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Drought study from NSF grant should aid national climate models

Little geologic evidence of the Dust Bowl of the 1930s exists in the Sand Hills. The plant life kept a hold on the sandy soils because groundwater and rainfall were adequate to maintain some vegetation, even as elsewhere much of Nebraska's topsoil blew away.

However, new evidence suggests that sometime in the last 1,000 years, major droughts occurred in Nebraska's sand sea that significantly reduced the sand-stabilizing vegetation and lowered water tables.

Jim Swinehart and David Loope, research geologist with the University of Nebraska-Lincoln Conservation and Survey Division (CSD) and professor in the UNL geology department, respectively, were awarded a \$144,000 National Science Foundation (NSF) grant to further explore the possibilities of these persistent droughts occurring within the latter part of the Holocene Epoch, the last 10,000 years.

Drought study continued on p. 2

New lab reveals that every groundwater picture tells a story

Every groundwater tells a story, says Edwin Harvey, a geochemist studying water-rock interaction at the Conservation and Survey Division of the University of Nebraska-Lincoln. You just need the right equipment, a trained eye and an inquiring mind.

Harvey hopes that a new water chemistry lab will help students trace the story of a water sample in Nebraska by analyzing its chemical composition, he explains. The main reason he wanted a lab is the chance to be creative and innovate and to control the analytical process.

"We're going to be able to do our own detective work," he says. "There is so much more flexibility on the part of the researcher to be able to look at a sample again or run a test over (when he has a lab)," he adds.

Without his own equipment, Harvey couldn't give his students hands-on experience or the chance to experiment with new situations. All the testing would be done off campus at a commercial lab that charged for each test and returned only the information requested.

Research and teaching in the water chemistry lab will include both graduate and undergraduate student work and will be a vital part of the new UNL School of Natural Resource Sciences, Harvey says. Current plans are to offer wetland hydrology/geology and possibly a lab methods class in the spring of 1998, followed by an introductory level groundwater chemistry course in the spring of 1999.

Water chemistry lab continued on p. 4

New geophysical equipment will save time and cut errors; can record measurements from seven different sensors at once

A new digital borehole geophysical logging system purchased by the Conservation and Survey Division (CSD) of the University of Nebraska-Lincoln for about \$30,000 should save time and reduce the chances of error.

The digital equipment is capable of recording measurements from seven different sensors at one time, said Steve Sibray, groundwater geologist at the University of Nebraska Panhandle Research and Extension Center, Scottsbluff. The old equipment could only record measurements on three or four sensors at once.

The new system records data digitally, giving the operator the flexibility to change the scales after logging.

"In older analog systems, if you had the wrong scale, you had to go back and relog the hole," Sibray said. "This way with one pass, you get the data you need."

The system sends electrical impulses into the borehole, measuring electrical resistivity of the rock units, natural radioactivity of the rock, temperature of water in the borehole, fluid resistivity, and spontaneous potential.

CSD will use the equipment to work with many groups, but one of the most immediate applications will be with the North Platte Natural Resources District and to install monitoring wells in that district.

"This is an excellent opportunity to get data," said Sibray. "It will give us a permanent record of the geophysical properties of the rocks and this will give us information about the aquifer and distribution of rock types."

In the future, the equipment will be useful in characterizing the shallow groundwater aquifers in the state.

Drought study continued from p. 1

Initial cores showed layers of fine-to-medium-grained sand inside peat deposits under wetlands between dunes.

"There are two major parts to the research," Swinehart said. "First is understanding the mechanics of how the sand gets out there, and then, second, determining the age of those sand sheets."

Swinehart and Loope will be searching for conclusive evidence in the first 5-6 feet of thick peat deposits located in at least 27 different interdune regions. Their previous work, also partially funded by NSF, determined that the base of the peat is about 12,000 years old and was most likely deposited when dunes dams blocked drainage in the area.

"To find a substantial thickness of sand, from a few inches to a few feet or more, interbedded with peat, we think represents sand bouncing out across the land, and that can't happen when the peatland is actively growing," Swinehart said. Vegetation stabilizes the sand and keeps it from blowing around.

The bulk of the grant money will fund student help and radiocarbon dating over two years. Most of the samples will be collected from three sites in Cherry County by coring and by excavating trenches. However, they will take enough samples from throughout the Sand Hills peat deposits to create a complete "inventory" of the evidence. Regional geology has helped preserve that evidence in easy-to-read layers, Swinehart explained.

"It's like changing the temperature of the ocean or a huge lake. You don't do it with one bad summer; you have to have a long-term reason," Swinehart said. "We think the dune-peatland system will record drought that might be missed in other environments."

Satellite View of Nebraska posters are in and ready for pick up!

Two sizes of a poster showing a mosaic of 18 Landsat Thematic Mapper satellite images of Nebraska are available from the Conservation and Survey Division Map Sales office, 104 Nebraska Hall, UNL, 68588-0517; (402) 472-7523.

Put out by the Center for Advanced Land Management Information Technologies, *Satellite View of Nebraska* was prepared as a part of Nebraska's Gap Analysis Project, a research

The scientists have ruled out fluvial (river-borne) deposition of sand sheets due to the high permeability of the sands, Swinehart said. Convex-up sand ridges, present at the edges of the sand sheet in the center of some interdune valleys, also indicate the place where the bouncing sand hit the remaining plant life and came to rest.

If Swinehart and Loope are right, their findings could have national implications.

"We have evidence that we may have two closely spaced sand sheets a little younger than a thousand years that may tie in with other evidence around the country that two big droughts occurred closely spaced," Swinehart said.

Studies of ancient climates completed on Minnesota lakes and California tree rings have already produced evidence of a series of droughts ending prior to 1200 AD. If similar data is found in the Sand Hills, it provides more data to help climatologists understand how wide-scale, rapid climate change can occur, particularly from fairly moist to very dry and back again, Swinehart said. Early sampling indicates the possibility of droughts much larger than any since European settlement of the western United States, which, if repeated in the future, would cause a major impact on human food production, he added.

The more evidence of severe, short-term climate change produced, the better the chance that such changes would be figured into scientific models and regional water planning. Evidence opposing the hypothesis will increase the support for current climate models, he explained.

The grant was awarded through the Earth System History category of the Geology/Paleontology program for the NSF Global Change Research program.

effort to determine how native plants, animals and natural communities are represented in the present mix of conservation lands. The satellite imagery in the poster is presented as a false color image of reds, blues, and grays, where red indicates actively growing vegetation at the time of imaging. Posters are available in two scales: 1 inch = 8 miles and 1 inch = 16 miles. Cost is \$10 for the smaller one and \$15 for the larger.

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To receive it free of charge, write to the address above. In the fall *Resource Notes* becomes the annual news magazine of the division. **The Conservation and Survey Division (CSD) is the agency designated by statute to investigate the natural resources of the state, to make available to the public the results of these investigations and assist in the development and conservation of these resources.** CSD provides information to all people regardless of sex, age, race, color, religion, national origin, sexual orientation, veteran's status or handicap. Background of nameplate depicts the rock column from the *Geologic Bedrock Map of Nebraska*. Shown are (from bottom) Precambrian, Cambrian, Ordovician, Silurian and Devonian rocks.

State's fish farming potential yet to be tapped, aquaculture expert says

Conservation and Survey can help with the location of quality water supplies

Dale Fattig, 70, and his family have farmed in western Nebraska since the early 1950s. He has faced the same concerns as other farmers in the state—weather, prices and consumer demand.

But when Fattig looks over one of his three properties comprising 540 acres near Brady, North Platte and Valentine, he doesn't see vast fields, rows of livestock buildings or grazing cattle.

He sees fish. Or fish runs, if you will.

Fattig, owner of Fattig Fish Hatchery in Brady, was among the first Nebraskans to get his feet wet in the growing industry of aquaculture, or "fish farming." Forty years ago, Fattig raised minnows and sold them for bait to make a few extra dollars. Today, he annually raises about 600,000 trout and 200,000 bass for human consumption. He's also planning to raise perch—perhaps a million each year.

The key to this success? Simple, according to Fattig.

"Water. We have fantastic freshwater resources in this part of the state, which can do nothing but enhance the growth of the industry in the state," Fattig said. There are about 50 licensed "fish farms" in Nebraska, according to the Nebraska Fresh Fish Farmers Association. Most use natural lakes, streams, farm ponds or deserted sandpits to grow fish. A few are man-made systems with elaborate filtration and circulation systems.

Because of the growth and increasing complexity of aquaculture, an increasing number of University of Nebraska-Lincoln researchers—including staff at UNL's Conservation and Survey Division and an extension specialist—are becoming involved with the industry.

Jim Goeke, CSD research hydrogeologist stationed at NU's West Central Research and Extension Center in North Platte, said CSD's role in developing and defining Nebraska aquaculture as an industry has been focused on technical support, advising and design assistance, especially with finding adequate supplies of good quality freshwater.

"We haven't been directly involved with a lot of fish farming projects, but CSD has certainly helped out from time to time," Goeke said.

"I'm sure we'll do more with aquaculture as it continues to grow in the state," he said.

Vince Dreeszen, CSD hydrogeologist emeritus and former CSD director, said the division has served in an advisory role for Nebraska fisheries and hatcheries in the past.

"Obviously, they need water—good, clean water from a reliable source—to keep operating," Dreeszen said. CSD's experience with the state's water resources, coupled with its extensive water well records, have proven beneficial to fish producers throughout the years, he said.

In 1956, CSD stepped in to help a Gretna hatchery, which relied on the Platte River for its water, dig a new well after the drought of the mid-1950s reduced the Platte's flow to a trickle.

Dreeszen also recalled a dire situation in a Platte Valley hatchery in which CSD was able to lend a hand. Apparently,

the groundwater being pumped in to the hatchery contained large amounts of dissolved gas—but it wasn't a problem of toxicity or general fish health.

It was the bubbles.

"The bubbles were making the eggs float to the top," Dreeszen said. Fish eggs are generally laid in groups at a significant depth, and they need to remain there to ensure safety and proper fertilization. CSD worked with the hatchery to correct the problem, Dreeszen said.

Nebraska is a member of the 12-state North Central Regional Aquaculture Center, which has offices in East Lansing, Mich., and Ames, Iowa. The center is one of five sites created by the U.S. Department of Agriculture to promote the industry.

Terry Kayes, aquaculture specialist with UNL Cooperative Extension, is a member of the North Central region's technical committee. He said the future of aquaculture in Nebraska continues to brighten, and the state's resources are the key.

"With Nebraska's abundant natural resources, we have the definite potential to be one of the top two or three aquaculture states in the country," Kayes said.

The state could add up to \$500 million in annual agricultural revenue if Nebraska reaches its potential in aquaculture, Kayes said.

Nebraska's primary products from aquaculture include fish fillets and fish jerky for food consumption, and fish eggs and fingerlings to stock lakes, ponds and streams for sport fishing.

The Nebraska Department of Agriculture launched a marketing campaign last fall to promote the state's booming freshwater fish industry. Its slogan is: "Nebraska Fresh Fish—Savor the Flavor."

Most Nebraska fish producers, including Fattig, export the bulk of their annual product to coastal states, the Great Lakes and overseas, where demand for fish is far greater than in the Midwest.

Water pollution and fishing restrictions in traditional fishing regions have increased the demand for imported fish in those areas, Fattig said. And states like Nebraska are beginning to step in to fill that niche.

"There are huge processing plants near the Great Lakes that have nothing to process," Fattig said. "The demand is there, and Nebraska can supply it."

According to the Nebraska Department of Agriculture, the state's largest fish producer is Coldwater Fish Farms, near Lisco in western Nebraska. Coldwater produces as many as two million salmon and trout each year. That's 600,000 pounds of fish, sold at an average of \$3 per pound.

Kayes said Coldwater is an example of how far aquaculture can go in Nebraska, and he is convinced that Nebraskans are ready to embrace this new production alternative.

"The idea of aquaculture as a kind of novelty has passed," he said. "It's practical, profitable and it's here to stay."

Water chemistry lab continued from p. 1

Once the CSD lab is fully operational, most likely next fall, students will be able to collect their own samples and do primary cation and anion analysis in the lab using an atomic absorption spectrometer, ion chromatograph, drying oven, analytical balance and other chemical-analysis equipment.

The lab will be renovated during the summer using a grant from facilities management at UNL, Harvey said. Water purification equipment and new benches with gas and power will be added to the room.

Some of the first research will involve solving the mystery of high fluoride concentrations found in western Nebraska, Harvey said. Rock specimens collected from the area will be dissolved in water and then the water will be tested for fluoride and other elements.

Depending on funding, other possible research will include the wetland chemistry project at Jumbo Valley in Cherry County, saline wetlands investigation at Rock Creek, near Lincoln, and Republican River research.

In the future, Harvey hopes to expand the equipment to allow four or five students to work in the lab at once and to add some organic-chemical analysis equipment, he says.

Resource News renamed Resource Notes, joins fall quarter magazine to curb confusion

Don't adjust your set. The name has been changed to protect librarians and others from getting confused. The Conservation and Survey Division has adopted a single name for

its news material to simplify cataloging and public awareness of our news organs. The fall quarter will continue to be a magazine and the other three will be a briefer newsletter.

Coming up: federal, state and local meetings and workshops

July

July 22-25 - Soil and Water Conservation Society Annual Conference, Toronto, Ontario Canada. Contact the Center for Grassland Studies, 222 Keim Hall, UNL, P.O. Box 930953, Lincoln, Neb. 68583-0953.

August

August 9-10 - North Central Nebraska Rockhounds swap, Ainsworth, Neb.

August 30-September 1 - Northwest Nebraska Rock Club swap, Crawford City Park, Crawford, Neb.

September

September 3-6 - 1997 National Groundwater Association Convention and Exposition, "Biological Aspects of Groundwater," Las Vegas Convention Center, Las Vegas, NV.. Contact Jackie Mack (614)898-7786.

September 5-7 - Fort Kearney Rock Club swap, Kearney Cottonmill Park, Kearney, Neb.

September 17-20 - The Great Basin Symposium on Glacial and Postglacial Drainage, University Park Hotel, Salt Lake City, Utah. Contact Don Curry, conference chair, (801)581-6419.

September 26-28 - Loup Valley Gem and Mineral Club show, St. Mary's Social Center, Schuyler, Neb.

October

October 4-5 - Nebraska Gem and Mineral Club show, Radial Hall, Omaha, Neb.

October 20-23 - The Geological Society of America 1997 Annual Meeting, "Global Connections," Salt Lake City, Utah. Pre-registration due September 19th. Contact (303)447-2020 or 1-800-472-1988. e-mail: meetings@geosociety.org.

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