor a bill once local disputes are settled.

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Denver Post 4/2/99

San Luis Valley ditch companies, water users, urged to cooperate

At the 16th Annual Southern Rocky Mountain Potato, Grain Conference in February, respected water engineer Alan Davey gave a warning to San Luis Valley farmers. Davey foresees a water shortage if farmers don't work together to put as much water back into the aquifer as they pump out. Davey said he would like to see the dozens of ditch companies and hundreds of water users cooperate to head off this potential problem. Since 1975, Davey has measured the aquifer's monthly rise and fall in 27 monitoring wells, especially in the Closed Basin area. The aquifer showed "significant declines during the 1970s from farm sprinkler system pumping, he said, but in the 1980s, after water users began to seriously recharge the system, it stabilized. Davey's latest measurements, taken in December 1998, showed an overall decrease of about 200,000 acre-feet from 1997. Ray Wright, president of the Rio Grande Water Conservation District, reported on a "Rio Grande Restoration Project" plan among water users, environmentalists, and state and federal agencies. The project's goals are to deliver Rio Grande Compact water to New Mexico and Texas, ensure that ditches get enough water, restore riparian areas and address wildlife and recreation issues. A $200,000 state allocation to continue the project is under discussion in the Legislature, Wright said.

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Denver Post 1/13/99

Official: California not out to steal Colorado water

California is not out to steal water from Colorado, the director of the largest municipal water user in Southern California, Jay Malinowski, told Club 20. He continued to say that Coloradans must join with the rest of the West in looking at the future use of water. Malinowski's district serves 16 million customers with five water plants, the largest of which produces 950 million gallons of water a day. He encouraged the Western states to unify because in the not too distant future water may become a free market enterprise and go the route of communications and the power industry.

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Daily Sentinel 3/07/99

WETLANDS

Wetlands bank in the works

Colorado's first wetlands bank— a method of preserving marshy habitats — could soon be on the way to Erie. The plan would provide a place for developers to compensate for building on existing wetlands in other areas. When construction of some kind is planned over a wetland area, the developers are required to try to soften the impact on the habitat as best they can, but are not penalized if a study yields no options. With the wetlands bank in place, a review panel headed by the Corps of Engineers, along with the Environmental Protection Agency and the U.S. Fish and Wildlife Service, could require the developers to purchase credits in the wetlands bank before progressing with their project. The wetlands consist of a series of dikes and terraces that send water from the ditch on the south side of the site to moisten the soil and raise the water table. A variety of native wetland plants would then be brought in. The town of Erie is also watching the project with designs of using the natural downward slope of the land to "bio-cleanse" excess nitrogen and phosphates from water it gets from Boulder Creek.

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Boulder Daily Camera 3/11/99

WHIRLING DISEASE

Biologists say Windy Gap is one of the state's worst hot spots for Whirling Disease. The 445 acre-foot reservoir is shallow, warm in the summer and filled with lots of mud — an ideal environment for the tiny tubifex worm that carries whirling disease. Though Colorado River water flowing into Windy Gap is relatively free of whirling disease spores, the water leaving the reservoir is loaded. Whirling disease spores are difficult to kill, biologists say, and individual spores can remain potent for up to 30 years. The Colorado Division of Wildlife is asking the Northern Colorado Water Conservancy District (NCWCD) to consider building a $1.5 million dam-within a dam at Windy Gap. Biologists say the new dam could change the reservoir's status as a major incubator of whirling disease. Building a 2,400-foot berm through the middle of the reservoir would isolate whirling disease spores in a settling basin inside Windy Gap and prevent them from flowing downstream. State officials met last week with the NCWCD, owner of the reservoir, to promote the plan. NCWCD officials say worries surfaced during their first review of the proposed dam. First, the 2,400-foot berm would take up a lot of space inside the reservoir, and could prevent the district from using its full legal water right. The new dam also could clog part of the reservoir with tons of sediment, which would have to be removed in expensive dredging operations.

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Denver Post 3/15/99

MISCELLANEOUS

Workshop to explain realignment of river

A landowner is proposing to alter the course of a one-mile stretch of the Yampa River in west Steamboat Springs to reduce erosion. But the net effect would be to move the river so it borders Wolf Run Ranch. Neighbors say moving the river would be a detriment to them. The erosion cure recommended by a Park City, Utah, hydrologist also would impact several homeowners in the Riverside subdivision who would no longer be able to enjoy the benefits of having the river run just outside their property boundaries. For reasons that remain unknown to scientists and politicians at this point, the Yampa abandoned its "original course" at two places along this length and was "captured" by new riverbeds. In that process, the grade of the stream increased, and its course was shortened through the loss of several meanders. Both of those factors increased the speed of the river, leading to erosion problems. Negative impacts on the river include cessation of natural cottonwood regeneration and an increase in sediment. The Army Corps of Engineers says the steep grade of the river has the sequence of riffles and pools of a healthy river for one long riffle which doesn't support riparian vegetation and does not support fish habitat.

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Streamboat Pilot 3/08/99

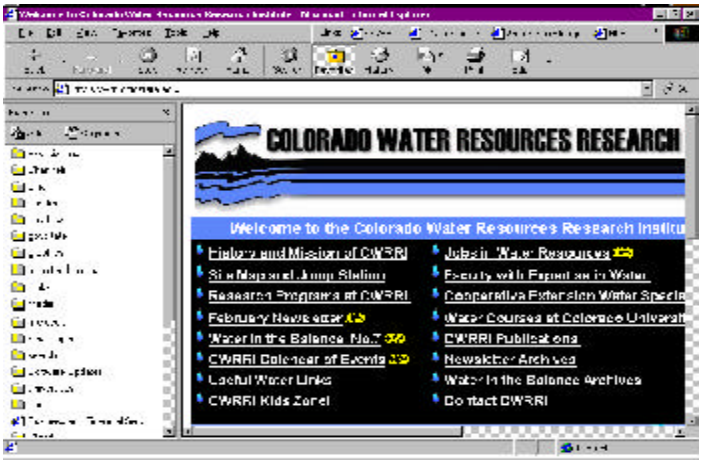
Study to target river improvement projects

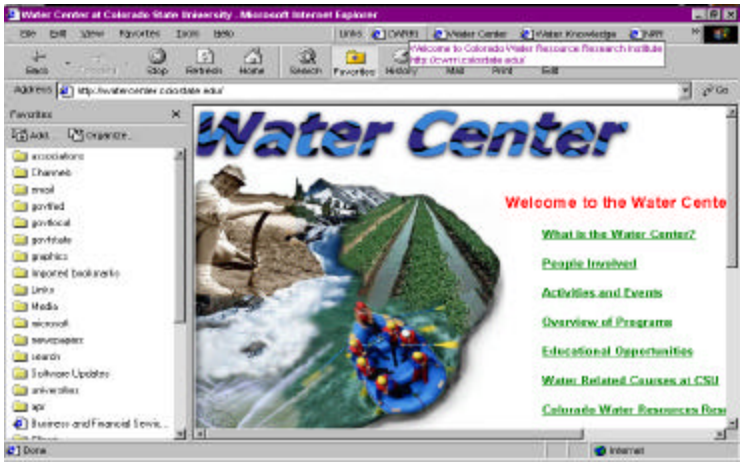
For about a year, technical advisory committee members of the Pueblo Natural Resources and Environmental Education Council (PNREEC) have talked about combining interests and efforts in a big way, and now their talks are starting to bear fruit in the Arkansas River-Fountain Creek Project. The city of Pueblo received a $40,000 GOCO planning grant in December for the project, and will match it with $15,000. In-kind matches will come from some of the partners. The planning grant will be used to hire someone in the next month or two to do the legwork for larger grants that would fund the actual project and to handle the mountain of details involved. The 16 projects are strung along the Arkansas River between Pueblo Dam and the Arkansas-Fountain Creek confluence and for 5 miles north along the Fountain. Each would include an environmental education component at the site; many would involve recreation; some would create or enhance wildlife habitat, open space and parks; and one — restoration work by the U.S. Army Corps of Engineers — would make improvements to the Arkansas River itself. That restoration, and the Corps' willingness to spend $4 million to $5 million in federal money, is the hinge on which the whole project would swing. The first eight projects — starting from the west — are a river trail link to Pueblo West; acquisition of remaining private land around old honor farm; improvements at the nature center and bridging the Arkansas River to the ponds at Transit Mix; acquiring and enhancing the ponds at Transit Mix; stream habitat improvements for the Arkansas; replacing existing drop structures in the river with boat chutes; acquiring lands adjacent to Olive Marsh (north of the river and east of the Pueblo Boulevard bridge) for use as buffer and to create additional wetlands; a river trail link to the Pueblo Zoo and enhancement of its exhibits by focusing on local and indigenous wildlife. The other eight projects are rehabilitating and enhancing the Arkansas River and Fountain Creek trail system; developing a Wildhorse Creek interpretive area; creating a system of directional and interpretive signs for the natural resource and recreation sites; improving access to the Runyon Lake wildlife area; creating wildlife habitat improvements along Thomas Phelps Creek; creating wetlands in the Fountain Creek levee area; creating a Fountain Creek park; and a river trail connection to the St. Charles Mesa area.

The Pueblo Chieftain 1/24/99

CWRRI AND WATER CENTER UPDATES

By David Bartecchi





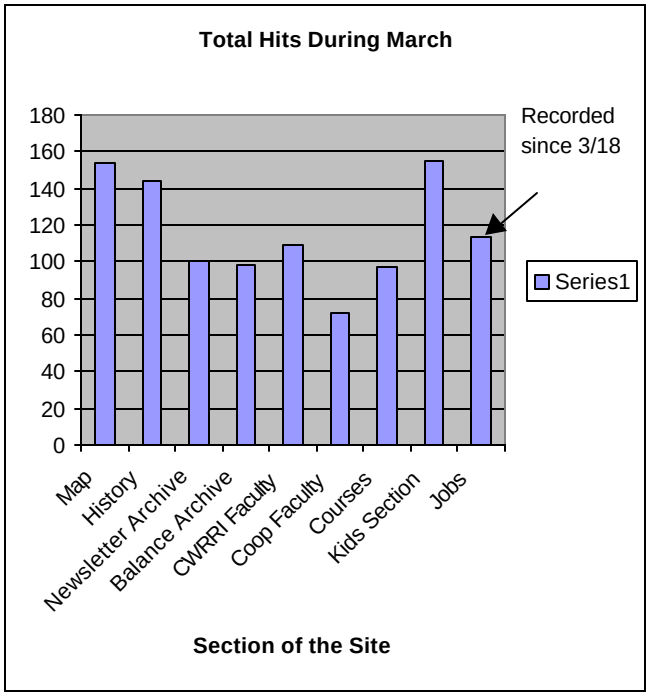
Those of you who regularly visit the three web sites maintained by CWRRI might have noticed the many changes that have occurred during the past few months. The updates are part of a continuing effort to make the information and services available from CWRRI as easily accessible to the public as possible. These changes include:

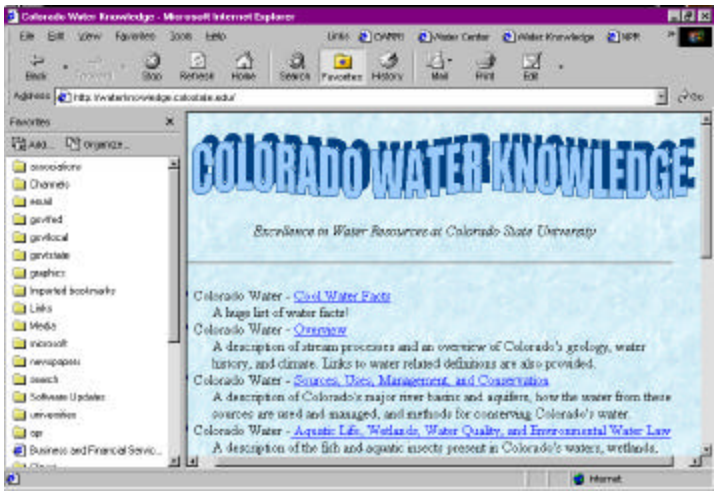
- Pull down menus that allow you to navigate through the entire site from any page.
- Bookmarks that make finding specific information on large pages easier.
- The CWRRI Newsletter and Water in the Balance reports available in PDF format which allows you to easily download and print out the entire document.
- Redesigned layout and graphics
- A site map where the organization of the entire site can be seen and navigated from a single page.
- Search forms where you can search, by keyword, a single site or all three of the sites maintained by CWRRI.

Aside from improving the appearance and navigability of the sites we have also added more content, including a section where kids can find information about water topics for school projects. The kids section includes many links to sites with basic water information designed especially for kids. We have also included a Java powered quiz with ten questions that gives you your score at the end. The kids section has proven to be very popular having almost 160 hits during its first month.

Another addition we made was adding an employment section. Anyone from a recent graduate to an experienced professional can find jobs in water resources from this page. On it you will find job listings from CWRRI, CSU, the Federal and State government, private companies, the major internet directories like Yahoo or Career Mosaic, or you can search through classifieds ads from newspapers around the world. Of all the additions made, this one has been the most popular. In its first two weeks it had almost 130 hits, making it the most popular section for that time period.

In order to better monitor the activity and popularity of the various sections of our site we added hit counters to each of the main sections of the CWRRI site. By doing this we can monitor the activity of our visitors and add content to areas that are popular and improve or phase out areas that have little activity. Below are the statistics of the first month of monitoring the page http://cwrri.colostate.edu:





Receiving almost 150 hits each day, The Colorado Water Knowledge site is by far our most popular URL. The reason...content. Colorado Water Knowledge is a rich source of information on virtually any aspect of water in Colorado. Since its inception it has been visited over 50,700 times and has been included in Yahoo!'s directory for kids Yahooligans. The site has also been included in the Learning Company's subscribtion based directory, www.webivore.com.

We at CWRRRI have been very excited about the popularity of our sites. We will continue to improve and update these sites so they will be your first stop on the internet for Colorado water information. Please visit our web sites and give us feedback on what you think of the changes and of what you would like to see added on later updates.

The addresses for the sites are:

The Colorado Water Resources Research Institute
http://cwrri.colostate.edu

The Water Center
http://watercenter.colostate.edu

Colorado Water Knowledge
http://waterknowledge.colostate.edu

CALLS FOR PAPERS

19th ANNUAL HYDROLOGY DAYS
August 16-20, 1999
Colorado State University — Fort Collins, CO

The objective of the Annual Hydrology Days is to provide a forum for hydrologists and hydrology students to get acquainted and to share problems, analyses, and solutions. Papers are welcome on all topics in hydrology and hydrologic engineering. Hydrology Days 1999 will be dedicated to the former students and worldwide professional colleagues of Hubert Morel-Seytoux. This will be the last year that Professor Morel-Seytoux will be the primary organizer of the group. The conference provides an opportunity for students to present papers in a friendly atmosphere, within the structures of a fully professional conference. The five-day program will include volunteered papers, invited papers, student papers, and a poster session. Awards and prizes will be given for the best student papers as oral or poster presentations in the following categories: B.S., M.S. and Ph.D.

Papers are welcome on all topics in hydrology and hydrology engineering. Sessions are under consideration with the following titles:

- Future of surface water and groundwater modeling.
- River flow forecasting and reservoir operations management.
- Optimization of water resources in integrated catchment management.
- Hydrologic models calibration and validation.
- Applications of geospatial technology in hydrology and water resources.
- Mountains and hill-slope hydrology, soil water processes, and snow hydrology in alpine and sub-alpine areas.
- Human impacts on hydrology.
- Links between hydrologic models and water quality models.
- Use of (large-scale) hydrologic and water quality models for integrated (multi-use) watershed management.
- Measurements and estimation of aquifer recharge in small to large-scale basins.
- Estimation of hydraulic properties of porous media.
- Multi-phase flow in heterogeneous porous media; infiltration, redistribution and contamination.
- Hydraulics of flow through waste impoundment covers, capillary barrier effects and design of waste landfills.
- New methodological developments in stochastic hydrology.

Send three hard copies (original plus two) of abstract(s) on a single page without a specific format, but font 12 minimum, and include: title, author name, affiliation, full mailing address, telephone, fax, e-mail, and indication of student status (M.S., Ph.D.), if applicable. Include a cover letter indicating presentation preference of oral or poster. Indicate special audio-visual needs. Abstracts submitted early will be given priority for oral presentation if accompanied by payment of a $30 abstract fee or a full registration. The $30 abstract fee will be refunded to full-time students at the time of the conference. Late abstracts will be considered according to availability of space within the program. For abstract/program information and registration forms contact H.J. Morel-Seytoux at HYDROLOGY DAYS, 57 Selby Lane, Atherton, CA 94027-3926; Phone and FAX 650/365-4080; or e-mail hydroprose@batnet.com. For registration/general information contact: Ms. Marilee Rowe (Hydrology Days), Dept. of Civil Engr., Colorado State University, Fort Collins, CO 80523-1372; Phone 970/491-5247; FAX 970/491-6787; e-mail mrowe@engr.colostate.edu. REGISTRATION FEES: $240 by June 30, 1999; $270 after June 30, 1999. Registration includes technical sessions, exhibits, posters, two lunches, refreshment breaks and two copies of the proceedings. One-day packages are available. DEADLINE: May 3, 1999. Website: **http://www.engr.colostate.edu/depts/ce/**.

AMERICAN WATER RESOURCES ASSOCIATION
ANNUAL WATER RESOURCES CONFERENCE
Watershed Management to Protect Declining Species
December 5-9, 1999
Seattle, WA

The Endangered Species Act (ESA) has created numerous challenges for water resources management since it was adopted in 1996. The conference will bring together case histories of regional water resources management schemes from around the country that have been driven by water-dependent protected species. Abstracts are to be submitted by June 1, 1999 using the two-part "Abstract Submittal Form." Contact AWRA at FAX 703/904-1228, E-mail awrahq@aol.com, or see the American Water Resources Association's website at http://www.awra.org.

To be Held in Conjunction with AWRA Conference:
Symposium on Water Resources and the World Wide Web

This Symposium will show how the World Wide Web is revolutionizing the way we obtain water information. The fully electronic proceedings, published on CD and the AWRA website, will provide a "snapshot" of the state-of-the-art at this early stage of the communications revolution. For information and instructions on submitting an abstract see the American Water Resources Association's website at http://www.awra.org. DEADLINE: June 1, 1999.

WETLANDS & REMEDIATION - An International Conference
November 16-17, 1999
Salt Lake City, UT

Two paper copies of abstract, an Abstract Submittal card and coauthor list are required. Contact Carol Young, Battelle, 505 King Avenue/Room 10-123, Columbus, OH for abstract submittal instructions, Phone 614/424-7604, FAX 614/424-3667, e-mail: wetlandscon@battelle.org. DEADLINE: May 31, 1999

TAILINGS & MINE WASTE '00
January 23-26, 2000
Colorado State University, Fort Collins, CO

The program will include the general topics of **Tailings and Mine Waste Management; Remediation, Restoration and Rehabilitation; Regulatory Framework; and other topics of general interest.** Submit a short abstract (one page or less, double-spaced), by Friday, June 9, 1999). For information contact Linda I. Hinshaw at Phone 970/491-6081, FAX 970/491-3584, e-mail: lhinshaw@engr.colostate.edu.

MEETINGS

5TH ARKANSAS RIVER BASIN WATER FORUM

Canon City, C0 — April 23-24, 1999

The 5th Arkansas River Basin Water Forum will be held April 23-24, 1999 in Canon City at the Canon Inn. The Forum will start April 23 with registration at 8:30 a.m. The first day's session, "Watershed Information and Orientation to the Issues," will feature Water Needs and Storage Assessment as affected by water rights, biological, recreational and social issues. The Lake County Initiative will show how citizens, politicians and agencies working together are making a difference. Saturday beginning at 8:30 a.m., will feature the session, "Current Opportunities in Our Watershed to Influence Decisions With Informed Opinions. It will have breakout sessions on Water Law, Health of our Watershed, Lower Arkansas Water Quality Issues, Water Exchanges and the Planning and Zoning Initiatives. The Forum will end with a luncheon presentation, "How Can We Participate in Our Watershed's Future. Registration is $35 for "early bird" or $40 at the door. For information on the Forum, contact David Cockrell at 719/549-2469, Larry Handy at 719/783-2481, Steve Reese at 719/539-7289 or Jim Valliant at 719/254-7608, or see the Forum website at http://www.uscolo.edu/arkriver.

NATURAL RESOURCES LAW CENTER
STRATEGIES IN WESTERN WATER LAW AND POLICY:
COURTS, COERCION AND COLLABORATION
PUBLIC PROGRAM ON WWPRAC, JUNE 8TH – CONFERENCE, JUNE 9TH – 11TH

The Natural Resources Law Center, University of Colorado at Boulder, will focus its 20th summer conference on the principal problem-solvingstrategies in Western water law and policy: Courts, Coercion and Collaboration. The program will address Colorado courts, the public trust, the Snake River and other basin-wide adjudications, ESA, TMDL Implementation, the Clean Water Action Plan, and CALFED. The June 11th program, "Collaboration in Western Water," will be available for separate registration and will include an analysis of collaborative processes in the Platte River Watershed. The conference will be preceded, Tuesday evening, June 8th with a free public program on the Western Water Policy Review Advisory Commission Report. For more information, contact Donna Peavy: call 303-492-1288; fax 303-492-1297; e-mail nrlc@colorado.edu or http://www.colorado.edu/Law/NRLC.

MARK YOUR CALENDAR AND REGISTER EARLY!

For the 1999 SUMMER SESSION - the 24th Annual

COLORADO WATER WORKSHOP

on the Western State College campus in Gunnison, Colorado

July 28-30, 1999

Garden of Dreams vs. High-Desert Reality: Can We Save Everything, Keep Our Lawns Green …AND Have Enough Water for Everyone?

We've transformed the western landscape and harnessed its waters in ways that John Wesley Powell never imagined possible. But now, with more people moving into the interior West than moving away from it, how do we maintain Colorado's largely manmade 'garden' as the number of demands on our water rapidly grows along with our net population? Is "having it all" still a possibility? Or is it just the wishful thinking of a post-WWII generation that has never experienced one of nature's biggest trump cards – a *major* drought - in the high stakes game of taming the West?

Join us at the 24th annual Colorado Water Workshop as we take an intensive look at our needs and desires as they relate to water. We'll explore some creative options for supplying precious water to users and interests old and new. We'll hear from the experts on drought forecasting, drought planning and preparedness. We'll also weigh the myriad impacts of the choices before us now – impacts that can turn the future into one person's dreamland and another's nightmare. This summer's conference will be rich with philosophy, technology, legal perspectives, environmental ethics, and politics. Bring your thinking cap, your voice, and your sense of humor. We'll provide the open forum - and a surprise or two. It's unlikely you'll be disappointed…unless you miss this one altogether!

- Check our web site* at http://www.waterinfo.org/workshop.html in late April for additional information. Previous participants can expect a registration brochure in the mail at the end of May; others can download the 1999 registration form from our web site at that time - or contact us to add you to our mailing list.

- *A limited number of full scholarships will be available for full-time college students and student interns only* - contact us as shown below for applicant requirements.

- *Want to be a sponsor or an exhibitor this year?* Contact Director Robin Helken in any of the following ways:

  by e-mail: water@western.edu *by phone:* 9970-641-6215 *by fax:* 970-641-6219
  or write: Robin Helken, CWW Director, 1181 County Rd. 20, Gunnison, CO 81230

*(*Many thanks to the Water Information Program in Durango for donating this web site to the Water Workshop).*

COLORADO WATER CONGRESS

Summer Convention -- August 26-27, 1999
Sheraton Steamboat Resort, Steamboat Springs, CO

Colorado Water Law Seminar -- September 13-13, 1999
CWC Conference Room, 1390 Logan St., Suite 312, Denver, CO

CWC Annual Convention -- January 27-28, 2000
Holiday Inn Northglenn, I-25 & 120 Ave., CO

1999 HIGH ALTITUDE REVEGETATION SUMMER FIELD TOUR
July 29th and 30th in Northern New Mexico

The free High Altitude Revegetation 1999 Summer Field Tour will visit some diverse and interesting mine reclamation and revegetation projects in Northern New Mexico. It will be an educational and enjoyable time in the pinyon juniper hills from the Colorado/New Mexico border area near Questa, NM south to the scenic Pecos River areas and historic Santa Fe. We have some award-winning reclamation sites lined up, as well as some very interesting archaeological and historical places to visit. The tour is free; bring your whole family, come and go as you please, and travel will be entirely by your personal vehicle (four-wheel drive not necessary. The traditional evening meal on Thursday will be held at the Pecos National Monument Facility in Pecos, NM. The Altitude Adjustment Hour will be sponsored by Revex and the catered evening meal will be sponsored by Nilex. As a special educational treat, the after-dinner program will be about Rock Art of the Upper Rio Grande. For additional information contact Mike Ellis at 303/279-8532, Tom Colbert at 303/322-1511, or Gary Thor at 970/491-7296. Visit the HAR website at www.highaltitudereveg.com.

WATER LESSONS OF WORLD DEVELOPMENT

Universities Council on Water Resources 1999 Annual Meeting

and

Water and Environmental Resource Management: Focus on Asia and the Pacific

International Water and Resource Economics Consortium

6th Biennial Meeting

Co-sponsored by

International Water Resources Association

June 29-July 2, 1999

Hilton Waikoloa Village Hotel -- Kamuela, Hawaii

CONTACT: Margaret Skerly, UCOWR, Southern Illinois University at Carbondale

Phone 618/536-7571 FAX 618/536-2671 E-mail: mskerly@uwin.siu.edu

CALENDAR

May 10-12	POTENTIAL CONSEQUENCES OF CLIMATE VARIABILITY AND CHANGE TO WATER RESOURCES OF THE UNITED STATES, AWRA Spring Specialty Conference, Atlanta, GA. Contact: Michael J. Sale, Phone 423/574-7305, TAX 423/576-8543, e-mail jon@orni.gov.
May 16-19	CLIMBING TO NEW HEIGHTS -- 1999 National Flood conference, Denver, CO. See National Flood Insurance Program Website at http://www.fema.gov/NFIP/99conf.htm or FAX to 301/918-1471.
June 2-5	FIFTH BENCHMARK WORKSHOP ON NUMERICAL ANALYSIS OF DAMS, Denver, CO. For information contact Pasquale Palumbo, Technical Secretariat, Via Pastrengo, 9, 24068 Seriate (BG), Italy. Phone 39-35-307-111, FAX 39-35-302-999, E-mail ppalumbo@ismes.it. See the U.S. Committee on Large Dams web page at www.uscold.org/-uscold.
June 7-9	6th ANNUAL WATER INFORMATION MANAGEMENT SYSTEMS WORKSHOP, Denver, CO. Contact: Cheryl Redding, Western States Water Council, at 801/561-5300.
June 8-11	STRATEGIES IN WESTERN WATER LAW AND POLICY: COURTS, COERCION AND COLLABORATION, University of Colorado, Boulder, CO. Contact: Natural Resources Law Center, University of Colorado School of Law, Phone 303/492-1272; FAX 303/492-1297; e-mail: NRLC@spot.Colorado.edu.
June 9-12	3RD NATIONAL WORKSHOP ON CONSTRUCTED WETLANDS/BMPs FOR NUTRIENT REDUCTION AND COASTAL WATER PROTECTION, New Orleans, LA. Contact: Dr. Frank Humenik, NC State Univ., Phone 919/515-6767, FAX 919/513-1023, e-mail: FRANK_HUMENIK@NCSU.EDU.
June 13-15	2ND NATIONAL MITIGATION BANKING CONFERENCE, Atlanta, GA. Contact Terrene Institute, 4 Herbert St., Alexandria VA 22305. Phone 703/548-5473, FAX 703/548-6299.

June 20-24	INTERNATIONAL CONFERENCE ON THE CHALLENGES FACING IRRIGATION AND DRAINAGE IN THE NEW MILLENIUM, Sponsored by U.S. Committee on Irrigation and Drainage, Colorado State University, Fort Collins, CO. See the USCID web site -- www.uscid.org/~uscid, or Phone 303/628-5430, FAX 303/628-5431, E-mail: stephens@uscid.org.
June 29-July 2	WATER: LESSONS OF WORLD DEVELOPMENT -- WATER AND ENVIRONMENTAL RESOURCE MANAGEMENT: Focus on Asia and the Pacific, International Water and Resource Economics Consortium 6th Biennial Meeting and Universities Council on Water Resources 1999 Annual Meeting, Kamuela, Hawaii. Contact: Margaret Skerly, UCOWR, So. Illinois Univ., Phone 618/536-7571, FAX 618/453-2671, E-mail mskerly@uwin.siu.edu.
June 30-July 2	SUMMER SPECIALTY CONFERENCE, AWRA -- Two tracks: Science Into Policy: Water in the Public Realm -- contact Vivian Drake, Phone 406/447-1668, FAX 406/447-1665, e-mail: drake@co.lewis-clark.mt.us. Wildland Hydrology: Contact Darren Olsen, Phone 801/752-4202, FAX 801/752-0507, e-mail: dolsen@bio-west.com.
July 7-9	WATERPOWER '99 — Hydro's Future: Technology, Markets and Policy Las Vegas, Nevada. Contact Liz Sigler at Phone 800/548-ASCE, ext. 6078 or 703/295-6078, FAX 703/295-6144, or E-mail lsigler@asce.org. Waterpower home page: www.waterpower.org
Sept. 1-3	EMERGING TECHNOLOGIES FOR SUSTAINABLE LAND USE AND WATER MANAGEMENT, 2nd Inter-Regional Conference on Environment-Water, Lausanne, Switzerland. Sponsored by ICID-CIID. Contact: EPF-Lausanne Institute of Soil and Water Mgmt., Phone +41.21.693 37 25/37 35, FAX +41.21.693 37 39, E-mail envirowater99@epfl.ch. (For Coloradans: Luis Garcia, Dept. of Chemical & Bioresource Engr. at CSU, is US representative on the Scientific Committee. Contact him at lgarcia@engr.colostate.edu.) The URL for the conference is http://dgrwww.enfl.ch/HYDRAM/envirowater99/.
Sept. 8-10	SETTLEMENT OF INDIAN RESERVED WATER RIGHTS CLAIMS, Missoula, MT. Contact: Western States Water Council, Phone 801/561-5300, FAX 801/255-9642, Website: http://www.westgov.org/wswc/.
October 10-13	DAM SAFETY '99, Sponsored by Association of State Dam Safety Officials, St. Louis, MO. Contact: Association of State Dam Safety Officials, Inc., 450 Old Vine, 2nd Floor, Lexington, KY 40507. Phone 606/257-5140; FAX 606/323-1958; e-mail: damsafety@aol.com.
Nov. 7-10	FOURTH USA/CIS JOINT CONFERENCE ON ENVIRONMENTAL HYDROLOGY AND HYDROGEOLOGY, Sponsored by American Institute of Hydrology, San Francisco, CA. Contact: AIH, Phone 651/484-8169, FAX 651/484-8357, E-mail AIHydro@aol.com, Website http://www.aihydro.org/.
Nov. 8-9	RESTORING NATIVE ECOSYSTEMS, 3rd Annual Conference, National Arbor Day Foundation, Nebraska City, NE. Contact: June Parsons, The National Arbor Day Foundation, Phone 402/474-5655; FAX 402/474-0820; e-mail jparsons@arborday.org.
Nov. 16-17	WETLANDS & REMEDIATION, Salt Lake City, UT. Sponsored by Battelle. Contact The Conference Group, Phone 800/783-6338 or 614/424-5461; FAX 614/488-5747; e-mail: conferencegroup@compuserve.com.

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