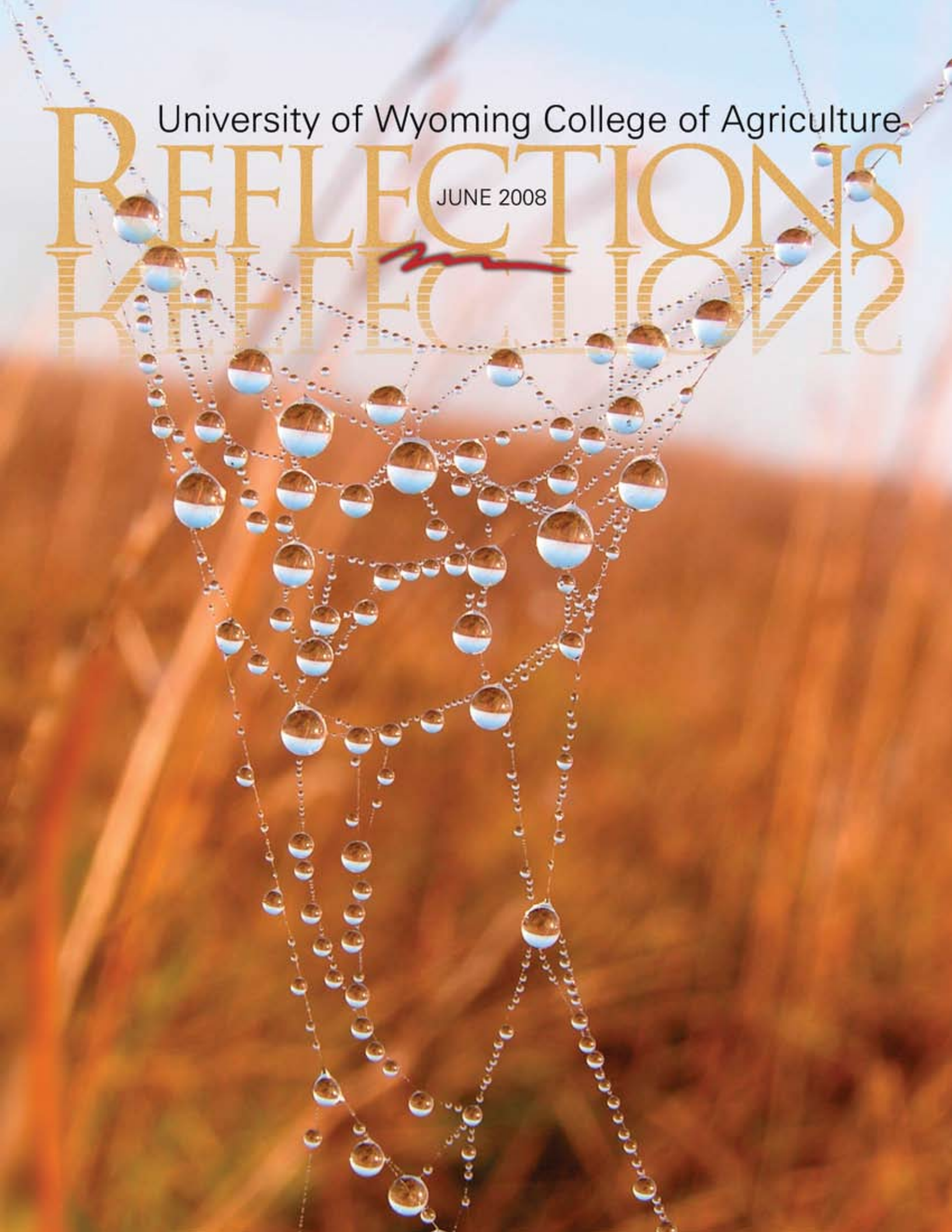
University of Wyoming College of Agriculture

REFLECTIONS

JUNE 2008



Humankind has not woven the web of life. We are but one thread within it. Whatever we do to the web, we do to ourselves. All things are bound together. All things connect.

Chief Seattle, 1854

FEATURED department

The Ag Development and College Relations office represents the College of Agriculture at public events throughout the year. They also work with alumni, corporations, and friends of the college to fund scholarships, outreach programs, and excellence funds for departments within the college. Office members include, top from left, Carolyn Herman, office associate, Jenna Norton, former student employee, and Anne Leonard, director, and Stephanie Anesi, bottom, deputy director.

a common thread

Much of the change we experience in our daily lives is the result of research that is pursued for months, years, and even decades. Researchers and educators work closely with the people they serve to apply a common thread involving the land-grant university principles of learning, engagement, and discovery. Scientists conduct research in laboratories at the research and extension centers and on private farms and ranches. Educators provide research-based programs and advisory boards. And individuals offer suggestions and direction on problems to study. With personnel in every county and with four research and extension centers located strategically around the state, the University of Wyoming College of Agriculture is working to provide research and outreach outcomes responsive to the needs of our stakeholders.

This issue of *Reflections* includes articles on the Department of Agricultural and Applied Economics experimental laboratory, sage grouse and livestock grazing, mosquito identification, foxtail barley management in irrigated pastures, use of genetic markers for livestock susceptibility to nitrate toxicity, diversity of insects at the Great Sand Dunes National Park and Preserve, the UW student farm, almond testing, prenatal programming, rural health care, unique Wyoming plant species, veterinary science programs, aquaponics, and the new bachelor of applied science (BAS) degree program.

With nine undergraduate and 20 graduate degree programs, the college's array of educational opportunities is impressive and designed to provide students a common thread for finding solutions to the complex array of interactions facing agriculture today. The college's research efforts provide a common thread of unbiased information for managing wildlife/livestock conflicts, natural resource development, and maintaining profitable and sustainable agricultural production systems.

The college has the sites and means to conduct cutting-edge research that discovers, generates, and synthesizes new knowledge for application to meet Wyoming's emerging technological, scientific, and social needs. Feel free to visit our campus, extension offices, and research and extension centers to witness faculty, staff, and student efforts firsthand. See how the college's tripartite mission of instruction, research, and extension/outreach provides a common thread to serve our stakeholders' needs. To learn more about the college, please visit our Web site: www.uwyo.edu/UWAG.

We hope you enjoy this issue of *Reflections* and the common thread running through the information it provides.

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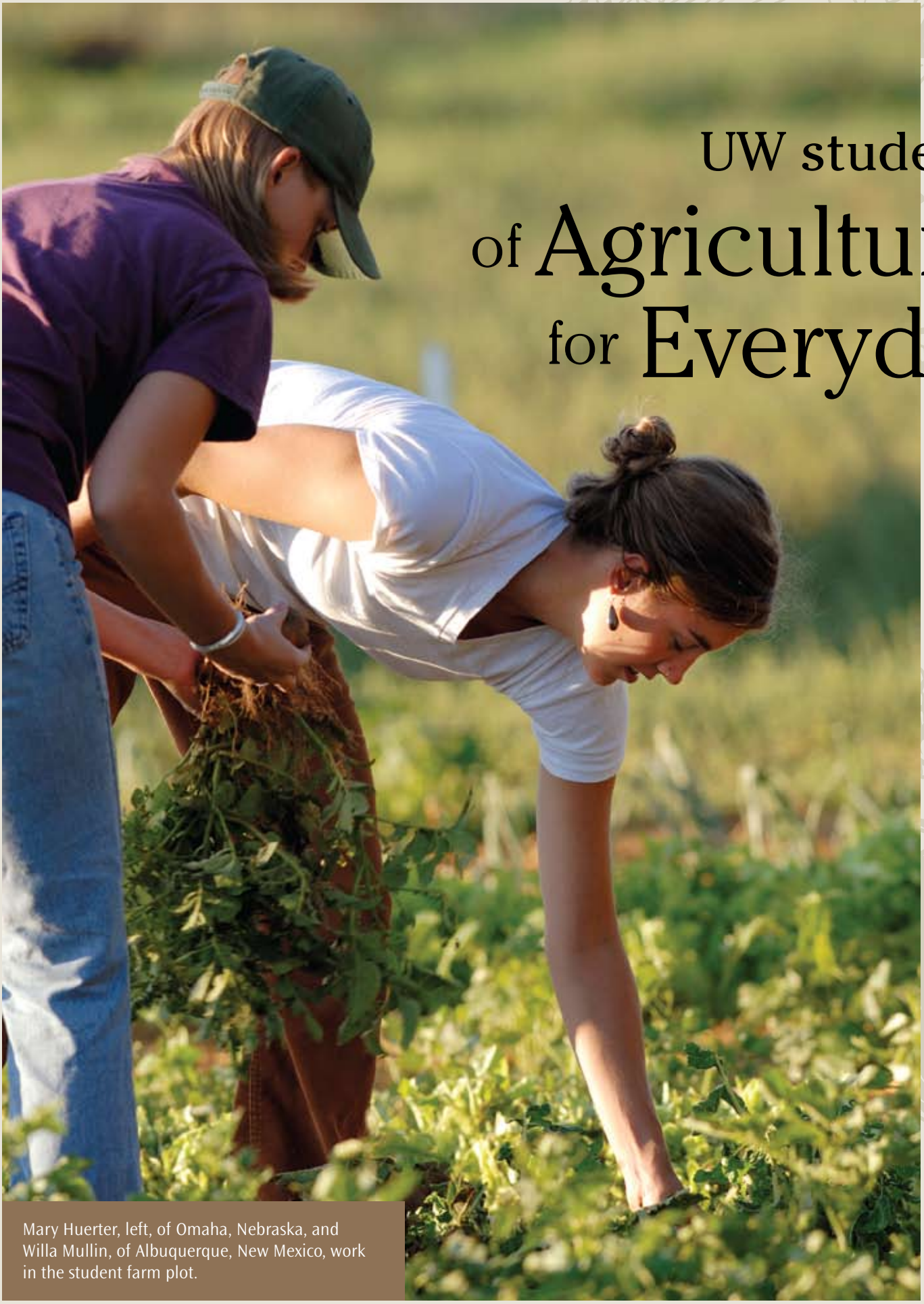
Reflections

contents

Photograph by Trice Megginson

UW students, of Agricultural for Everyday



Mary Huerter, left, of Omaha, Nebraska, and Willa Mullin, of Albuquerque, New Mexico, work in the student farm plot.

community reap harvest

Community Resources Sustainability farm

Rik Smith
Assistant Professor of Agroecology
Department of Plant Sciences

I stood, stretched, rubbed my aching back, and looked down at the bucket full of rainbow chard at my feet. I surveyed the rows of onions, lettuce, spinach, and potato plants and couldn't help but smile. This was the University of Wyoming's student farm, ACRES – Agricultural Community Resources for Everyday Sustainability.

It was a Friday afternoon in August, the second week of sales for the ACRES group at the Laramie Farmers' Market, and the harvested greens and vegetables the students had taken to the market were almost all sold within an hour! Thus, my present condition of aching back and a bucket of chard at my feet, having been the only person available to harvest more produce.

A little more than a year earlier, Mary Huerter, a senior agroecology major from Omaha, Nebraska, sat in my office and shared her desire for a hands-on farming experience as part of her academic experience at UW. We require all of our agroecology majors do an internship as part of their major, but only rarely do the internships involve farming – most internships are with crop consultants or federal agencies or golf courses.

Mary's suggestion more than intrigued me. I knew there were many student farm programs at colleges and universities around the country – why not at UW?

In the months since our conversation, much had happened to amaze, encourage, and impress me as Mary and her ACRES compatriots planned, planted, and harvested – creating a garden where previously had been a weed patch.

Mary started researching other university farms and began approaching department heads, deans, and other administrators to see how much interest and support there might be for a student farm in the College of Agriculture. When she talked to Stephen D. Miller, associate dean and director of the Wyoming Agricultural Experiment Station, the incredible amount of support within the college was made manifest when he granted us use of an acre of unused land near the ag greenhouses at 30th Street and Harney for a farm site!

I knew there were many student farm programs at colleges and universities around the country – why not at UW?

That fall, Alyssa Wechsler, a junior zoology and physiology/environment and natural resources major from Sheridan, stopped by my office to discuss her campus sustainability class project – proposing a student farm. I introduced Alyssa and Mary to one another, and they enlisted the aid of another agroecology major, junior Nate Dittman of Omaha, Nebraska, and the three of them almost immediately began work on a grant proposal to submit to the Associated Students of the University of Wyoming (ASUW) for funds to buy seeds, tools, a storage shed, and a high tunnel (an unheated greenhouse). Though the ASUW proposal was unsuccessful (the committee thought the farm would not benefit enough students across campus) an editorial and several letters in the UW student newspaper, *Branding Iron,* generated a lot of discussion around campus. When we offered a one-credit seminar called Student Farm, 13 students registered and got right to work planning. Their lack of funds didn't deter them for a minute. They received donations of seeds from both local and national sources, tools and hoses from Laramie hardware stores, potting mix and plants from a local nursery, and a used 6-foot by 12-foot mini-greenhouse from a Laramie resident.

Photograph by Trice Megginson

Senior political sciences/ENR major Katelyn Parady of Rock Springs sells onions to a satisfied customer at the Laramie Farmers' Market.

Farm Operations

We knew we would be challenged by Laramie's 90-day growing season. The student's plan from the start has been to buy and build a 20-foot by 48-foot "high" tunnel. These unheated, greenhouse-like structures are used by organic and market farmers to extend the growing season and increase the amount of vegetables grown and sold.

Adding a month to either end of Laramie's growing season with a high tunnel will help sustain their production, increase yields, and make local produce available longer to Laramie customers.

The students have been talking about the seasonality of vegetable production and availability from the start. In these modern days of huge supermarkets filled with packaged and processed foods, South American grapes, New Zealand apples, and Mexican tomatoes, we've lost a connection to the growing season.

After Mike Doherty, a UW College of Business graduate student, finished tilling the farm field in mid-April, Mary and Nate planted a couple rows of cabbage and fava beans, an Old World plant in the pea family that bears large pods containing edible seeds. Though the cabbage succumbed to the next frost, the fava beans survived several snows and bitter frosts to produce beans and give the gardens a friendly splash of green while other crops were germinating.

By the end of June, student farmers had planted five varieties of beans, two kales, broccoli, cabbage, spinach, five lettuces, white and yellow onions, three varieties of potatoes, four varieties of tomatoes, cucumbers, turnips, shallots, leeks, snow peas, three chards, two varieties of squashes, two varieties of radishes, and basil. Though not everything survived (the beans were wiped out by gophers, the squash couldn't take the 24 degrees Fahrenheit the morning of June 8, and hail damaged the tomatoes), the production from the farm generated $998 in sales! The vegetables were sold at the Laramie Farmers' Market and, starting in September, through the Big Hollow Food Cooperative, a new member-owned natural food store in downtown Laramie.

The 2007 summer season was a challenge for the farm. With most of the students away for the semester, the work of planting, weeding, watering, and protecting crops from pests fell to the two or three students who stayed in Laramie.

Mike Baldwin, a junior agroecology major of Fairfax, Virginia, chose to pass up a lucrative internship with

Photograph by Trice Megginson

Senior agroecology major Mike Baldwin of Fairfax, Virginia, with turnips harvested to sell at the Laramie Farmers' Market.

a crop consultant to stay in Laramie, work in a local nursery, and commit all his spare time to the ACRES farm. Lyndsy Soltau of Eugene, Oregon, a junior wildlife biology and fisheries management major, was drafted by a friend to volunteer one day and ended up spending much of her summer working in the gardens. The support of the Haub School of Environment and Natural Resources for ACRES has been immense, having given two ACRES students grants for compost system development and for buying and planting fruit trees on the farm. Perhaps their greatest investment has been in assigning Katelyn Parady, a senior political science/ENR major from Rock Springs, to us for her ENR summer internship. She has stayed with the group, serving as the ACRES secretary, writing our weekly newsletter, and helping to keep us organized.

A very important aspect of agricultural sustainability is soil fertility. The ACRES students identified an opportunity to help reduce the food waste that's sent to the landfill from the university's dining facilities. They have been working with Eric Webb of UW Residence Life and Dining Services and Mark Zieres at Washakie Dining Center to compost a portion of the dining hall's pre- and post-meal waste. Washakie has been preparing for this possibility for some time, having installed a food grinder during their most recent remodel. The staff there is very excited by the potential and has been working closely with the student farmers to clean up the post-meal waste by switching from

The support shown to the student farm by the Laramie community is overwhelming and indicates a level of success that will grow as the farm produces more and better produce.

Photograph by Trice Megginson

Senior agroecology major Nate Dittman of Omaha, Nebraska, turns compost in the student-designed compost facility at the ACRES farm.

plastic to compostable paper plates. They have changed from a chemical detergent and deodorant for alleviating the smell to an organic product that won't interfere with the composting process. In addition to Washakie's food waste, scraps from UW Catering and several area coffee shops and barley mash from a Laramie microbrewery are included in the ACRES compost program. As the student farm builds its composting system, this rich organic matter will be used to increase the farm's soil fertility and will be shared with Laramie gardeners to improve their vegetable production.

Success

How do we measure the success of ACRES?

We can look at the farm success from an economic perspective. The group received grants totaling $3,500, including $2,000 earmarked for the compost system. Volunteers provided all the labor while the seed, tools, hoses, drip irrigation system, and mini-greenhouse were all donated. The university paid the water bill until the first of September and provided the tractor and diesel fuel used to prepare the fields. Between fees and supplies for the farmers' market and the water bill in September and October, the farm had costs of about $160. With $3,500 in grants, $998 gained from sales of produce at the farmers' market and food co-op, minus the $160 in costs, the farm netted $4,338 in its first year of operation.

There are other measures to consider. Academically, the College of Agriculture has granted about 20 undergraduate and three graduate credits in plant sciences to 16 students who have been involved in ACRES. The partnership between ACRES and UW Residence Life and Dining Services, while still at an early stage, promises to reap modest rewards for all. The support shown to the student farm by the Laramie community (it was they, after all, who bought $998 of produce from us) is overwhelming and indicates a level of success that will grow as the farm produces more and better produce.

The measure I hold most dear, though, is the personal growth I've seen in all of the students involved. They've done something incredible, and they know it.

And they keep going! In fall 2007, the students continued to meet every week for planning and organizing. They've begun to implement the composting system they designed and are picking up food scraps from the local businesses, UW Catering, and Washakie Dining Center twice a week. They're also researching high tunnel designs with solar or wind energy options and are making plans to purchase a system in the spring. They've ordered raspberry, currant, and cherry plants with which to develop a local source of fruit for sale to the community and have planted several cold hardy apple trees as well.

They are advising me on what they would like to see for future student farming classes. These classes will serve as an important recruiting tool to help ensure the continuity – or sustainability – of student involvement in the farm. They are also pursuing opportunities for more summer internships on the farm through ENR and AmeriCorps, a national and community service organization.

As I bent back over to harvest more rainbow chard, I felt very proud to be involved with this diverse group of highly motivated students. Though my aging back was not happy, my head and my heart were overjoyed to be providing fresh, local produce to our community and a sustainable farming experience to our students.

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EXPERIMENTAL ECONOMICS LAB puts Adam Smith's invisible hand under the microscope

Amy Nagler
Assistant Research Scientist

Christopher Bastian
Assistant Professor

Dale Menkhaus
Professor

Department of Agricultural and Applied Economics

Photograph by Amy Nagler

Professor Dale Menkhaus demonstrates a laboratory market to graduate students Paul Frankowski and Ashley Miller.

Economists in lab coats?

Traditionally, data used by economists come from observing real-world markets; however, economic experiments designed to examine the behavior of "homo economicus" in a controlled setting are taking place behind the door of room 228 in the College of Agriculture.

Experimental economics is an increasingly popular tool for economists to create virtual markets and study decision making. Using university students as experiment participants has proved useful to put economist Adam Smith's metaphor of the "invisible hand" under the microscope.

The discipline of experimental economics has been used to shed light on interesting questions in economics: How are economic decisions motivated by self-interest, altruism, rational thought, cooperation, and fairness? Are there cultural or gender differences in bargaining and trust?

The 2002 Nobel Prize for Economics went to Professor Vernon Smith of George Mason University, a pioneer of experimental economics. He used laboratory markets to

A state-of-the-art laboratory has already been used to research a diverse number of topics including alternative trading institutions, family economic behavior, and allocations of land for habitat conservation.

Photograph by Robert Waggener

University of Wyoming Associate Vice President Nicole Ballenger, Vice President Myron Allen, and College of Agriculture Dean Frank Galey at the dedication ceremony for the new experimental economics laboratory, March 2007.

examine how the design of auctions can affect the final price agreed upon between a buyer and seller.

The University of Wyoming's New Experimental Laboratory

A state-of-the-art laboratory in the Department of Agricultural and Applied Economics, dedicated in March 2007, has already been used to research a diverse number of topics including alternative trading institutions and methods of delivery in agricultural markets, family economic behavior including links between childhood obesity and parenting, and allocations of land for habitat conservation. The lab is also used to teach students about economic theory and individual behavior.

One ongoing study uses the lab in collaboration with the U.S. Department of Agriculture's Economic Research Service (USDA ERS) to evaluate potential agricultural policies.

A Cooperative Policy Study

A cooperative agreement between the College of Agriculture and the USDA ERS began in 2004 to study consequences of alternative agricultural policies *ex ante* – or before they are enacted. Policymakers and legislators in Washington, D.C., are interested in agricultural legislation that facilitates international trade, provides free market signals for agricultural producers, and reduces deficit spending.

Decoupling Under a Bond Scheme

In the parlance of agricultural policy, "decoupling" refers to whether a government subsidy paid to farmers influences their production decisions or market prices. A policy that is "decoupled" is a good thing in the eyes of the World Trade Organization (WTO) with reasoning along these lines: Say Wyoming took its newfound mineral wealth to enact a policy guaranteeing every cattle rancher in the state a minimum price of $5,000 for each steer or heifer sold at market. Two things might happen. Wyoming ranchers would have a big incentive to increase their herds. Next, cattle ranchers in neighboring states would begin to complain. Their under-subsidized bovines would not

Free trade proponents argue the best prices are those set in a free market – relying on Adam Smith's invisible hand to balance production supply and consumer demand.

be able to compete with Wyoming beef, especially as the increase in production began to flood markets, artificially dropping market sale prices in local auction barns.

This coupled policy would clearly influence production and market prices.

This is what is at issue in international agricultural markets when developed countries pay large subsidies leaving the WTO concerned about market impacts on farmers from countries whose governments are less able or willing to pay. Free trade proponents argue the best prices are those set in a free market – relying on Adam Smith's invisible hand to balance production supply and consumer demand.

One potentially decoupled policy the United States as well as European Union policymakers are interested in would pay 15 or 20 years' worth of existing coupled payments up front in exchange for producers giving up all other future program payments. This "bond" would offer producers currently receiving government payments a transitional bridge to a more free-market environment. Such a scheme would allow farmers who wanted to retire or diversify into other sectors to cash in their future payments. Others might want to use returns from the bond to invest in their agricultural business or spend as household income. Such a proposed bond scheme is the focus of a recent set of market experiments in the University of Wyoming lab.

The Nuts and Bolts of Experimental Markets

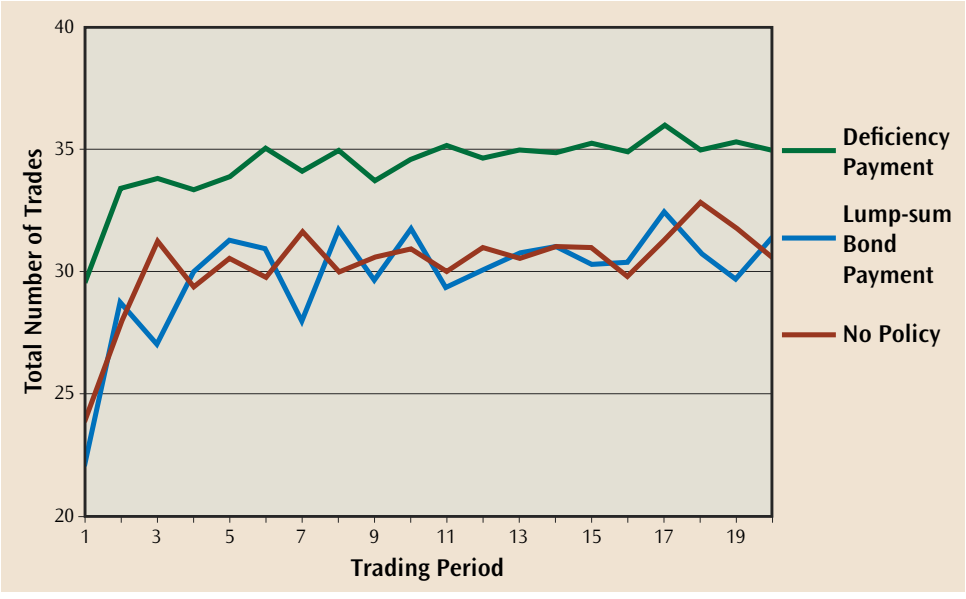
Cash is used to motivate experiment participants to reveal their behavior in markets. Students recruited to participate in laboratory markets trade "units" for "tokens" over a computer network. Units are an imaginary commodity and have no intrinsic value except for their redemption value. Tokens are a virtual currency with a fixed exchange rate of 1 token equals 1 cent. At the beginning of each experiment, participants are given an initial balance of 700 tokens (or $7) to offset the costs of producing units in early periods. Earnings accumulate during a sequence of production/trading periods, and participants are paid their token equivalent in cash at the end of the experiment. Payouts for this set of experiments ranged from $67 to $97.

To investigate the market impacts of a bond policy, a simplified experimental market was designed consisting of six producer/sellers making decisions on how many units to produce under different policy treatments with the experimenter acting as buyer.

Policy treatments imposed on this "sellers-only" market included a control or base treatment with no policy implemented, a traditional target-price policy that is coupled to production through a guaranteed target price, and the untried bond subsidy in which a lump payment paid to sellers was theoretically not tied to production.

Some Experimental Market Results

As shown in the figure below, with no policy in place, the number of trades or "production" in this experimental market converged near 30 trades per production period. As expected, and consistent with other



Trades/Production in an Experimental Sellers-only Market by Policy Treatment

Photographs by Amy Nagler

Economic experiment participants view instructions and participate in an experimental market buying and selling "units" for "tokens" they exchange for cash at the end of the session.

Student Jessica Hanson participates in the laboratory market.

experiments, production under a deficiency payment designed to boost prices by setting a minimum target price was significantly higher – increasing to more than 35 trades per period. Interestingly, payment of a lump-sum bond (equal to the total amount paid to sellers for 20 production periods under the deficiency-payment treatment) resulted in production not significantly different from a market with no policy. This result suggests a bond policy would likely be decoupled and acceptable to policymakers and the WTO.

Results Presented in Washington, D.C., and Ongoing Experimental Work

Results from this and other policy-related experiments were presented to policymakers in Washington, D.C., in May 2007. USDA officials also were asked to participate as buyers and sellers in an experimental market. This experience was an eye-opener for many of these policymakers and government economists who found themselves being very competitive. This research also will be presented at the American Agricultural Economics Association meetings in July, 2008, in Orlando, Florida. Ongoing experiments will examine the impact of various agricultural policies on land-rental values.

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A FISHY BUSINESS!

Researchers see if fish and vegetable system could prove profitable

Nathaniel Storey, Graduate Student

David Wilson, Senior Lecturer

Karen Panter,
Extension Horticulture Specialist

Photograph by Nathaniel Storey

This vertical acroponic technique is one of several methods being researched. A nutrient solution trickles down inside the tubes.

What do you get by combining a livestock tank, some septic pipe, lettuce seeds, and a few fish?

Aquaponics!

Aquaponics combines aquaculture and hydroponics (growing plants in a nutrient solution instead of soil) to produce both a fish and a vegetable crop. Although the word aquaponics sounds high-tech and modern, the idea is as old as many ancient civilizations. Ancient cultures in Asia and South America grew fish and plants in close proximity and profited from the complementary nature of the two crops. The idea really hasn't changed much over the centuries, and aquaponics promises to be a simple, sustainable way to produce fish and vegetables in the same system.

Fish and plants are perfect for each other. Fish waste supplies 10 of the 13 major nutrients needed by all plants, and plants are very efficient at removing these nutrients from the water. Ironically, the highest costs of aquaculture are often removing or disposing of these "waste" nutrients from the water while the most difficult part of hydroponic crop production is often mixing and providing these same nutrients to the plants. With the increased costs of hydroponic production, increased water costs, and increasingly strict water-quality legislation, combining hydroponics and aquaculture seems to make sense.

It also makes sense for places like Africa and Southeast Asia. Many developing areas have very poor soils and very poor food security due to recent urbanization, worn out soils, and poor fertility management. One of the goals of this project is to determine if this vegetable and fish growing technique could work in these areas of the world as well as here in the United States. If this technique is feasible, then it could be a great agricultural tool for many areas that need simple, dependable vegetable and fish production.

The goal of this aquaponic experiment was to build a system under several restrictions. First, the system must contain components as affordable and accessible as possible. For this reason, only inexpensive, universally available components were used.

Another guideline was the system had to be simple to understand and relatively easy for a layman to build. For this reason, the entire system can be built with nothing more than common hand tools: a saw, a drill, and an optional $10 hair dryer (for molding plastic pipe). It also had to be simple to operate with little reliance on electricity or resources that might not be available in other areas of the world. Because of this, the system can be powered by old solar panels, a car battery, or simply climbing a ladder and manually dumping a bucket of water into a gravity-fed tank.

Photograph by Nathaniel Storey

Nile tilapia used in the research originated in the Nile River.

Here's How It Works:

A 300-gallon stock tank serves as the fish tank. Water from this tank is pumped up to a gravity-fed tank that also acts as a manifold, distributing water to different hydroponic components. Almost all of the piping connecting these different components is black polyethylene pipe available at hardware stores. Water flows from the gravity-fed tank through the hydroponic components, where it is purified by the growing lettuce and naturally occurring filter system bacteria. It then flows back into the stock tank, purified and clean for the fish. When run on solar panels, the system cycles as long as the sun is shining, which is also when plants are respiring the most. When the gravity-fed tank is filled by a battery-powered pump or by hand, the system cycles periodically throughout the day.

The fish used in the system are Nile tilapia. These fish originally came from the Nile River in Egypt. Tilapia have been successfully grown around the world, and many people call them "sea chickens." Perhaps the name "sea pigs" is more fitting because they will eat just about anything! They efficiently gain weight on anything from algae to lawn clippings to commercial feeds, and they're happy in a variety of conditions, including saline and poorly aerated (almost stagnant) water. These broad tolerances of water qualities and wide range of feed inputs make these fish ideal for this system. They also readily reproduce, making it easy to establish brood stock for future production.

Not only are they easily grown, but they're excellent eating, and tilapia are rapidly becoming one of the most-consumed fish in the world due to their flaky white flesh and mild flavor. Walk into any supermarket and tilapia fillets can be found retailing for approximately $4 to $10 per pound. The market for this fish is growing with few signs of slowing in sight!

The plants grown in this system are lettuce varieties normally found in a supermarket, although a large variety of plants can potentially be grown in this system, including many different herbs, cucumbers, and tomatoes.

The project, located in the Laramie Research and Extension Center, is testing three different plant growing techniques: one is the Nutrient Film Technique (NFT) used by many commercial growers, one is a gravel-bed technique using 55-gallon barrel halves filled with road-base gravel, and the third is a novel vertical system (designed at UW by Nate Storey and Dave Wilson), which, if successful, could decrease necessary growing space by six-fold compared to traditional techniques.

If this technique is feasible, then it could be a great agricultural tool for many areas that need simple, dependable vegetable and fish production.

Photograph by Dave Wilson

Basil grows in the hydroponic troughs in an aquaponic system at the Maricopa Research Station at the University of Arizona.

In the gravel-bed technique, plants are grown in gravel with nutrient solution trickling through it. In the NFT and vertical techniques, the plants are grown suspended in troughs or septic pipe with small amounts of water trickling down the bottom or along the sidewalls. The plants in these last two techniques are primarily suspended in air, which is why these techniques are called aeroponic. Both the NFT and the vertical components are primarily made of PVC piping, making them easy and affordable to build.

Cool Temperatures a Consideration

In northern latitudes, the system needs to be operated inside a greenhouse during winters because the only thing the fish can't handle is water cooler than 50° Fahrenheit. Warmer regions of the United States or other parts of the world would not require a greenhouse, while colder regions could use inexpensive Quonset greenhouses to house the system or more cold-tolerant fish species. As the months grow warmer, the experimental system will be moved outside to see how it performs. Hopefully, the system will perform as well outside as inside, indicating its potential for summer outdoor use in areas with climates like Wyoming.

As this research continues, it could prove to be a great agricultural tool for developing regions, as well as a great source of alternative farm income. Because of the wide range of fish food possibilities, aquaponics could prove a valuable way to loop farm wastes back into farm systems, producing valuable renewable inputs, decreasing off-farm costs, and creating higher profit margins.

This research also offers many future research opportunities. Researchers may look at using manure and manure tea inputs in the system, running the system in greenhouses heated using alternative energy sources, and using cold-tolerant fish species or coal-bed methane discharge waters in various systems. This system also offers a great deal of research potential in organic fish and vegetable production.

Ultimately, this project could benefit many people. It addresses the needs of developing regions needing vegetables and protein. It could provide an option for producers looking for alternative farm income opportunities. And, it could provide a use for resources like manures or coal-bed methane produced waters that are being wasted. Hopefully, for the price of a stock tank, septic pipe, seeds, and a few fish, we can make growing vegetables an efficient, profitable, fishy business.

A nutrient solution feeds plants in a gravel bed.

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Mountaintops to LOWLANDS

Extension educator's odyssey across Wyoming's mountains and plains yields rugged plants that lead to new landscape options

Tom Heald, Educator
University of Wyoming
Cooperative Extension Service

The question was exactly the answer I was looking for.

"What if we had a drought and our landscape plants didn't know it?" asked Panayoti Kelaidis, director of education outreach of the Denver Botanic Gardens during a class I was attending.

As an extension educator for two decades with an emphasis in horticulture, I was perplexed in what I was seeing in our Wyoming landscapes – a consistent decline in the health of trees and shrubs. His question provoked me to rethink what "adapted" means for Wyoming conditions.

Kelaidis's lecture focused on plant materials for landscapes in the arid West. As a plant explorer, his passion is to collect specimen plants from the world's dry, windy, and cold places – the Asian and Russian steppes, Patagonia, and the western United States. His research suggests plants that do well in those locations should do well in most areas in Colorado and Wyoming.

Although following in Mr. Kelaidis' steps of being a worldwide hunter of plants sounded intriguing and exciting (Tom Heald, Indiana Jones of Plants!), I knew I didn't have the time, credentials, or money to do so. Nonetheless, investigating the ultimate adapted plants for Wyoming – our own native trees and shrubs – made perfect sense.

In 2005, the University of Wyoming, the UW College of Agriculture, and the UW Cooperative Extension Service supported my interest in researching Wyoming natives for their landscape potential by granting me six months professional leave. Six months of exploring Wyoming's ecosystems! The Indiana Jones side of me yelled with excitement! An unbelievably great assignment! What I found in my

travels through Wyoming's prairies, deserts, and mountains excited me! Call them tough and weathered, but I see them as beautiful ornamentals for our landscapes.

Spring 2005 was shaping up to be in another drought, when, as I began my quest, the rains came, and it was a perfect time to have a look-see of the Black Hills near Sundance in northeastern Wyoming. Both Wyoming and South Dakota share this mountain range (with approximately one-third of the "Hills" in Wyoming), which begins just south of Newcastle and extends north of Sundance. They lack the elevation of our other mountain ranges (the highest point is Harney Peak at 7,242 feet), and the towns of Laramie and Pinedale would be at eye level to their highest point.

The Black Hills are known for their cultural significance to American Indians. They are considered sacred. The Black Hills are a sacred place for plants as well. It is here I found western, Great Plains, and northern forest species co-existing. This is a true melting pot for trees. Ponderosa pine (*Pinus ponderosa*), the most common tree of the "Hills," was right at home here, and I found them flourishing in the rocky, gravelly soils. These pines are well known in the horticulture industry and will do well across Wyoming – and I noted they were never found where their roots did not have drainage – near swamps, ponds and creeks. A take-home lesson – don't plant these trees where moisture is in abundance from overwatered lawns!

Hawthorn

Black Hills spruce (*Picea glauca* var. *densata*), on the other hand, was found along the mountain creeks, its needles darker green in color than the Colorado blue spruce and not quite as tall. I never found them in areas that retain water for long periods even though they can tolerate wetter conditions. My conclusion was these trees would do well in traditionally cared-for lawns but probably not lawn areas with slow-to-drain clay soils.

Our state tree, the plains cottonwood (*Populus sargentii*), was in abundance along the lower sections of the Hills and always found along the creeks. This majestic shade tree and its hybrid cousins are probably the most planted tree in Wyoming; this is the tree that wants water! Too often, I have seen cottonwoods planted on windblown hillsides only to succumb to the ravages of not having enough water.

Hawthorns (*Crataegus* spp.), small trees with abundant thorns, were also found throughout the Hills near streams. They have a unique ruggedness and beauty. I saw them produce beautiful white flowers in May and bright red fruit later in August.

Hawthorns have a unique ruggedness and beauty. I saw them produce beautiful white flowers in May and bright red fruit later in August. Hawthorns are tolerant of various soil and moisture conditions.

Hawthorns are not planted much in the Wyoming landscape and yet they are tolerant of various soil and moisture conditions.

Paper birch (*Betula papyrifera*), found throughout the Boreal Forest of Canada, was at home here. They are considered remnants of the last ice age. I found them in colonies much the way one finds aspens.

But the most dominate deciduous tree was the bur oak (*Quercus macrocarpa*). Unlike the cottonwoods, this oak was at home alongside the ponderosa. A tall shade tree (height 60 feet, width 35 feet) with a massive trunk and stout branches, its leaves are dark green on top and gray-green beneath and it has acorns up to 1-inch. The bark is deeply furrowed. I was looking at a warrior of a tree I knew would do well in many parts of Wyoming! This slow-growing tree can tolerate the harshest of conditions and survive periods of drought.

One of the more exciting finds happened when I was travelling along the 33-mile stock trail up the southern end of the Big Horn Mountains in north-central Wyoming. The

The author, right, exploring Wyoming flora.

Bigtooth maples

Bur oak

trail, southwest of Kaycee, is aptly described – this is no place for a car. A good horse would make the most sense, but I had my trusty 4X4 truck. This is where the plains meet the mountains, and, unlike the mountains, it is dry and windswept. The trail is still used today to trail livestock into the high country in spring and back again in autumn. This is the same area outlaws Butch Cassidy and the Sundance Kid escaped to in those early years to avoid law enforcement.

As I started to ascend the trail, small, broadleaf evergreen shrubs were found dotted in abundance – the curl-leaf mountain mahogany (*Cercocarpus ledifolius*). It has an upright habit, is 10- to 20-foot tall and 10- to 15-foot wide at maturity, and it has dark green, hairy leaves that curl under giving it its name. This shrub would make a great accent plant in a xeric (low-water) landscape with the added bonus of remaining green through Wyoming's long winters. What really astounded me as I went farther along the trail was finding bigger and older specimens. They were no longer shrubs but beautiful, small, bonsai trees. I say bonsai because wildlife and domestic animals have browsed the tips of the branches creating a canopy of branches and leaves so dense a browsing animal could not poke its face into it to take a bite.

> Today, as drought continues and global warming intensifies, the horticulture industry is renewing its interest in bringing native plants to market.

Later, during research, I came across an article that dated curl-leaf mahogany in northwest Nevada at 5,000 years old! I was not in northwest Nevada, but I was in the presence of a life form at least one thousand years old and quite possibly much, much older! As a reference point, some bristlecone pines of the Sierra Nevada Mountain Range in California have been dated to be 6,000-plus years old – the oldest known living organisms in the world. Nonetheless, I suspect these mountain mahogany specimens are the oldest living organisms in Wyoming.

August and September found me exploring the Teton and Salt Creek mountain ranges of far western Wyoming. I noted the beautiful mountain ash (*Sorbus scopulina*), laden with its cherry-red fruit and the colonies of quaking aspen (*Populus tremuloides*) leaves rustling with the breeze on the hillsides. Amongst the aspens was another deciduous tree with outstanding ornamental potential, the bigtooth maple (*Acer grandidentatum*). In summer, this tree, with a height of 25 feet and width of 15 feet, has dark green, five-lobed leaves. In autumn, these leaves turn brilliant colors of yellow, orange, and red. Their autumn colors brilliantly standout from the yellow of aspen leaves. Ecologists have theorized this maple and the sugar maple of the northeastern United States is essentially the same tree but developed separately as ice ages scraped the North American landscape.

In researching horticulture literature reviews, I found the bigtooth maple to be highly tolerant of alkaline soils and periods of drought. Here was a tree with outstanding opportunity to be in Wyoming landscapes, and, to think, one did not have to go to Vermont to see extraordinary autumn colors!

I never thought southern Wyoming, just south of Rawlins, would

Curl-leaf mountain mahogany

Plains cottonwood (left) and bur oak.

be a plant mecca. But, on this wind-swept sagebrush steppe, where winter winds exceed 80 miles an hour and the snow that does fall gets blown into huge snowdrifts and which has hot, dry, windy summer days, I was finding shrubs not only existing but thriving.

Here was antelope bitterbrush (*Purshia tridentata*) growing as a ground cover shrub in a full bloom of spring yellow flowers with waxy, thick, small "three-dented" leaves. In my mind's eye I saw this as an excellent candidate for someone's dry hillside landscape or planted near a boulder where it could crawl up and around it. True mountain mahogany (*Cercocarpus montanus*), standing upright with no apparent look of being deformed from the constant winds, reminded me of a color guard on duty. What a standout specimen for some of our most windy landscape sites in the state!

Fourwing saltbush (*Atriplex canescens*) was found in the basins of this steppe country – it is only 3-foot tall and 4-foot wide and, as the name suggests, is salt tolerant. In summer, it possesses gray-green foliage, and in autumn the female plants develop four-winged fruit and take on a soft rose tint. This is a plant that needs to be used more often in our most challenging soils. It provides color and presence when quite possibly nothing else could live.

One shrub stood out as a tribute to its robustness in this wicked environment – the Utah serviceberry Koehne (*Amelanchier utahensis*). Here was a very dense shrub (height 12 feet, width 8 feet) that in spring is blanketed in white flowers followed by edible bluish to black fruit cherished by birds. This is a shrub that should be on everyone's list as an outstanding windbreak and wildlife specimen!

There were more – lots more – and I was thinking Kelaidis needed to explore this area, only three to four hours from his home in Denver!

My six months flew by. The Indiana Jones of Wyoming Plants had to hang up his hat!

Today, as drought continues and global warming intensifies, the horticulture industry is renewing its interest in bringing native plants to market. Wyoming is still untapped for its potential to play into this market. A few Colorado plant propagators/ nurseries have actively started collecting in Wyoming, but I believe the door is wide open for a Wyoming business to set up shop.

As for me, the work I did in 2005 exponentially increased my skill sets. I am much better equipped to assist homeowners in making solid choices for their home landscape – Wyoming choices that reflect the answer to the question.

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The buzz on West Nile

Do mosquitoes have distinctive signatures?

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Wyoming has one of the highest per capita rates of West Nile virus infection in the nation. By the current 2007 data posted on the Centers for Disease Control and Prevention Web site for reported human cases, the state had 180 cases. If you take the number of human cases reported in each state (http://www.cdc.gov/ncidod/dvbid/westnile/Mapsactivity/surv&control07Maps.htm) and divide by the states' July 1, 2007 U.S. Census Bureau population estimates rounded to the nearest 1,000 (www.census.gov/popest/states/tables/NST-EST2007-01.xls), North Dakota is highest with 0.573 cases per thousand, Wyoming is second at 0.344, and South Dakota is third at 0.260. Colorado had the highest number of reported cases in 2007 at 555, but, with 4,861,000 people, that is only 0.114 cases per 1,000. Fremont County in Wyoming had a very high incidence of 3.5 cases per 1,000 in 2007.

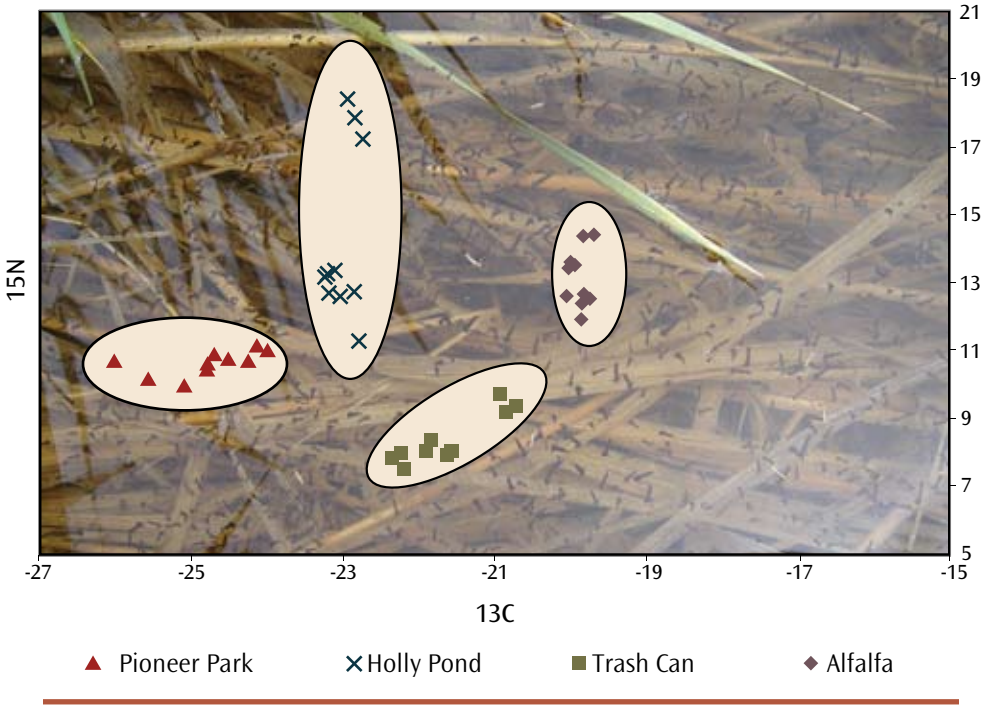
This recently introduced, mosquito-borne disease has stimulated lots of research in applied mosquito ecology.

There is a possibility of even more serious insect-vectored diseases, such as Rift Valley fever, making it to our shores. Rift Valley fever is fully described here: www.who.int/mediacentre/factsheets/fs207/en/. Essentially, this disease would be devastating to livestock producers due to high abortion rates in pregnant sheep, cattle, and horses, and high death rates in young livestock. In humans, the three worst forms the disease can take are ocular, meningoencephalitis, and hemorrhagic fever, which can cause vision impairment to blindness, permanent neurological deficit, and death.

This encourages novel approaches, such as the application of stable isotope technology, to mosquito monitoring and management. Headquartered in the College of Agriculture's Department of Renewable Resources, the UW Stable Isotope Facility (SIF) houses a high-tech research instrument, an isotope ratio mass spectrometer (IRMS), that may be very useful in helping control our age-old enemy, the mosquito.

Mosquitoes can't write, but elements in their bodies form a one-of-a-kind signature that reveals their original habitat. Stable isotopes are forms of common elements, such as

Scatter plot of *Culex. tarsalis* mosquitoes' isotopic ^{13}C and ^{15}N signatures from diverse larval habitats sampled in 2005.



virus

carbon and nitrogen, which differ in atomic masses, are not radioactive, and make up very small percentages of the commonly occurring elements.

The natural abundance of the isotopes can vary with habitats. The SIF's IRMS can measure the amount of these stable isotopes in very small samples, such as individual mosquitoes. The stable isotope signature of mosquitoes hatched from rainwater caught in an uncovered trash can or an old tire turns out to be very different from the signature of one that originated from the tail-waters of an irrigated cornfield.

The source of carbon in the organic matter in the water will determine if it is enriched or depleted in the C13 isotope. Warm-season grasses, like corn, take up more of the heavy carbon than forbs like alfalfa or cool-season grasses due to the different chemical pathways the warm-season grasses use for photosynthesis. Nitrogen fixed by leguminous plants and incorporated into organic matter will have a different isotope ratio than nitrogen from synthetic fertilizer. Biogeochemical processes can either favor or discriminate against the stable isotopes of the common elements. This allows us to determine the source of a mosquito's isotopes by the sources of carbon and nitrogen in its larval habitat.

Graduate student Travis Gilchriest prepares mosquitoes for testing in the UW Stable Isotope Facility.

How would this information be of help to mosquito managers? Mosquito control districts use traps to monitor adult pest populations. If, after treating all the known larval habitats in the district, mosquitoes still continue to arrive in the trap, the supervisor may submit mosquito samples to SIF. The stable isotope analysis of these samples would help determine where the insects are coming from. The isotope signature may indicate an untreated mosquito source habitat or one that is outside the boundaries of the district.

Mosquitoes can't write, but elements in their bodies form a one-of-a-kind signature that reveals their original habitat.

Elements in a mosquito's body can reveal its original habitat.

The stable isotope signature of mosquitoes hatched from rainwater caught in an uncovered trash can or an old tire turns out to be very different from the signature of one that originated from the tail-waters of an irrigated cornfield.

The signature test would help exclude habitats but couldn't pinpoint exactly where in a habitat the mosquito came. For example, if a district is treating floodwater areas and continued to catch mosquitoes with a floodwater habitat signature, the SIF test probably would never be specific enough a manager could look at the data and conclude a need to retreat a specific portion of the habitat. The manager would have to re-survey all of the district's floodwater habitat to find the source. It doesn't take long to run a sample and the cost is not extravagant for the common elements, but it is not "real-time" fast and the wait time depends on the length of the queue. Or, the test may show the control level in the already-treated habitat was not sufficient enough to kill all the mosquitoes. Such information would help mosquito managers better direct control efforts.

This pilot research project was conducted on mosquitoes collected in and around Torrington, Wyoming, and has yielded promising results. Initially, the study was funded by Professor Emeritus of Entomology Jack Lloyd, who covered the costs of the sampling of wild mosquitoes and the SIF analysis of 188 samples. He was able to do this with gift money leftover after retiring in 2005 from more than 37 years of research on veterinary and medical entomology problems of importance to the state of Wyoming. Furthermore, using the remaining gift money, Lloyd created an endowment to support an ongoing scholarship for an entomology graduate student. One of the possible projects for such a student could be further development of this promising stable isotope technique and making it a useful tool for mosquito managers.

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Researchers travel Wyoming to determine rural residents' healthcare wants

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Imagine you are really ill with a headache, cough, and nose so congested you have to breathe out of your mouth. To make matters worse, you are in the middle of calving season and you've been up all night every night for what feels like weeks. You finally decide you need help. You call in to town to set an appointment with the new doctor. Your friend has seen her and says she seemed nice. Since your nurse practitioner just left town, you really don't have many options. You get an appointment for two days from now (that was the first available appointment) and make plans to be gone for the day.

If all or part of this sounds familiar, you are not alone. Health care in rural settings continues to be a challenge facing many Wyoming families.

The issue is more than having a physician, physician's assistant, or nurse practitioner. This is important, but the quality of health care received by rural Wyoming families is equally important.

One gauge of healthcare quality is the use of "evidence-based practice" – where providers base their care on current research and clinical experience as well as the values and beliefs of the specific individuals and families they serve. Providers consider the specific values and beliefs of individuals and families and use this information in concert with current research in the field and their own clinical judgment.

Trouble is, most providers tend to focus solely on the research aspect of evidence-based practice; that is, they are continually updating their practices based on the latest medical studies. While important, many providers know nothing about the specific values and

beliefs of their patients much less the unique values and beliefs of rural patients.

In particular, they may not be aware of the values and beliefs regarding something many rural families face several times a year – the common cold. This knowledge is important for rural families to receive the best healthcare possible.

This study, a partnership between the two authors, is an attempt to address the question – what are the values and beliefs of rural Wyoming families regarding the common cold?

To answer this question, we set out across the state. We met with small groups of people in communities in all four corners of the state, posed questions, and listened. We discovered rural families have specific needs regarding access to healthcare and unique concerns and resources that need to be acknowledged – needs regarding access to healthcare and a need to be appreciated as an individual. These needs are described in further detail below.

Parents of children with special conditions, such as asthma, want to be valued for their knowledge of their child's specific symptoms.

Access to Healthcare

Rural family members want to be listened to and to be valued for the knowledge they have of themselves in terms of illness symptoms and "what works."

Rural families desire prompt and cost-effective care. By the time they call for an appointment, most are **really** sick – and can't wait another week to come in. Families report frustration when they call in and are told they have to wait three or four days for an appointment.

They wish to be seen in one appointment and permitted to follow up with a phone consultation. Due to costs, travel, work, and other logistics, rural families do not want to make two visits for the same illness and do not want to hear: "Your problems are not that bad right now, but, if they get worse, come in again and we'll reevaluate the situation." They prefer to call their provider after they have had an initial visit and discuss symptoms if they get worse. The following quote illustrates this expectation:

> Well, I go to Gillette. We live 14 miles out in the country. So I drive 14 miles (to the highway) and 48 miles on (into town) … And my time is as important as anyone's, I feel, so I do not expect to have to go back in because I don't want her to say, "Well, you know, your lungs are a little iffy today, but I think I'll hold off"…. "Do you know where I live? Do you know how far this is?"

During visits, rural families report wanting advice on managing symptoms; they are not necessarily seeking antibiotics but symptom relief – for example, receiving recommendations on treatments or medication for a stuffy nose, sore throat, etc.

Lastly, rural families seek the same access to their healthcare providers as other members of their community – for example, being allowed informal phone consultations, same-day appointments, etc. Due to the small nature of many rural communities, people tend to report they "know" what is going on – for example, that some people get in quickly to see certain providers and others have to wait. Or, that others are allowed quick phone calls, even to the provider's home, and others are not. This may or may not be the case, but the perception of unequal or "unfair" treatment can be a challenge to individuals as well as providers.

Appreciation of Self and Family Knowledge

In our study, rural individuals reported they "know" themselves – how they respond to illness and how their family members respond to illness. And, in particular, the knowledge they may have of the symptoms of specific members of their families — for example, a son with asthma or an elderly grandmother who is prone to pneumonia. Families in our study reported a strong desire for healthcare providers to understand and appreciate the knowledge they have of their symptoms during their appointment and factor this knowledge in to any treatment plans or recommendations made. In our opinion, this is related to the desire of rural families to be seen only once. Because many rural families have to travel great distances

or have challenges getting to their provider promptly, there seemed to be a sense of urgency to be understood and acknowledged during the visit. Some participants did report it was easier to be appreciated when one had a relationship with a provider; it was more challenging when a relationship with a provider was new or not established.

Appreciation of Family and Community Resources

Families in rural communities report drawing on informal consultations with community-based providers for initial symptom management. For example:

> Like with the kids at school, I call the school nurse and say, "You know, their ear is hurting. They've had a runny nose. Will you look at it?"

Some may solicit advice from family members who are healthcare providers, from nurses to veterinarians. So, by the time they see a healthcare provider, chances are they have asked and been given a range of suggestions, cures, and recommendations.

Family may play a role in how rural families manage a cold – in particular, the cures and treatments they report using often come from family members.

As noted above, family members may also provide advice and information; however, we also discovered, for many rural individuals and families, support may also come from fellow community members. They may also look to fellow community members for advice and assistance when actually ill.

Rural individuals value established relationships with healthcare providers.

> That's one thing about this community. If you are down sick someone will come and check on you and will do something for you….it's like a family. We kind of look out for each other.

The community also serves as a "warning" for illnesses going around and what to do if you catch it…

> Everyone knows everybody, and, if you know there's something going around at school and you call your friends and say "this is going around and this is what you do for it."

Based on the stories shared by the participants in our study, it is clear to us rural families have certain values and beliefs, that, when considered by their healthcare providers, could lead to an improvement in the quality of care for rural families. Of course, not all rural families may have these same values and beliefs, but an awareness and appreciation of some of the unique values and beliefs held by rural families may bring to a visit with a healthcare provider would go a long way in helping improve the quality of care they receive. Although we were specifically asking about how families dealt with colds, it's likely these values and beliefs would hold for other health-related issues. We look forward to sharing our results with healthcare providers and community members and being a part of the solution to improve healthcare for Wyoming families.

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Scientists try to outfox foxtail

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A plant cannot pick up its roots and move to a more desirable place to grow; however, some are very sly and fox-like in their ability to adapt to various conditions.

That ability to adapt could be the rationale for the common name foxtail barley. Its appearance when the seed head is mature and bushy – much like a fox's tail. Foxtail barley is a native, short-lived, cool-season perennial bunchgrass that spreads by seed and grows in dense bunches with shallow fibrous roots. Other common names include wild barley, skunk-tail grass, flicker-tail grass, tickle grass, and sea barley grass, all of which describe the plant's mature seed head appearance. The pale green heads or spikes are 2 to 4 inches long with spreading slender barbed awns 1 to 3 inches long (picture 1 on page 27).

> This weed presents a large economic loss to the livestock industry because of the reduction of available grazing land or the decreased value of hay.

The plant is fairly palatable to livestock and wildlife until it matures and develops a seed head. The plant then poses a serious threat to livestock and wildlife because the barbed awns may cause serious eye and mouth injury, though livestock and game animals generally avoid the grass when awns are present in a grazing situation (picture 2 on page 27). Hunting and stock dogs can also be adversely affected by these awns if they get into the ears or eyes of the dog; they will cause infections that are difficult to treat.

Likewise, hay has little to no value when foxtail barley awns are present. It is very difficult to time hay harvest for when the awns are not present because seed heads mature throughout the growing season and, by the time the hay is ready to harvest, foxtail barley has headed out.

This weed presents a large economic loss to the livestock industry because of the reduction of available grazing land or the decreased value of hay. The cost of treating animals with abscesses and the decreased animal performance is also a direct economic loss to livestock producers.

Foxtail barley acclimates well to a wide array of environmental conditions allowing for a broad geographical distribution. Infestations have been noted throughout the world. The species is indigenous to most of

barley in irrigated pastures

Photograph by Randall Violett

Picture 1. Foxtail barley infestation following a fallow year after sugar beet production. (This picture illustrates how fast and dense this weed will establish if not controlled.)

North America except in the southern Atlantic and Gulf Coast areas. The soil texture can range from light sands to heavy clays with the best germination of seed occurring in heavier soils. The moisture regime can be as equally broad, from dry to wet; therefore, infestation sites can vary greatly from cultivated fields and pastures to disturbed lands and waste areas.

More recently, minimum-till or no-till conservation practices have allowed foxtail barley to take a chokehold over such production areas. Tillage was once the main method of control because of the shallow fibrous root system. Today, with conservation methods and increasing costs of tillage, new methods of control need to be established.

A project was developed by the University of Wyoming Powell Research and Extension Center, to use cooperators' private land in the Big Horn Basin to conduct three separate studies dealing with the ecological characteristics and develop control practices for foxtail barley in irrigated pastures.

The first study was to determine if any ecological niche is being filled by this species and how can that ecological niche be filled with a more desirable grass species. This study was a survey of 10 separate sites throughout the Big Horn Basin of northwestern Wyoming. Soil samples were taken to the depth of 18 inches using a hand probe. Identification of plant species was done to develop an inventory and to assist in determining foxtail barley interaction zones. The soil samples were used to compare zones with foxtail barley to those without. The soils' pH, texture, and electrical conductivity (EC_e) were used for the comparisons because these three characteristics of soil are good indicators of soil-water interactions. The pH proved to be

Picture 2. Magnification showing the barbs on a foxtail barley awn.

the only soil characteristic that had no significant difference between the zones within a site, while soil texture and EC_e showed some relationship to foxtail barley concentrations. As the texture became more clay and the EC_e became greater, foxtail barley populations became denser confirming what was previously described as foxtail barley's ability to adapt to conditions few other plants can grow in.

One other grass species observed at these 10 sites growing close to if not within the foxtail barley stand was Garrison creeping foxtail, a much more desirable grazing grass that does not have the barbed awns. Additional research is being conducted to determine how to culture Garrison so it will out compete the foxtail barley within a pasture.

The second study was conducted on two separate sites in Park County using three different herbicides at

Photograph by Alan Gray

Picture 3. Herbicide screening trial shows Plateau's ability to control foxtail barley at different rates.

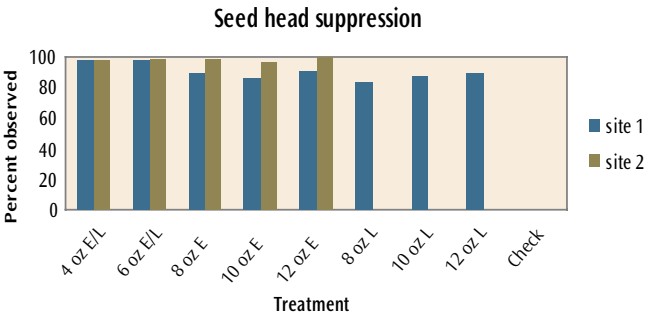

Chart 1. Foxtail barley seed head suppression with early (E), late (L) and split applications (E/L) of Plateau. Split applications are the most effective for suppressing seed head production of foxtail barley.

six different rates (picture 3). This herbicide screening study led researchers to a product labeled (Plateau) imazapic.

The third study was then established to determine timing and rate of Plateau application for maximum control of foxtail barley. Two sites were identified in Park County similar in soil characteristics and foxtail barley concentrations. Plateau treatments consisted of two application timings; 2-3 leaf stage (early) and 4-6 leaf stage (late), using five different rates: 4,6,8,10, and 12 oz/acre and two split applications using 4 and 6 oz/acre (early/late) (picture 4).

Early application of Plateau at 10 oz /acre was the most effective single application in reducing the weight of biomass grown throughout the growing season by 56 to 73 percent as well as suppressing seed

Picture 4. Plateau rate and timing trial shows the difference in control primarily based on timing of application. The green plots were treated early and no seed heads developed the entire growing season. The brown plots were treated late after some seed head production. The white plots are checks and this is what the entire study area would look like if the Plateau treatments were not effective.

head production by 90 to 95 percent. A split application using 6 oz/acre increased foxtail barley control by 12 percent and gave the best seed head suppression at 98 percent. The level of seed head suppression in this study was a pleasant surprise not observed during the herbicide screening study. Seed head suppression is a valuable reaction to this herbicide from the standpoint of allowing a land manager to graze the pasture and take advantage of a relatively high feed value grass without the hazards of the dangerous awn (chart 1).

Further research is needed to determine the length of time the seed head will be suppressed and how grazing affects the effectiveness of the herbicide. The work done in this study with split applications poses the question of how early in the growing season could a land manager spray, or could a fall and spring split application be more effective? This research is under way, and the results will be made available at the conclusion of the 2008 growing season.

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Disclosure: Common chemical and trade names are used in this article for clarity by the reader. Inclusion of a common chemical or trade name does not imply endorsement of that particular product or brand of herbicide and exclusion does not imply non-approval.

UW entomologists help develop the Vital Signs Monitoring program in the Great Sand Dunes National Park

Great Sand Dunes yields wonders within

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In southern Colorado, shadowed by the spectacular, snow-capped peaks of the Sangre de Cristo Mountains, lays one of the most geologically and biologically diverse parks in the nation. The Great Sand Dunes National Park and Preserve provides a unique environment for a diverse assortment of animals such as black bear, deer, antelope, bison, and many more. It is also home to insects found nowhere else on earth.

The tallest dunes in North America, rising 750 feet above the valley floor, the Great Sand Dunes are a natural oddity created by a coalescence of unique geological and hydrological forces. These forces have produced an environment like no other in the surrounding region – a

Photograph by Alexandre Latchininsky

Great Sand Dunes tiger beetle feasting on an ant.

miniature "Sahara" desert at the foot of an alpine wilderness. No wonder some inhabitants of this one-of-a-kind ecosystem are also quite unique. Among the more than 1,000 known local arthropod species, there are at least seven insects that find this mobile sandy environment exclusively home.

How did the sand dunes appear among the peaks of the Rocky Mountains? Over thousands of years, wind and time dispersed sediment of a massive prehistoric lake into what we see today. Now a massive and stunning dune field, it is kept in constant development by the recycling action of Sand and Medano creeks that flank it. All this adds up to a perfect recipe for speciation, and, in the case of the Great Sand Dunes, insects have taken up the challenge.

The Great Sand Dunes had been a national monument since 1932 and, in 2000, was declared a national park and preserve, increasing its managerial scope and conservation status. The health of this complex ecosystem is being permanently monitored to ensure natural processes are unhindered. To do this, the National Park Service, which manages the Great Sand Dunes National Park and Preserve, is developing the Vital Signs Monitoring program for all national parks. This program calls for selection of a variety of key components of a park's ecosystem that would be indicators of that ecosystem's health.

For the Great Sand Dunes, such Vital Signs are their seven unique insects. These insects are closely adapted to their environment and thus affected by its change. Like the blood pulsing through our veins, which is a vital sign of the health of our body, so are these insects a natural vital sign of the health of the Great Sand Dunes ecosystem.

After being contacted by the National Park Service, University of Wyoming College of Agriculture entomologists began close collaboration with the park's biologist, Phyllis Bovin, to start developing monitoring protocols for these endemic insects. The first step consisted of regular collections and observations of these insects the summer of 2007.

We were focusing on eight insects of interest, seven of which are truly endemic. The choice was made because each developed amazing behavioral and morphological adaptations to the challenging life in the harsh, sandy environment – an

Looking east over the dunes to the Carbonate Mountains, Blanca Peak to the far right and Mount Herard to the far left.

Photograph by Travis Gilchriest

environment constantly reshaped by the wind and where midsummer surface temperatures can reach 140 degrees Fahrenheit by noon. In addition to the eight species of focus, other insects were also collected to see if they might act as indicator species.

The best known of the endemics is the Great Sand Dunes tiger beetle, *Cicindela theatina*. This beetle, like many other species in its family, is colorful and distinctively patterned**.** These patterns are likened to stripes, thus the origin of the name "tiger beetle." Anyone who has observed the behavior of a tiger beetle would also understand the other reason to which it owes its name. The tiger beetles are ruthless and voracious predators that stalk, chase, and kill their prey. They are equipped with sinister-looking, sickle-like jaws or mandibles to subdue their prey. The Great Sand Dunes tiger beetle stands out from the 111 other species of this family in North America due to the distinctive pattern on its shell-like hind wings. Looking at one of these beetles, one can imagine a reddish-brown ink blot running down its back, and that pattern is the same for every individual of this species. This is contrasted by a striking metallic green midsection and head. The Great Sand Dunes tiger beetle is not an uncommon sight. One can observe these ½-inch long tigers of the sand scurrying across the dunes on stilted legs in search of prey. During the hottest period of the day, they seek shelter from the merciless midsummer heat.

At dawn or at dusk, the Great Sand Dunes visitors can also see the endemic darkling beetle *Eleodes hirtipennis*. At first sight, this medium-sized, ½- to ¾-inch long, beetle looks similar to many in its family; however, while other darkling beetles inhabiting the dunes are larger and more conspicuous, there is one characteristic that sets the endemic one apart from them. This beetle has unique hair-like structures called setae covering its back, which gives it a slightly fuzzy appearance. In fact, the species Latin name, *E. hirtipennis,* means "hairy wings." In the blazing sunshine, these beetles are very hard to find as they dig burrows into the sand to escape the excruciating heat.

Three other endemic beetles inhabiting the dunes are far less conspicuous. Little is known about their

Photograph by Travis Gilchriest

Giant sand treader camel cricket

life and habits due to their tiny size and sparseness. One, the endemic beetle from the Histeridae family, is a species that still remains unnamed. This hister beetle (*Hyppocaccus sp.*) is small, about 1/8-inch in length, round-bodied, and shiny black. It spends most of its time in the open dunes strolling between patches of blowout grass, one of the few plants able to survive on the shifting sands.

There are two even smaller endemic beetles that can also be found. These are the Werner's and Triplehorn's ant-like flower beetles *Amblyderus werneri* and *A. triplehorni*. These beetles are small enough

Photograph by Travis Gilchriest

Fence line disappearing into a dune

to be easily blown across the sand by the wind. If they cannot escape the wind, they just hold their legs into their body and go where the wind blows them. This adaptation is a very effective "tumbleweed" strategy as they are scavengers, and the wind blows them into the debris pockets in which they find their dinners.

Our research addressed such questions as when and where to look for the endemic insects. The findings have led to methods on how to estimate their abundance and gain insights in their biology, ecology, and behavior. Using these remarkable creatures, the Vital Signs Monitoring program will monitor the health of the unique Great Sand Dunes ecosystem in our ever-changing climate.

Another insect included in this project is the giant sand treader camel cricket *Daihinibaenetes giganteus*. Once thought to be endemic to the Great Sand Dunes, recent studies have discovered it inhabiting similar sandy environments in the western United States. At roughly 1.5 inches in length, this is one of largest and more common insects on the dunes, which makes it a valuable and easily noticeable vital sign; however, unlike the beetles, the crickets are nocturnal and will only be observed if one takes a nighttime stroll into the dunes with a flashlight. During the day, one would never guess they were there, except for tracks left in the sand after their nighttime promenades. To avoid the light and heat of the day, these crickets typically burrow 18 to 35 inches into the side of a dune, where temperatures are much lower than at the surface.

They accomplish this with the aid of unique hind legs armed with long spines, which form the so-called "sand basket." This is a characteristic unlike any other sand-dwelling insect at the Great Sand Dunes and allows them to excavate sand with great ease.

The remaining two endemic insects are a moth and a fly. The moth (*Copablepharon* sp.) belongs to a large family, Noctuidae, which includes the common "miller moths." Unlike the majority of this family, which is gray and drab in color, the endemic moth is more colorful. Its wings are light yellow and bear an intricate longitudinal pattern of lighter and darker yellow stripes. Our research found it to be fairly common in late summer, when dozens of moths were coming to lights every night. Yet, little is known about its biology, especially of the immature stages (caterpillars).

The endemic fly (*Protacanthus* sp.) is among the largest insects inhabiting the Great Sand Dunes at nearly one inch in length. This fly belongs to the predatory family known as robber flies (Asilidae). Their common name reflects the method of capturing prey in which they perch on an object waiting for an insect to fly by. When some unlucky, unsuspecting insect gets within sight of a robber fly, it darts up to capture the victim in midflight with its grasping, raptorious legs, and the meal is carried off for a feast in the shade.

Since these insects, with the exception of the giant sand treader camel cricket, are found only in the Great Sand Dunes, they warrant special attention. The field studies conducted by the UW entomologists are the first step in the development of a comprehensive program that will continually monitor these indicator species in their harsh habitat.

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Veterinary sciences approach identifies 'Signatures' of infection in Wyoming elk

Some bacterial virulence proteins remain unchanged through course of evolution

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For years, diagnostic methods for brucellosis have been limited because of the lack of bacterial products that are consistent and reliable indicators of infection that ensure high specificity and sensitivity. More recently, DNA-based tests have been evaluated as a next-generation approach to early diagnosis/detection, although standardization of methodologies and a more diverse repertoire of target genes still need to be established.

Brucellosis in elk has been particularly enigmatic and can be attributed, at least in part, to a lack of knowledge of how this host's immune system interacts with *Brucella abortus*. In an effort to better understand the interaction of the pathogen-host interactions in this biological system, our laboratory has embarked on an effort to identify components of *B. abortus* that stimulate the immune system of Wyoming elk and contribute to infection.

Most genes and their products associated with *Brucella* virulence have been identified using laboratory-grown bacteria. Host factors that turn on some virulence genes may or may not be present in these laboratory-grown cultures. One approach that overcomes this problem utilizes immune serum from blood processed to specifically remove antibodies to bacterial proteins constitutively expressed, while retaining those antibodies to bacterial proteins expressed exclusively during infection. This technique is known as in vivo induced

antigen technology, or IVIAT, and has been successfully used in other laboratories with more than 20 bacterial pathogenic species to date. This gene "discovery" methodology has been used in our laboratory over the past two years to identify more than two dozen bacterial proteins expressed during infection by *Yersinia pestis*, the causative agent of plague.

Our collaborative partners in the Department of Defense are evaluating a sampling of these proteins for their ability to protect against bubonic plague in a laboratory animal model. More recently, we have also successfully applied IVIAT to the identification of novel *B. abortus* virulence proteins expressed during infection in elk. Specifically, serum collected from sero-positive animals at the National Elk Refuge near Jackson, Wyoming, was pooled and processed for use in IVIAT. John "Jake" Lowry of Hubbard, Ohio, a UW Department of Veterinary Sciences graduate student in my laboratory, has thus far screened more than 18,000 *B. abortus* DNA fragments expressed in *E. coli* and, as a result, has identified six *B. abortus* gene products reactive with the processed elk serum.

These proteins by no means represent the entire repertoire of bacterial components required for *Brucella* infection but rather a sub-set of factors whose expression is stringently dependent on "signals" within the host. Preliminary characterization of these potential novel in vivo induced (IVI) virulence factors has been performed, and they are being evaluated not only for use as diagnostic targets but for their assessment as components in a next-generation *B. abortus* vaccine that efficiently protects the animal host from infection.

Our diagnostic focus centers around the integration of candidate proteins into a serology-based hand-held cassette, which can be used chute-side for rapid determination of infection.

Our diagnostic focus, in collaboration with Associate Professor Larry Goodridge at Colorado State University, Department of Animal Sciences, centers around the integration of a number of these candidate proteins into a serology-based hand-held cassette, which can be used chute-side for rapid determination of infection. Ideally, this device will incorporate IVI proteins that will distinguish between animals infected by field strains of *B. abortus* and animals immunized with a vaccine. The cassette consists of a small, plastic holder that encases a strip of special filter paper. The strip is impregnated with several selected IVI proteins. The "test" animal's serum is added to a hole in the plastic case and allowed to flow over the strip. Antibodies specific to one or all of the IVIV proteins will stick to the strip, while others will be washed away in a subsequent rinse step. A detection chemical will then be added to the strip to display the adherent, infection-specific antibodies through a color reaction. Several commercial companies have developed this technology, which can be easily applied to the field diagnosis of brucellosis provided the right proteins are selected.

While analyzing the preliminary collection of both plague and *Brucella* IVI proteins, we've made an interesting observation concerning the nature of these bacterial products. Most, if not all, of the bacterial proteins identified to date fall into either one of two National Center for Biotechnology Information (NCBI) computer databases: "COGs," or Clusters of Orthologous Groups [of proteins])," or the conserved domain database (cdd).

By definition, these groups of proteins are of ancient origin, which means they have remained unchanged throughout the course of evolution. Furthermore, they are common to many different bacterial species, bacterial pathogens and non-pathogens alike.

In regard to a pathogen's survival during infection, many COGs/cdds may represent common proteins with similar fundamental virulence functions among numerous bacterial species,

while others may serve more general roles in maintenance of the microorganism regardless of environmental niche (inside or outside of an animal host).

Interestingly, gene products expressed during infection of more frequently encountered COG/cdd functional categories have already begun to emerge from our analyses, the details of which are beyond the scope of this article.

As we predicted, our six *Brucella* IVI proteins fall into one of the two NCBI conserved protein databases; however, despite this observation, two of these proteins do not share significant similarity to bacterial gene products outside the taxonomic order in which *Brucella* is classified. This observation suggests the potential for use of these antigens as *Brucella*-specific diagnostic targets in elk. Thus, collectively, although the majority of IVI genes identified to date fall into either one of the two NCBI databases, our findings suggest the profiles/patterns of these in vivo-induced conserved sequences, or IVICS, may represent unique immune "signatures" among different host species susceptible to infection.

The gathering of additional data and analysis of the intact genes and the expressed IVICS protein products should provide insight into the unique biologic processes of *B. abortus* associated with infection in this host and reveal the genetic pattern of the pathogen's survival strategy in other susceptible hosts.

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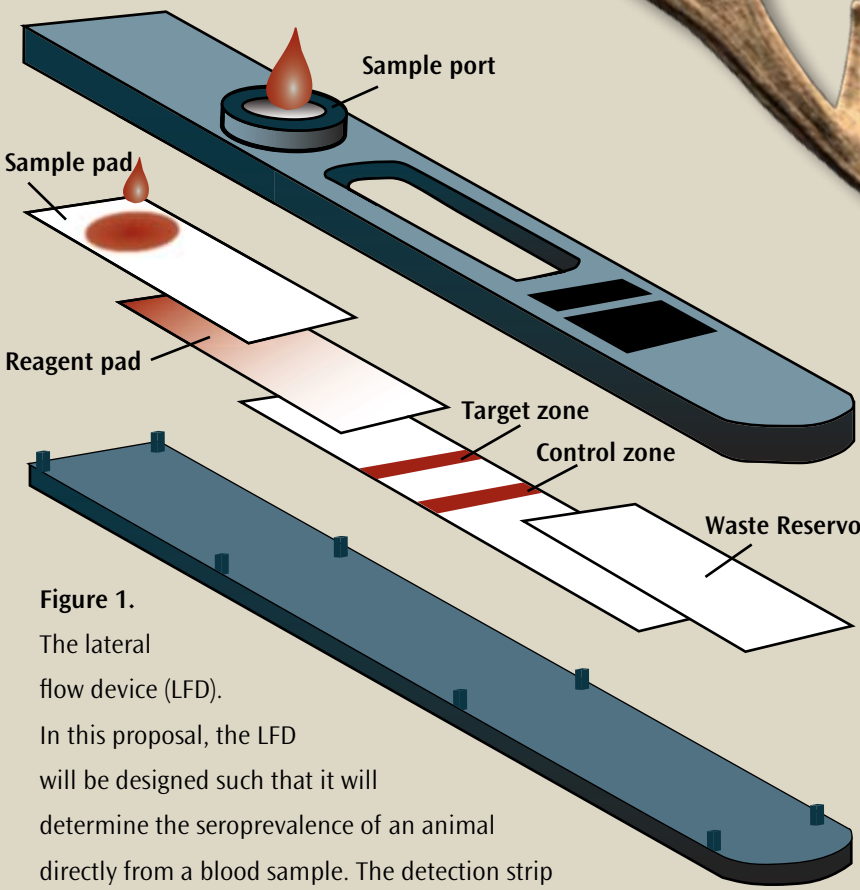

Figure 1. The lateral flow device (LFD). In this proposal, the LFD will be designed such that it will determine the seroprevalence of an animal directly from a blood sample. The detection strip will contain an in vivo induced *Brucella abortus* antigen as the *B. abortus* specific capture probe, as well as a reagent control applied in distinct lines. The sample (blood) to be tested will be introduced to the sample port. Blood serum will be separated by a filter and will be absorbed into the sample pad, and it will travel toward the end of the device. Any antibodies that recognize the *B. abortus* antigen will be trapped at the target zone. The reagent pad will contain a dried and stabilized detection reagent consisting of a colloidal gold-protein G conjugate. The protein G conjugate will bind to the antigen-antibody complex at the target zone and form a color reaction, visible to the naked eye. The formation of a line in the control zone indicates the test has been performed successfully (quality control). If a line at the target zone is present, a positive test is indicated. If the line at the target zone is absent, a negative test is indicated, while the absence of a line at the control zone at any point indicates the test did not function properly and should be repeated. The test result should be visible within two to 15 minutes.

Genomic tools may help livestock

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Livestock consumption of toxic plants results in annual losses of more than $340 million to western U.S. producers. Many forage crops become toxic during drought conditions due to high concentrations of nitrate, the principal nutrient form of nitrogen found in soil.

Although all plants contain some level of nitrate, stress conditions can lead to nitrate accumulation, causing plants to become toxic to livestock. In normal conditions, nitrate is absorbed from the soil and quickly utilized by the plant; however, during drought conditions, plant growth is stunted and nitrate accumulates in the plant. High nitrate levels due to drought occur in corn, bromegrass, millet, fescue, sorghum, alfalfa, and numerous cereal grains. Weeds such as red root pigweed, common lambsquarter, ragweed, Canada thistle, and velvetleaf also may contain excessive nitrate.

Nitrate toxicity is often observed in cattle and sheep during periods of drought. Ironically, it is not the nitrate itself that is toxic to ruminant animals. Nitrate consumed by ruminant animals is converted to nitrite, which is then reduced to ammonia; however, excessive nitrate consumption leads to nitrite accumulation, as the nitrite formation rate exceeds its reduction to ammonia.

What are Nitrate Toxicity Symptoms?

Nitrite is absorbed into blood and reduces the capacity of red blood cells to deliver oxygen to the body eventually leading to suffocation. Signs of mild, or chronic, nitrate toxicity include watery eyes, reduced appetite, weight loss or no weight gain, rough hair or wool, and diarrhea. Symptoms of severe nitrate toxicity include salivation, grinding of teeth, excessive tearing of eyes, and thyroid insufficiency. Increased pulse rate, labored breathing, muscle tremors, weakness, convulsions, and cyanosis (turning "blue") are symptoms that appear in animals in severe distress due to nitrate toxicity, and these animals often die. Symptoms of nitrate toxicity may appear within hours after ingestion of high nitrate forages or not appear for several days.

Nitrate levels greater than 1.5-percent dry matter can result in severe nitrate toxicity in cattle, and less severe symptoms may occur at levels of 0.5- to 1.5-percent dry matter. Nitrate levels ranging from 0.9- to 2.2-percent dry matter are potentially toxic to sheep. Tolerance to elevated dietary nitrate may vary across herds or flocks, and some breeds may have a higher level of tolerance than others. Animals may adapt to higher dietary nitrate if consumed in small amounts over a period of time; however, rapid consumption of feedstuffs with elevated nitrate levels results in severe symptoms and often results in death.

What is Being Done?

Researchers in the College of Agriculture's Department of Animal Science are taking a unique approach to studying nitrate toxicity in ruminant animals. The research team of Cammack, Senior Research Scientist Kathy Austin, and master's student Rebecca Cockrum, of Beebe, Arkansas, noted individual animals respond differently to the same levels of dietary nitrate, indicating some animals are more tolerant to nitrate than others; therefore, an experiment funded by UW's Agricultural Experiment Station Competitive Grants Program was initiated to determine if more tolerant and less tolerant animals are genomically different.

According to Cockrum, who is heading the experiment as part of her degree program, "The purpose of the study is to establish if there is a genetic predisposition toward the susceptibility of certain individuals to the toxic effects of nitrate."

Additionally, researchers wanted to focus more on chronic nitrate toxicity as opposed to severe toxicity. A majority of past studies have focused on severe nitrate toxicity, as it is

producers prevent nitrate toxicity

Many forage crops become toxic during drought conditions due to high concentrations of nitrate, the principal nutrient form of nitrogen found in soil.

Nitrate levels of 0.9- to 2.2-percent dry matter are potentially toxic to sheep.

easier to recognize and diagnose; however, chronic nitrate toxicity is now thought to be of greater economic concern as it results in depressed appetite and weight loss or failure to maintain weight. Unfortunately, the non-specificity of these chronic symptoms most often results in either a diagnosis failure or misdiagnosis; therefore, the research team, along with the help of Paul Ludden, associate professor of animal science, administered purebred Suffolk ewes (above) at the Laramie Research and Extension Center's stock farm either a control supplement containing no nitrate (0-percent nitrate dry matter basis) or a treatment supplement containing a moderate amount of nitrate (1.5-percent nitrate dry matter basis) designed to elicit chronic nitrate toxicity.

Liver Biopsies Conducted

Prior to being placed on the experimental diets, liver biopsies were performed on all ewes to obtain tissue for genetic analysis. Previous studies have demonstrated that elevated dietary nitrate results in liver damage. The biopsy procedure allows for a small amount of liver tissue to be removed from the live animal using only a local anesthetic. Ewes remained on the experimental diets for an eight-day period and then were biopsied once more. Ewes were also weighed throughout the eight-day period to detect weight changes.

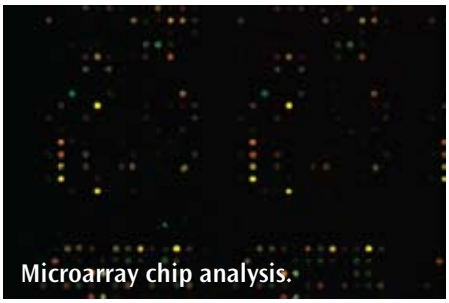
Ewes fed the nitrate supplement consumed only 46 percent of their daily supplement compared to 95 percent consumed by sheep fed the control supplement (figure 1), confirming that elevated dietary nitrate is associated with lower feed intake. Intake of ewes fed the nitrate supplement was strikingly variable, ranging from 28 percent to 91 percent of daily intake. The five ewes consuming the most nitrate supplement and the five ewes consuming the least nitrate supplement were identified as being nitrate-tolerant and nitrate-intolerant, respectively. On average, the nitrate-tolerant ewes consumed 82 percent of their daily supplement while the nitrate-intolerant ewes consumed only 30 percent. Additionally, the nitrate-intolerant ewes lost approximately 3 pounds over the eight-day period, compared to a 0.5-pound gain by the tolerant ewes. Behavioral differences were also apparent by daily observation. Nitrate-tolerant ewes were more active than intolerant ewes, and, in general, they were difficult to distinguish from those ewes not administered any nitrate (control ewes).

Determining Genomic Differences

The next step will be to determine if the nitrate-tolerant ewes are different from the nitrate-intolerant ewes on a genomic level. To do this, Cockrum will team with Jerry Taylor, a professor in the Division of Animal Sciences at the University of Missouri, during the summer of 2008. They will use an advanced

technique called microarray chip analysis to look for differences in gene expression within liver samples. A single microarray chip contains thousands of target genes and allows for the presence and expression level of those genes to be determined in the tissue sample. If the gene is present in the tissue sample, the corresponding spot on the microarray chip will fluoresce, and differences in fluorescence indicate differences in gene expression among samples (right). Microarray chip technology essentially provides researchers with a "snapshot" of gene expression at a particular time in a particular tissue or cell type. These researchers believe differences in expression of genes within the liver partially contribute to the differences observed among individuals fed nitrate-contaminated feedstuffs. In other words, genes are expressed differently in livers of nitrate-tolerant and nitrate-intolerant ewes.

Genes differentially expressed between tolerant and intolerant animals may help producers better identify those individuals that may be more vulnerable to nitrate-contaminated feedstuffs. Identification of less tolerant animals would allow producers, especially those in drought-stricken areas, to employ preventative management techniques to avoid cases of nitrate toxicity. Producers may alternatively choose to minimize the risk of nitrate toxicity by eliminating those animals from their herds or flocks. In the long term, there is potential that genes may be identified that could be used in a marker-assisted selection program, providing producers an opportunity to select for nitrate-tolerant animals within their breeding stock using DNA technology.



If a gene is present in a tissue sample, the corresponding spot on the microarray chip will fluoresce.

The Future?

Other studies have shown an association between elevated dietary nitrate and decreased female reproductive performance in ruminant livestock. Cammack, Austin, and Cockrum have a keen interest in reproductive function in livestock; therefore, a future focus of their study will be on the reproductive aspects of nitrate toxicity, including impacts on both the mother and the fetus.

Cammack also plans studies regarding younger animals. "Nitrate toxicity is often a problem with younger animals, as they tend to be more susceptible. The hope is that the genes identified in the present study can be used to identify younger animals that may be intolerant but have yet to be exposed to higher nitrate feedstuffs," she says.

With the persistent drought conditions in livestock production areas throughout the western United States, nitrate toxicity appears to be a long-term problem many producers are likely to face. Chronic nitrate toxicity is particularly problematic due to its non-specific symptoms and economic impact. The researchers hope their study will be the first step in helping producers identify animals that may be particularly vulnerable and minimize the risk of nitrate toxicity in their herds or flocks.

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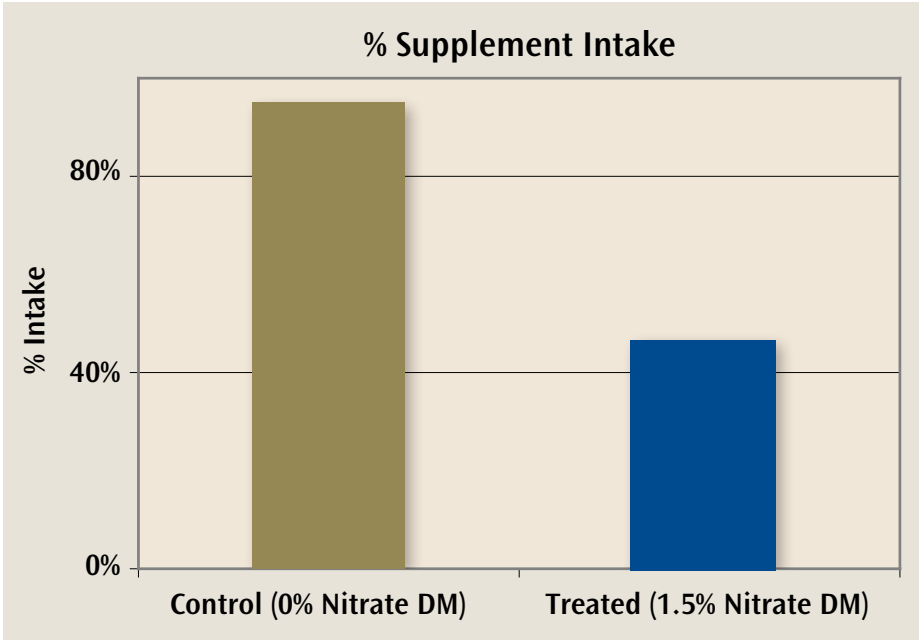

Figure 1. Daily supplement intake (percent) in ewes fed a control (0-percent nitrate dry matter basis) or a nitrate (1.5-percent nitrate dry matter basis) supplement over an eight-day period.

Grazing management suggestions maintain or improve

SAGE GROUSE HABITAT

Sagebrush, grass cover protects nests, provides cover and food for young chicks

Michael Smith
Professor
Department of Renewable Resources

Sage grouse numbers have declined over the past several decades throughout the West, including Wyoming. The decline can be attributed to a variety of reasons, although many are not fully understood. Locally, there may be clear reasons for the decline or expatriation of sage grouse; however, the reasons vary regionally. Knowing the extent of the decline and trends are hindered by lack of reliable data on population size until recent years. The majority of greater sage grouse are found in the Wyoming Basin (figure 1) areas and adjacent states dominated by Wyoming big sagebrush.

Livestock grazing is a common use of sage grouse habitats. The concern that livestock grazing generally could be affecting sage grouse is understandable but not usually accurate because, since the 1930s, trends in livestock numbers have been down

and intensity of management has increased. Breeding habitats, especially nesting and early brood rearing, are usually considered the most critical to sage grouse survival because of the vulnerability of nests and young chicks. Although inappropriate management can be detrimental, livestock grazing, as discussed below, can be managed to provide adequate cover for nesting birds and maintain desirable plant communities.

Cover provided by sagebrush and grasses protects nests from predators such as ravens, crows, badgers, and ground squirrels. These habitats also provide cover and food for young chicks.

Small-scale diversity in sagebrush cover and density and in the herbaceous vegetation understory is desirable to provide nesting cover in proximity to foraging areas for the relatively immobile young chicks. Small insects, such as ants, grasshoppers, and beetles, are important foods for chicks. Insect abundance may be affected by the plant species composition. Large animal grazing of all kinds can, over the long term, change plant communities to less desirable states or, in the short term, reduce cover available to protect nests.

Figure 1 – The Wyoming Basin

Successful sage grouse populations have been linked to the quality of sagebrush-steppe habitat.

Understanding ecological site vegetation progression in sagebrush-dominated upland habitats and the role of vegetation consumption by grazers (herbivory) is fundamental to creating grazing plans that address sage grouse habitat needs and monitoring grazing management actions.

Sagebrush-sage grouse relationship

Successful sage grouse populations have been linked to the quality of the sagebrush-steppe habitat. Sagebrush provides food for adults and overhead cover while the understory vegetation provides screening cover for nests and forbs for food. The dependence of the species on sagebrush through all seasons has been well documented and cannot be over-emphasized.

Long-term nesting and early brood-rearing success of sage grouse is increased by maintaining a bunch grass (i.e. needleandthread or green needlegrass) dominated understory, enabling optimal rhizomatous grass (ie. thickspike wheatgrass or western wheatgrass) growth where that understory dominates, and maintaining forbs (many species are locally common) in the plant community. Sage grouse nest, raise their young, and winter in sagebrush-dominated areas, and sagebrush makes up a substantial portion of their diet most of the year. Forbs are important food for chicks as they age while insects are dominant dietary items in early adolescence.

Long-term management to promote desirable plant communities and annual management of the standing crop for nesting cover would appear to be the objective of grazing management of sage grouse habitat.

Long-term planning should direct management of livestock to foster plant growth during the spring growing season. Generally, the vegetation objective of grazing management in sagebrush habitat is to provide for cool-season grass growth. Important forage grasses in Wyoming are cool-season plants, thus this strategy should maintain bunch grasses or optimize rhizomatous grass growth. Annual growth of herbaceous vegetation in the Wyoming Basin sagebrush habitat occurs in approximately six weeks in the spring, depending on altitude, from early April through May. Repeated grazing during the growing season

Sage grouse nest, raise their young, and winter in sagebrush-dominated areas, and sagebrush makes up a substantial portion of their diet most of the year.

consistently interrupts the exchange of nutrients between the forage plants' leaves and roots, leaving the forage species susceptible to being out-competed for available nutrients and water by ungrazed plants.

In many situations, annual grazing levels are the foremost consideration in vegetation management, particularly with sage grouse because of the need to provide nesting cover. In addition, timing and degree of use combine to affect the vegetation species composition. Even repeated spring use during the critical growing season for cool-season grasses may be acceptable if use is consistently light. Conversely, even a well-considered seasonal grazing strategy will not adequately compensate for repeated heavy use both because of the reduced cover for nesting birds and the detrimental effects on the plant community.

An appropriate utilization guideline is to use less than a moderate 35-percent use on total herbaceous vegetation and less than 60-percent use of key species (dominant forage species) depending upon the timing and frequency of grazing. Generally, rangeland used at the moderate level takes on a patchy appearance where seed stalks of preferred forage species are still present. The "landscape appearance method" (described in *Wyoming Rangeland Monitoring Guide*) provides an adequate tool for describing this. It is a recognized method by all relevant land management agencies in Wyoming. The guide is available on the Web at http://wyagric.state.wy.us/forms/natres/rangelandmonitoring.pdf. The guide provides the following description of rangelands grazed at a moderate level (41 to 60 percent):

> "The rangeland appears entirely covered (by livestock) as uniformly as natural features and facilities will allow. Fifteen to 25 percent of the number of current seed stalks of key herbaceous species remain intact. No more than 10 percent of the number of low-value herbaceous forage plants are utilized."

To effectively use the area available for grazing and given appropriate livestock numbers and season of use, ensure a relatively good distribution of grazing over the area to prevent areas of overuse. Overuse typically occurs around water sources and riparian zones. The desire for effectiveness has to be tempered with consideration of the cost and the availability of skilled labor needed to achieve better distribution. When means to ensure better distribution of grazing are not implemented, the areas proximate to water sources would be where utilization guidelines should be used.

Grazing management strategy benefits

In many circumstances, intensive grazing management strategies can result in high levels of economic productivity while providing for plant growth and sage grouse habitat requirements. In general, grazing programs with shorter grazing periods and more pastures are better for management of vegetation primarily because of better control of utilization levels. The downside of more intensive grazing programs is the greater investment in infrastructure, such as fencing, water development, and labor for active management. Effective herding can substitute for a substantial portion of infrastructure if there are large enough herds to justify the full-time personnel investment needed.

A key component of managing grazing to address sage grouse habitat involves overcoming misconceptions with regard to the successional pathways in sagebrush habitat. Vegetative

progression in sagebrush is not linear, and a stand of sagebrush, because it has limited herbaceous understory, is anything but in an early stage of development and is not poised to respond to better grazing management or no grazing. Understanding what can and cannot be achieved with grazing management is a critical first step to developing coordinated livestock grazing and sage grouse habitat objectives.

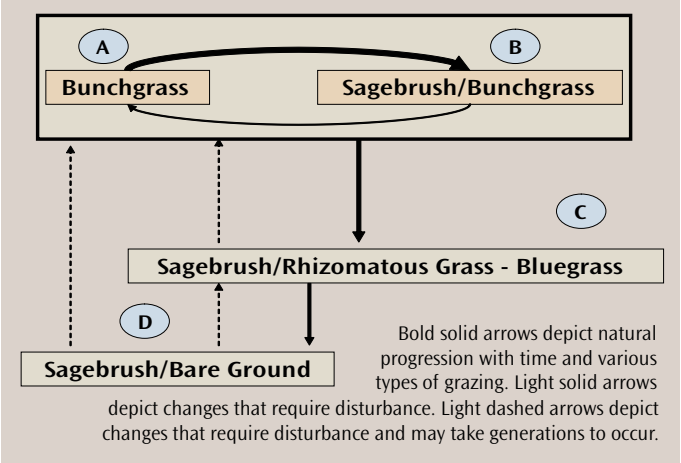

Figure 2. Plant community states and transitions that typically occur in the Wyoming Basin sagebrush

Three plant communities typically occur in Wyoming Basin sagebrush environments (figure 2).

Transitioning the landscape

The historic climax state primarily consists of varying proportions of sagebrush and prevalent bunch grasses. Moderate grazing and occasional sagebrush management, reduction, or removal, will perpetuate this state. Time, no sagebrush management, and repeated spring or heavy grazing can result in this state transitioning to a sagebrush-rhizomatous wheatgrass state. This state is resistant to change because of the domination by sagebrush and the resilience of the wheatgrass to grazing. Extreme grazing can transition the sagebrush-rhizomatous wheatgrass to a sagebrush-dominated plant community with little to no herbage understory that is even more resistant to change from grazing management activities. Grazing management alone cannot restore the sagebrush-bunch grass state from other states without additional sagebrush management and some residual bunch grass plants. Management of utilization and rotating seasonal grazing are appropriate for maintaining the existing qualities of sage grouse habitat.

Periodic disturbance to rejuvenate the herbaceous component of the plant community and reduce sagebrush abundance is needed to maintain the best quality habitat. At the landscape scale, a slow transition in the plant community is needed to maintain benefits to sage grouse in the long-term. A properly executed sagebrush treatment that removes sagebrush will reduce sage grouse habitat for many years before the beneficial aspects of site progression accrue. The literature suggests no more than 20 percent of the landscape should be converted to a bunch grass plant community at any one time, and that additional treatments should wait until areas in the previously treated bunch grass plant community transition into the sagebrush/bunch grass state. A very small scale, low-intensity disturbance regime to remove or reduce sagebrush conducted over time is recommended. Prior to any conversion program being considered, monitoring of rangeland species composition is required to ensure the desirable bunch grass species are present.

Sagebrush treatments

Sagebrush treatments such as chemical thinning, mowing with a rotary shredder, and selective grazing (i.e. goats) can be used to reduce sagebrush. These thinning treatments allow the plant community to have continued value as sage grouse habitat compared to more prevalent treatments such as burning, which can completely remove sagebrush for several years. Planned and effectively executed grazing and sagebrush management programs are essential for maintaining the best possible sage grouse habitat. Curtailing or removing grazing, as many fear possible and advocated by the uninformed, will not provide the most benefit for sage grouse. Optimal management practices should consist of a moderate level of grazing with rotation of grazing to prevent repeated spring use of the same area and periodic reductions of sagebrush abundance to maintain optimal levels of understory grasses and forbs.

This paper is the summary of deliberations of a group convened in early 2007 by the Wyoming Department of Agriculture (WDA) and Wyoming Game and Fish Department. It consisted of personnel with the Bureau of Land Management, WDA, and Natural Resources Conservation Service, the author, and independent sage grouse specialists. The group was facilitated by Bob Budd, executive director of the Wyoming Wildlife and Natural Resource Trust. We addressed the underlying vegetation ecology of sage grouse habitats and the somewhat limited role of grazing in the present environment.

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Water pressure effectively reduces *Salmonella* on surface of raw almonds

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Department of Animal Science
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Two outbreaks of food poisoning caused by *Salmonella* (salmonellosis) since 2001 have been linked to consumption of raw almonds. As a consequence of these outbreaks, millions of pounds of almonds and almond-containing products had to be recalled, resulting in vast financial losses to the almond producers; therefore, new treatment options to reduce *Salmonella* contamination on the surface of almonds had to be developed.

This study focused on the use of high hydrostatic pressure (HHP) – extreme water pressure – treatments to kill and thus reduce *Salmonella* presence on the surface of raw almonds. The use of HHP proves lethal to the bacterium while still providing a raw final product, which is preferred by the producer.

Between 2000 and 2001, a *Salmonella enterica* serovar Enteritidis bacterial food poisoning outbreak associated with the consumption of raw almonds caused 205 cases of food poisoning in Canada and the United States. Epidemiological analysis indicated a rare type of *S.* Enteritidis, PT30, had caused the outbreak. The 2000-2001 outbreak was the first time *Salmonella*-associated food poisoning had been associated with the consumption of raw almonds. In 2004, another outbreak of *Salmonella* was associated with raw almonds. As with the 2000-2001 outbreak, *S.* Enteritidis was identified as the causative agent, and the Centers for Disease Control and Prevention (CDC) identified 29 cases of food poisoning with illness onsets ranging from September 2003 to April 2004. Analyses to determine the specific *Salmonella* strain identified another rare type, PT 9c, as the cause of the 2004 outbreak. Ultimately, the 2004 outbreak led to the voluntary recall of approximately 18 million pounds of raw almonds, granola-type bars, muesli-type cereals, and other products containing almonds.

> Any processing method developed to reduce microbial contamination on raw almonds would have to effectively reduce the bacterial counts, be capable of high throughput, not alter the taste, smell, texture, and hardness of the almonds, and be cost effective. Water pressurization addresses most of these attributes.

High hydrostatic pressure processing utilizes extremely high water pressure (14,500 -100,000 pounds per square inch [PSI]) in an enclosed chamber containing the food to destroy bacterial cell membranes and proteins; thus, HPP is considered as an emerging control option to destroy pathogenic and spoilage microorganisms in foods, and HPP of foods at

John Willford, a graduate research assistant, found suspending the almonds in water, pressurizing them, and drying at several temperatures reduced *Salmonella* by 99.999 percent.

low or moderate temperature is being increasingly utilized as a non-thermal processing method to reduce the microbial load in foods.

HPP is often carried out in a stainless steel chamber and utilizes either water, a water/oil mixture, or unpackaged liquid food (e.g., orange juice), depending on the food and packaging, to increase the pressure by pumping increased amounts of the specific liquid into the chamber. In a previous study, we discovered that, due to low amounts of available water (water activity) on the surface of the almonds, HHP was ineffective at reducing the *Salmonella* concentration on raw almonds; however, when the almonds were suspended in water and then pressurized, an increased reduction in the *Salmonella* concentration was achieved. The objective of this secondary study was to further investigate and better document the use of "water pressurization" as an effective method to reduce *Salmonella* concentrations on raw almonds.

The results of this study demonstrated a synergistic combined effect of water pressure and heat in reducing the *Salmonella* concentration on experimentally inoculated almonds. For example, water pressurizing the almonds at 60,000 PSI for six minutes, followed by drying the almonds at ambient temperature, resulted in a 4.025 log ($10^{4.025}$ or a 99.9906 percent reduction) average decrease in the *Salmonella* concentration, when compared to the control (dry, unpressurized *Salmonella* inoculated almonds). Suspending the inoculated almonds in water for six minutes, followed by drying at ambient temperature did not affect the *Salmonella* concentration. The almond industry requested a 5 log (10^5 or 99.999 percent reduction) decrease in *Salmonella* concentration, as was deemed necessary by risk analyses to prevent food poisoning.

The above results demonstrate the effectiveness of pressurizing the almonds directly in water, followed by drying at ambient temperature; however, the dry step took up to 45 minutes, and the combined HPP/

drying process should be completed in as short a time as possible (ideally only a few minutes), making HPP processing of raw almonds on an industrial scale realistic based on available pressurization equipment and throughput needs.

To address this, we processed *Salmonella*-inoculated almonds at 60,000 and 70,000 PSI and evaluated a rapid drying procedure using blowing air at two mid-level temperatures (55 and 65°C). A portable hair dryer was used to provide warm blowing air, and this allowed the almonds to be dried in five minutes, regardless of the temperature. When the almonds were pressurized at 60,000 PSI and dried at 55°C, a 3. 58 log (99.97 percent) decrease in the *Salmonella* concentration was observed. Drying the almonds at 65°C resulted in a 3.96 log (99. 98 percent) decrease. Pressurizing the almonds at 70,000 PSI followed by a dry step at 55°C decreased the concentration of *Salmonella* on the surface of the raw almonds by 4.41 logs (99. 996 percent). All of these were below the required 5 log (99.999 percent) reduction; however, when the almonds were dried at 65°C, a 5.05 log (99.9991 percent) decrease was achieved. The average *Salmonella* counts for each pressure treatment are shown on figure 1.

Willford prepares a sample for testing.

Many of the above results were found to be statistically significant using an analysis of variance (ANOVA) procedure. The p-value for these analyses was preset at 0.05; therefore, any significant differences would have to be at least 95 percent certain. Specifically, pressurizing at either 60,000 or 70,000 PSI showed significantly higher ($p < 0.0001$) *Salmonella* death values as compared to the control; however, no significant difference ($p > 0.7885$) was observed between the two HPP treatments. Additionally, the treatments that included pressure with drying at 25°C, 55°C, or 65°C did not significantly differ ($p > 0.48$) from one another.

Taken collectively, the results confirm our earlier observations that water pressurization of raw almonds effectively reduces the *Salmonella* concentration on the surface of raw almonds. It is also apparent water pressure and heat act synergistically in reducing the *Salmonella* concentration on raw almonds. Remarkably, the combination of 70,000 PSI and 65°C drying control measures achieved the 5 log (99.999 percent) reduction that is desired by the almond industry to prevent *Salmonella*-caused food poisoning.

In these studies, we developed a water pressurization procedure in which the almonds were directly suspended in water prior to pressurization, pressurized, and dried at several

A 2004 outbreak of Salmonella led to the voluntary recall of 18 million pounds of raw almonds and associated products.

temperatures. The rationale behind this strategy was that suspending the almonds in water would increase the available water (water activity) at the surface of the almond, allowing the pressure to impart a more destructive effect on the bacteria. These data support those observed in the previous study. Temporarily raising the available water on the almond surface, and subsequently to the *Salmonella*, makes the bacterium more susceptible and allows the HPP to better damage bacterial cell membranes and proteins. In addition, the fact almonds would need to be dried presented an opportunity to examine the combined effects of pressure and heat (imparted through air drying) as an effective method to reduce the *Salmonella* concentration on raw almonds.

It is apparent any processing method developed to reduce microbial (*Salmonella*) contamination on raw almonds would have to effectively reduce the bacterial counts on the almonds, be capable of high throughput, not alter the sensory characteristics (taste, smell, texture, hardness, etc.) of the almonds, and be cost effective. Water pressurization addresses most of these attributes. Furthermore, the method is rapid, easy to perform, and is amenable to high throughput with the use of industrial scale horizontal processing units that directly employ water as the pressurizing medium. A simple air blower could be set up downstream of the pressure unit to dry the almonds prior to packaging.

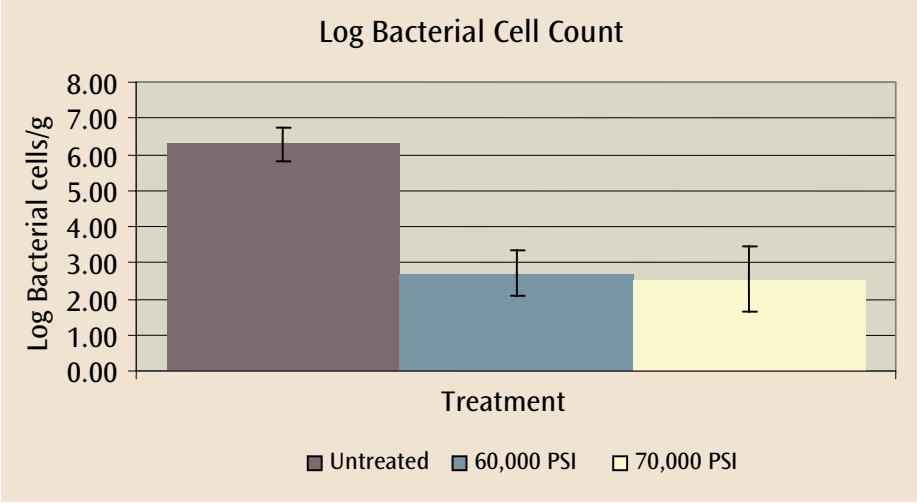

Figure 1. Average *Salmonella* cell counts in logarithmic units (logs) for untreated and pressurized treatments.

This study has demonstrated the ability of this system to provide the desired 5 log (99.999 percent) reduction in *Salmonella* contamination and prevent food poisoning from this bacterium. The effects of this control method on sensory characteristics of the almonds has yet to be determined; however, the system provided a final product that is still considered raw and showed no visual effects of treatment.

Due to its ability to maintain the sensory characteristics of food, HHP continues to find increased application within the food industry, although the process is still economically expensive. The use of water pressurization as a processing method for dry foods is intriguing. Several dry foods such as raw almonds, cocoa powder, cocoa beans, chocolate, dried milk, aniseed, and cereal products have been implicated in outbreaks of *Salmonella*-caused food poisoning. Depending on the physical nature of the dry food, suspending the food to be pressurized directly in the pressurizing medium (water) may be possible.

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How much we eat can affect the health of our children for generations

Department of Animal Science research finds obesity infiltrates our inheritance

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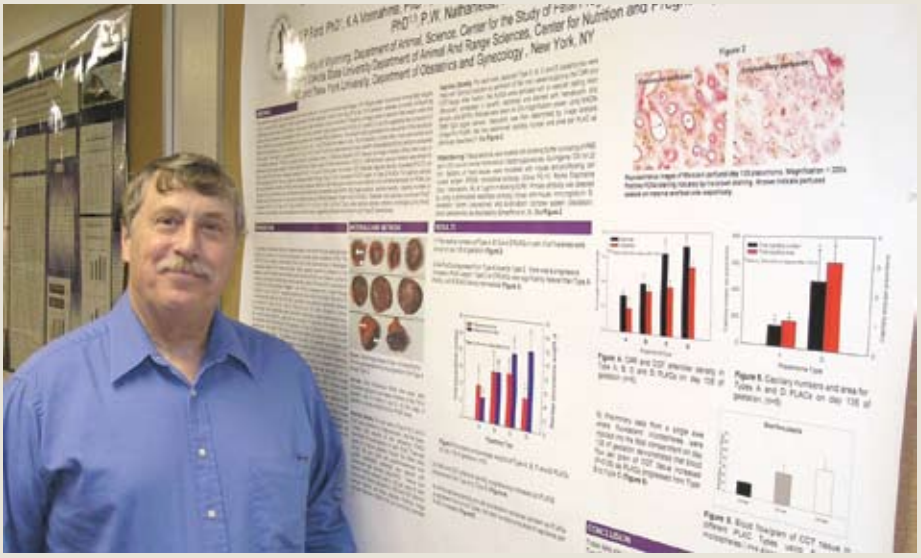
Due to an overabundance of food, obesity is increasing progressively in the United States and other developed countries and is now beginning to affect significant numbers of women of childbearing age.

While being overweight is associated with poor health and several chronic conditions such as Type II diabetes and cardiovascular disease, including hypertension and stroke, another important issue is the potential impact of maternal obesity on fetal growth and development and offspring health.

A major goal of our ongoing studies in the Center for the Study of Fetal Programming is to develop a badly needed, large animal model that will allow us to study the fetus in utero during maternal over nutrition and obesity. Information obtained from this animal model will provide important information to clinicians so dietary guidelines and weight recommendations can be developed for pregnant women and those planning to become pregnant to optimize fetal development and offspring health.

When we eat, glucose (blood sugar) levels increase in the bloodstream. This signals the pancreas to release the hormone insulin, which functions to accelerate glucose transport into body cells for metabolism and/or storage. Resistance of body cells to insulin-induced glucose uptake (insulin resistance) alters body composition (increases fat-to-lean ratio), and it leads to elevated blood glucose levels, obesity, and often to Type II diabetes and cardiovascular disease.



Professor Stephen Ford and collaborators are using sheep to study the effects of maternal obesity on offspring.

Impact of Maternal Obesity

Preliminary data from several laboratories have provided evidence for the impacts of maternal obesity and a high plane of nutrition on fetal pancreatic structure and function. Specifically, we have shown that induction of maternal obesity by a high nutritional plane from before conception through mid-gestation markedly increases baseline glucose and insulin concentrations in maternal and fetal blood. In addition, insulin-to-glucose ratios were higher in the mother, suggesting the pancreas needed to secrete much more insulin into the bloodstream to transport glucose into body cells indicating possible maternal insulin resistance (often referred to as gestational diabetes). This insulin resistance can extend to the baby, as several human studies have shown a positive correlation between maternal obesity, increased birth weight, and postnatal insulin resistance (Dorner, 1994; Catalano, 2003; Boney et al., 2005).

Insulin resistance often leads to obesity, Type II diabetes, and cardiovascular disease in these offspring in later life. Further, and perhaps more importantly, there is significant evidence these health problems can be passed on to subsequent generations if the mother was subjected to maternal obesity in utero.

There is a lack of knowledge regarding the mechanisms whereby maternal obesity and high-energy diets modify fetal pancreatic development and fetal organ insulin sensitivity. Basic research is limited by the lack of an animal model that allows long-term sampling from the fetus. The Center for the Study of Fetal Programming has developed such a model in sheep and proposes to determine the changes in the fetal pancreatic response to glucose and amino acids as well as fetal insulin sensitivity that result from maternal obesity and a high-energy diet.

Our preliminary studies indicate maternal obesity coupled with a high-energy diet accelerate fetal pancreatic growth and beta cell (site of insulin secretion) development and produce changes linked to insulin resistance. We have also shown abnormal pancreatic function in this model postnatally. Correct pancreatic development is important for lifelong health. We have obtained preliminary data to demonstrate that pancreatic function and glucose tolerance are altered in newborn lambs of obese ewes compared with control-fed ewes.

This important finding strengthens the need to understand the development of abnormal function during fetal life. We base the rationale for our

> Information obtained from this animal model will provide important information to clinicians so dietary guidelines and weight recommendations can be developed for pregnant women and those planning to become pregnant to optimize fetal development and offspring health.

studies on the importance of understanding adverse effects of maternal obesity on the developing fetus and our preliminary observations demonstrating that: 1) fetal pancreatic development is accelerated in the presence of maternal obesity and a high-energy diet; 2) fetal skeletal muscle shows signs of insulin resistance in this model; and 3) lambs born to obese mothers show impaired glucose and insulin metabolism.

We have obtained preliminary data to demonstrate that pancreatic function and glucose tolerance are altered in newborn lambs of obese ewes compared with control-fed ewes.

Data exist to support accelerated pancreatic development in fetal cadavers from obese women, but there are no data, nor indeed could data ever be produced, on the in vivo responsiveness of the human fetal pancreas or in vivo fetal insulin sensitivity. The absence of physiological data on these systems during fetal life demonstrates the need to determine whether there are any in vivo changes in fetal pancreatic secretion and peripheral insulin sensitivity. In addition, there is a pressing need to determine whether recuperative dietary measures (weight loss) can be taken in pregnancy to attenuate, or even reverse, the combined harmful effects of maternal obesity and a high-energy diet on fetal pancreatic development and offspring health.

Fetal Growth Retardation

In the sheep, insulin can be detected in fetal pancreatic tissue and systemic blood by 40 and 60 days of gestation, then rises progressively between mid- and late-gestation to plateau near term (gestation length in the sheep is about 150 days). Previous studies have implicated insulin as a major fetal growth-promoting hormone. More specifically, chronic fetal hyperinsulinemia (elevated insulin levels) induced by gestational diabetes has been shown to lead to macrosomia (enlarged fetuses), while fetal hypoinsulinemia (reduced insulin) is associated with fetal growth retardation in a variety of species including the sheep and human (Gluckman and Liggins, 1984; Milner, 1988).

Pancreatectomy (removal of the pancreas) of the ovine fetus resulted in a decrease in growth rate and birth weight. Glucose has been shown to stimulate insulin secretion by pancreatic beta cells both in chronic in vivo fetal studies and in vitro experiments with cultured pancreatic beta cells in several species, including sheep. Further, fetal insulin levels were positively correlated with fetal blood glucose levels over a wide range of concentrations. Moderate maternal diabetes in rats and sheep (preliminary data from our laboratory) leads to an increase in fetal pancreatic insulin content, enhanced insulin secretion in response to glucose, and greater proliferation of islet cells.

Two notable maternal conditions that predispose offspring to increased size and fatness at birth are maternal obesity and maternal diabetes. Women with elevated pre-pregnancy maternal body mass index (BMI), an indirect measure of fatness, and triglycerides tend to give birth to infants with higher birth weights. These heavier babies have increased body fat mass in comparison to infants born to women of normal weight. Further, fetuses large for their gestational age have higher proportions of total body fat and relatively lower lean body mass than infants who are appropriately sized for gestational age. Thus, fetal hyperinsulinemia may exert lasting influences on body composition by increasing fat cell size or number in early life leading to overweight and obesity in adolescence. Evidence for this hypothesis is the observation that amniotic fluid insulin levels, which reflected fetal pancreatic insulin production, correlate with obesity of offspring of diabetic mothers during adolescence.

Use of Sheep in Study

The fetal sheep is the only available model in which long-term chronic instrumentation studies combined with carefully controlled challenges (nutritional, endocrine, stress, etc.) can be conducted. The ability to catheterize a wide variety of fetal blood vessels with ease and to collect blood for several days with a high success rate is a unique strength of this model. Repeated blood samples can be taken from key sites: 1) the umbilical vein (carries blood from the placenta to the fetus) and 2) the umbilical artery (returns blood from the fetus to the placenta). Comparing samples from these two sites provides data on umbilical venous-arterial differences, and thus fetal uptake. Taken together, these capabilities assist in the evaluation of fetal phenotype in a way not possible in other precocial (independence displayed at birth) species and not at all possible in altricial (helpless at birth) species, such as a rat. Since these chronic instrumentation techniques were developed in the 1960s, the number of fetal sheep catheterized for a wide variety of placental, cardiovascular, endocrine, metabolic, neurophysiologic, and behavioral studies runs into several thousand by research groups around the world.

A further justification for using the fetal sheep model is fetal sheep have a metabolism similar to the fetal human, and the maternal/fetal weight ratio is similar to that of the human as shown by the large number of studies by other investigators.

In conclusion, we have demonstrated that maternal obesity induced by a high plane of nutrition results in maternal and fetal hyperglycemia and hyperinsulinemia by mid-gestation in our sheep model, in association with an increase in fetal weight. Pancreatic, but not other fetal organ weights relative to body weight, increased markedly in fetuses gestated by obese mothers, in part due to an increased mitotic rate of beta cells, resulting in increased beta cell numbers and insulin content by mid-gestation.

Increases in beta cell numbers and insulin availability during fetal development may be stimulated, in part, by increases in maternal glucose concentrations known to diffuse readily into the fetal compartment. Overstimulation of pancreatic endocrine function may define a mechanism whereby the fetus adapts its somatic cell growth to respond to excess nutrient availability. An acceleration of fetal pancreatic growth and cell number, as observed in those fetuses gestated by obese ewes in our model, could be expected to alter cellular composition and function of the pancreas in later life. Failure of the pancreas to return to a normal cellular composition and function postnatally could lead to obesity, altered insulin secretion, and diabetes in the offspring. Changes in postnatal body composition and health status of offspring born to obese mothers are currently under investigation.

Sheep have a metabolism similar to the fetal human.

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College of Agriculture offers new degree

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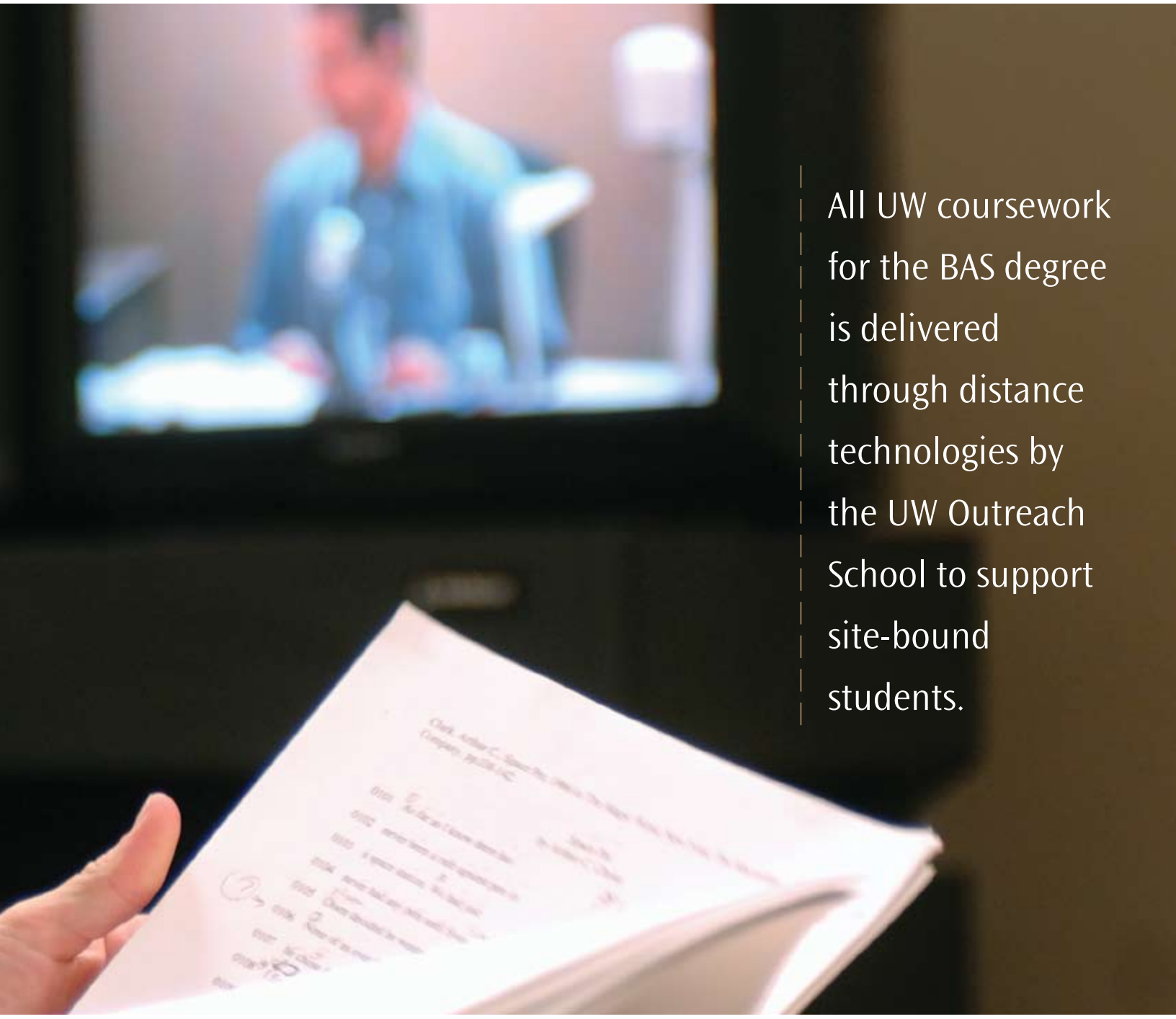
There's a new degree at the University of Wyoming through the College of Agriculture!

The bachelor of applied science (BAS) in organizational leadership degree was approved by the UW Board of Trustees in January 2007. By the time the fall semester arrived and before a public announcement had even been made, four students had already enrolled in the program. Professor Karen Williams, head of the Department of Family and Consumer Sciences, is director of the degree program. There are now 17 students enrolled. Routinely, a degree program will be studied for several years and submitted to the UW Board of Trustees for approval, and then courses will be developed prior to accepting students. The process from start to finish can take more than five years – with at least a year between approval and implementation. But the BAS program had one of the quickest degree implementations ever seen on the UW campus. Courses were ready by the fall of 2007, and a formal



All UW coursework for the BAS degree is delivered through distance technologies by the UW Outreach School to support site-bound students.

public announcement was made October 23 during a ceremony at the UW Outreach School in Casper.

The BAS degree is unique at UW. Undergraduate degrees are usually titled bachelor of arts or bachelor of science in a particular program; for example, a student can obtain a Bachelor of Science in animal science. The new degree is a Bachelor of *Applied* Science, which can cause confusion for students trying to differentiate between programs. The BAS is designed for a very specific group of students, and the traditional entering freshman is not eligible. While nationally recognized and just as rigorous as a conventional bachelor's degree, the BAS is much less common.

To be eligible, students must have completed an associate of applied science (AAS) degree at a Wyoming community college (or an equivalent degree at another accredited institution), and have a minimum of two years work experience. An AAS degree emphasizes technical and professional skill, and includes coursework frequently not transferrable to the Bachelor of Arts (BA) or Bachelor of Science (BS) degree. With the BAS degree, students are able to utilize more of their AAS credits toward the

bachelor's degree and increase their opportunities for advancement in the workforce.

The BAS in organizational leadership has four basic components:

1. University studies, the general education program all UW undergraduates must complete;
2. A career specialty component, which incorporates courses taken as part of a student's AAS curriculum;
3. A professional concentration component, which are courses specific to the organizational leadership goals of the degree;
4. And an elective component.

All UW coursework for the BAS degree is delivered through distance technologies by the UW Outreach School to support site-bound students.

The degree came about as a collaborative effort between Wyoming's seven community colleges, the Wyoming Community College Commission, and UW. State community college leaders were the first to recognize the need for such a program. Many of their students who had completed the AAS degree found they could not move into management positions in their fields without a bachelor's degree; however, because so much of their AAS coursework was non-transferable, they would face a lengthy stay in college to complete a traditional BA or BS degree.

> "Community and economic development efforts have traditionally been major components of our land-grant mission, and the opportunity to help individuals acquire additional job training and skills is part of that mission."

The community colleges brought their concerns to the Wyoming Academic Deans Conference, a yearly meeting of the academic deans from UW and the Wyoming community colleges. Rollin Abernethy, associate vice president for Academic Affairs, pulled together a group of individuals from UW, including Jim Wangberg, associate dean and director of the Office of Academic and Student Programs in the College of Agriculture, Professor Karen Williams, head of the Department of Family and Consumer Sciences, and Arietta Wiedmann, associate dean of the Outreach School, to create a degree that would maintain UW's high standards of academic rigor and meet the needs of students in the state.

UW President Tom Buchanan noted in his fall convocation address the state will require a larger and better-educated workforce as it diversifies and grows. "Our responsibility to provide that well-educated workforce goes way beyond our responsibility to educate Wyoming's newly minted high school graduates – to think otherwise would be naïve. Whether it is a degree from UW, a community college program, or an accredited technical program, we need to fill that workforce pipeline with learners of all kinds."

The BAS degree helps workers broaden their skills and knowledge and gives them the means to move into leadership and management positions.

Frank Galey, dean of the College of Agriculture, says, "Community and economic development efforts have traditionally been major components of our land-grant mission, and the opportunity to help individuals acquire additional job training and skills is part of that mission." As Galey notes, the College of Agriculture was first in line to host this new degree program and continues to work with the UW Outreach School to refine the program, add courses to the program's menu, and market the program to potential students.

Ed Boenisch, deputy director of the Wyoming Community College Commission, says Wyoming's community colleges have long endorsed the establishment of the BAS degree in Wyoming.

"We are very pleased it is now one more option available to Wyoming community college graduates with applied science degrees," Boenisch says. "It will be an essential tool for those who want to increase their opportunities for advancement in the workforce."

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