COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

AG NEWS

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UW President Laurie Nichols presents Katie Lee of Baggs with the reserve champion ribbon in the Champion of Champions Market Lamb Challenge.

State Fair Photos, page 26.

UW COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

Dean Frank Galey

"All the food we eat, whether Brussels sprouts or pork bellies, has been modified by mankind. Genetic engineering is only one particularly powerful way to do what we have been doing for eleven thousand years."

Michael Specter

Dear Friends and Colleagues,

Long before Mendel's pea plant experiments and his discovery of the laws of inheritance, genetic principles were intertwined with agricultural advances. Today, genetics continues to be a rich arena for scientific discovery. This issue of *Ag News* highlights a few of the new frontiers for genetic-based research.

Melanie LaCava, a veterinary sciences graduate student working with Professor **Holly Ernest**, is using DNA analysis to identify genetically distinct pronghorn populations in Wyoming. Ultimately, her work could be used in pronghorn population management plans. Wyoming is home to approximately one-half of the world's pronghorn antelope.

Plant sciences Assistant Professor **Sadanand Dhekney** is part of an effort to develop new guidelines and regulations for emerging biotechnologies. Many techniques Dhekney and others now use rely on modifying existing plant genes rather than inserting new genes into a plant or animal. He and colleagues from across the nation are making recommendations to update guidelines and regulations that use these newer technologies.

Genetic technology in its many forms is perhaps one of the most polarizing topics in today's world. This is a place where the land-grant university can contribute scientifically based information on the benefits and potential risks of adopting these new technologies, in addition to discovering new methods to help meet the projected demands for food later in this century.

This issue also highlights this year's recipients of our Outstanding Alumni, Legacy Award, and Outreach/Research Partner of the Year awards. **Doug Miyamoto**, director of the Wyoming Department of Agriculture, is being recognized for his many contributions to the agricultural industry. A Wyoming native, Miyamoto heads a department assisting an industry that contributes more than a billion dollars to the state's economy.

Bill Gross, a successful livestock and feedlot operator and this year's other outstanding alum honoree, is also working with faculty member **Mark Stayton** on a new breeding program, which they hope will eventually lead to Bovine Pulmonary Disease (BVD) resistance in cattle.

Another contributor to Wyoming's agriculture industry is the sheep and wool industry. **Wyoming Wool Growers Association** is this year's Research/Outreach Partner of the Year Award. The association has worked with faculty members over the years on many projects and continues to work closely with faculty members and UW Extension educators.

Each year the college also recognizes an individual or organization that has made a lasting contribution to the success of our students, programs, and research. This year it is our pleasure to name the Honorable **John Hines** as the college's Legacy Award recipient.

I hope you enjoy reading more about each of our honorees and the other exciting activities within the college.

Frank

Dean Frank Galey
College of Agriculture and Natural Resources

Molecular biologist's lab has two papers among top 100 most influential

Telling bacteria stay! or go! really is like giving commands to man's best friend to sit or fetch – a scientist just needs to know the keywords in the micro world to unlock the language.

One key is cyclic dimeric guanosine monophosphate, mercifully shortened to c-di-GMP, and in bacterial speak is responsible for their deciding to stay put or swim away.

University of Wyoming molecular biologists were among the first to determine how this molecule is made and broken down.

Molecular biology Professor Mark Gomelsky with former postdoctoral associate Zehra Tuzun Guvener.

Two papers by Professor Mark Gomelsky's lab were nominated by the editorial board members of *Journal of Bacteriology* to represent the 100 most influential papers published in this journal since 1916. *Journal of Bacteriology*, the flagship journal of the American Society for Microbiology, is celebrating its centennial.

The Gomelsky papers published in 2005 helped open a new field in bacterial signaling. Each paper has acquired over 400 citations, according to Google Scholar.

"We stumbled upon this new field quite unintentionally," says Gomelsky, "but in some ways intentionally."

Unknown Universe

Gomelsky wasn't aware of c-di-GMP and had no intention of studying it. The late Professor Moshe Benziman of Hebrew University, Israel, discovered c-di-GMP and described enzymes involved in its syntheses and hydrolysis (Gomelsky dedicated both papers in Benziman's honor).

Gomelsky's lab was studying light-activated proteins at the time (it still does), and one of their proteins, he says, was strange, containing "domain of unknown function 1" and "domain of unknown function 2."

Domains are large modules from which proteins are made. Gomelsky wanted to understand how their strange, light-activated protein worked.

"I was stunned," he recalls. "Unknown domains 1 and 2 were not just in our protein; they popped up everywhere in the bacterial genomes. It was difficult to believe people would not know about this apparently undiscovered universe."

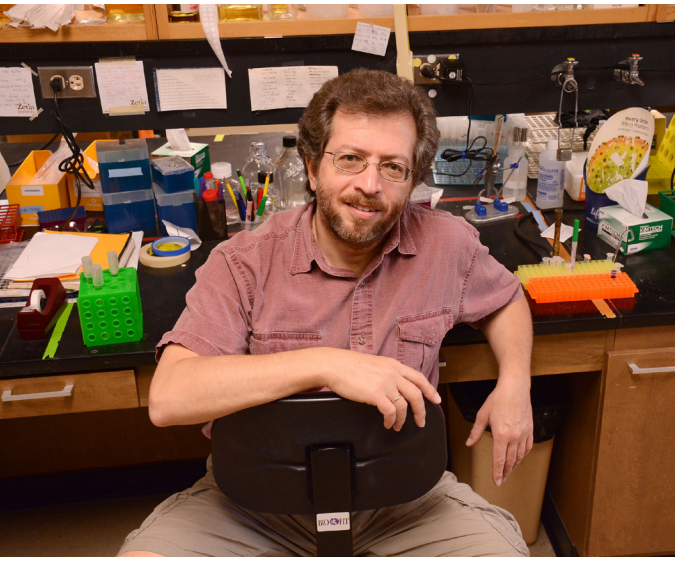
He says he decided to address the issue head on, driven by scientific curiosity, by deciphering what these domains of unknown function actually do.

And did.

"Our studies were not overly sophisticated," says Gomelsky. "We explained that c-di-GMP was made by the domain of unknown function 1 and that it is broken down by domain of unknown function 2. We also offered hard evidence that c-di-GMP is a widespread and probably important molecule."

Once these papers were published, along with a few others at about the same time, a surge began.

"Suddenly there was the gold rush," says Gomelsky. "At the



Mark Gomelsky joined the Department of Molecular Biology in 1999.

beginning, there were just a few papers exclusively from the Benziman group, then a handful of influential papers appeared in 2004-05, and now the annual number of papers about c-di-GMP is in the hundreds."

Brawny Biofilms

Why is understanding whether bacteria attach to a surface and stay put or swim by without attaching important?

Gomelsky says when grown on surfaces – whether human organs, medical implants, or water pipes underneath kitchen sinks – bacteria form biofilms. Biofilms are like bacterial cities in which cells are very diversified.

Gomelsky compares bacterial diversity to human diversity.

"Like in a city, people differ by occupation, incomes, origins, mentality. The same type of diversity happens in bacterial cities, biofilms," he says. "Growth on surfaces within self-made protective matrices produces bacteria with different physiologies. Diversification provides strength to bacterial communities, just like it does to human communities. It's difficult to eradicate a diverse population."

Antibiotics dropped into a test tube culture, where bacteria are similar, will kill practically all the bacteria.

"If you do the same thing with biofilm, the antibiotic will kill the top layer but won't necessarily even reach the inner areas due to physical and chemical constraints," says Gomelsky. "Some of the cells in the bacterial city are dormant and not even susceptible to antibiotics."

Treated chronic bacterial infections go away but usually come back because some of the bacteria survive the antibiotics onslaught. After multiplying in the absence of the antibiotic, they can cause another episode of acute infection, says Gomelsky.

Mindful Persuasion

If scientists could tell the bacteria to go instead of allowing them to build a biofilm, or if they could tell bacteria in an existing biofilm to disperse, antibiotics would destroy bacteria more readily.

"Speaking bacterial language helps us designing 'psychological warfare' agents against pathogens," he says. "We want to trick bacteria into making bad decisions during infection."

By combining antibiotics, which are regular warfare agents, with drugs that meddle with bacterial "minds," Gomelsky says bacteria can be eradicated more efficiently. Studies on c-di-GMP opened the ways for designing new types of antibacterial drugs.

Former Ph.D. student Dmitri Ryjenkov, post-doctorate researchers Marina Tarutina and Oleg Moskvin, and technician Andy Schmidt worked with Gomelsky on this project. Ryjenkov is employed by a U.S.-Russian biotech company, Tarutina returned to Russia, Moskvin is a research scientist at the University of Wisconsin, and Schmidt went on to study medical technology.

THE TWO PAPERS

"C-di-GMP: the dawning of a novel bacterial signalling system"

bit.ly/C-di-GMP

"The ubiquitous protein domain EAL is a cyclic diguanylate-specific phosphodiesterase: enzymatically active and inactive EAL domains"

bit.ly/ubiquitous-protein

Plant sciences Assistant Professor Sadanand Dhekney

PLANT SCIENCES RESEARCHER SEEKS TO HELP BEGIN NEW TECHNOLOGY REGULATIONS DIALOGUE

Plant sciences Assistant Professor Sadanand Dhekney is part of an effort through the Society for In Vitro Biology to start a dialogue to develop new guidelines and regulations for emerging biotechnologies.

Technologies like CRISPR (Clustered regularly interspaced short palindromic repeats) and TALENS (Transcription activator-like effector nucleases) are making obsolete the regulations put into place for genetically modified crops more than 20 years ago.

The society is emphasizing the issue at its 2017 conference in Raleigh, North Carolina, June 10-14.

Old technology inserts genes into plants to modify crops, such as making them herbicide-resistant.

"The next generation has nothing to do with inserting genes in plants," says Dhekney, who co-chairs the Plant Biotechnology section for the society's 2017 meeting. "The existing genes in plants are modified; nothing new is added."

> "The technology is so new, the government doesn't have any regulations in place."

Dhekney is a faculty member in the Department of Plant Sciences and based at the Sheridan Research and Extension Center. He uses techniques in breeding and biotechnology, along with improved management practices, for expanding grapevine production in Wyoming.

The new technologies for modifying plants are creating gray areas, he says.

"They are considered non-GMO crops by the government now but people against GMO consider CRISPR (crops) to be GMO," he says. "The technology is so new, the government doesn't have any regulations in place."

The current regulatory protocols are obsolete for what is happening.

"Nobody is starting a dialogue on this process," says Dhekney. "It needs to start somewhere, and the conference is the first step toward a dialogue for a framework for developing protocols for these emerging technologies."

Agricultural Experiment Station honors exceptional research partners during `state fair ceremony

Research partners of the Wyoming Agricultural Experiment Station were recognized during the Wyoming Department of Agriculture's annual program at the Wyoming State Fair and Rodeo in Douglas in August.

The Agricultural Experiment Station is celebrating its 125th year with events and programs across the state.

Bret Hess, associate dean and director of the Wyoming Agricultural Experiment Station

WDA director Doug Miyamoto extended an invitation to share the awards program, says Bret Hess, associate dean and director of the WAES, based in the College of Agriculture and Natural Resources.

"The event evolved into something very special, not only because we were co-hosting with the Wyoming Department of Agriculture, but also because we honored different organization's that have been exceptional research partners over numerous years," he says.

Frank Galey, dean of the College of Agriculture and Natural Resources, and Glen Whipple, associate dean and director of UW Extension, presented the honors to representatives of the WDA; USDA Agricultural Research Service; the U.S. Sheep Experiment Station in Idaho; Wyoming Wool Growers Association; USDA-ARS High Plains Grassland Research Station near Cheyenne; and Thunder Basin Grasslands Prairie Ecosystem Association.

In addition to processing research grant monies into the college, the AES directs four research and extension centers in the state: Laramie, Powell, Sheridan, and the James C. Hageman Sustainable Agriculture Research and Extension Center near Lingle.

Ford receives USDA Abraham Lincoln Honor Award

Animal science Professor Steve Ford is a member of a four-member team to receive the USDA's Abraham Lincoln Honor Award this September in Washington, D.C.

"The award is the highest that USDA gives out, so it was a real surprise and pleasure for us to receive it," notes Ford, Rochelle Chair, reproductive biology, fetal programming, in the Department of Animal Science.

Secretary of Agriculture Tom Vilsack formed the Animal Handling and Welfare Review Panel in response to a New York Times article alleging animal mistreatment by the U.S. Meat Animal Research Center (MARC) at Clay Center, Nebraska, by a retired employee.

The panel reviewed, evaluated, and prepared a guiding document on animal care and well-being at MARC and other Animal Research Service facilities from February 2015-August 2015.

The panel was on a very short timeline so the document could be submitted to Congress quickly, says Ford, director of the Center for the Study of Fetal Programming.

The USDA notes the review resulted in significant improvement in the management and research practices of the animal research programs and ensuring animals used in research are treated humanely and cared for appropriately.

Steve Ford

Vilsack presented the award September 13 in the Jefferson Auditorium at USDA headquarters in Washington, D.C.

Sheridan Research and Extension Center field day celebrates Wyoming Agricultural Experiment Station's 125 years

Robert Ligocki's team harrows a field.

Robert Ligocki and his team of Belgian horses

Old, newer, new horse and tractor harrowing and an antique tractor show blended with research projects and the 125-year history of the Wyoming Agricultural Experiment Station during the Sheridan Research and Extension Center field day in July.

These and other photographs can be seen at bit.ly/sheridangallery.

Brian Mealor, right, and Frank Galey, dean of the College of Agriculture and Natural Resources

David Kruger, who presented an oral history of the Wyoming Agricultural Experiment Station.

UW ANIMAL SCIENCE GRADUATE FINESSES 21-TON BEHEMOTH

This 1964 animal science graduate from the University of Wyoming works with a beast.

Keith Murray of Powell has a large collection of antique tractors, but the 42,000-pound 1910 Avery steam tractor might be the most unique. Not because of its heft, but because there are only six in the world and his is one of three that run.

It hadn't in 18 years until July, when Powell Research and Extension Center farm manager Camby Reynolds asked if Murray would be willing to do some disking during the field day July 19.

"It took a couple days to free everything up and pressure test it," says Murray. He farms near Powell. "Some things were stuck on it."

Lance and Jolene Streets of Pryor, Montana, guided the 24-foot-long behemoth several times down a strip of ground, the 14-blade disk turning over dirt. A 1941 John Deere B belonging to John Spomer of Powell and pulling a plow joined alongside the tractor at different times, as did the draft horse team of Pistol and Pete, pulling the College of Agriculture and Natural Resources renovated sheep wagon.

Keith Murray

Events at the center commemorated the 125th anniversary of the Wyoming Agricultural Experiment Station.

Pistol and Pete pull the renovated College of Agriculture and Natural Resources sheep wagon alongside Keith Murray's 1910 Avery steam tractor at the Powell Research and Extension Center field day.

Article examining beef DNA testing published in CHOICES journal

College of Agriculture and Natural Resources faculty examining the economic issues of beef cattle DNA testing published a recent article in CHOICES, a publication of the Agricultural and Applied Economics Association.

Authors are Department of Agricultural and Applied Economics Professor Nicole Ballenger, Associate Professor Chris Bastian, University of Wyoming Extension educator Bridger Feuz, graduate student Justin Schaffer, Associate Professor Kristi Cammack, formerly in the UW Department of Animal Science, and Garry Griffith, professorial research fellow at the UNE Business School, University of New England, Armidale, NSW, Australia.

At the time of its publication, only two companies offered comprehensive genomic prediction tools at prices ranging from less than $10 to test for parentage and simple traits to $79 to glean information on a panel of economically relevant complex traits, authors state.

Genomic tools would speed the process of selecting and breeding for genetics by providing information about inherited traits not readily observed or cost-effectively measured and the expected genetic merit of breeding bulls and cows too young to have performance records.

"What each cattle producer or buyer has to decide is if the current cost of buying a genomic test is worth the benefit down the road in the form of more valuable or less costly-to-raise offspring," the authors state. Only a few economic analyses have examined the profitability of DNA testing of cattle. The authors conclude more economic research on the use of genomics is needed to help potential users of genomics make better decisions.

The USDA has placed priority on animal breeding, genetics, and genomics to better meet future food needs. Additional economic analyses would help the USDA prioritize funding for genomically oriented research on economically relevant traits.

"Working in tandem with genomic experts, who can tell us more about the potential timeline and likelihood of development of genomic advancements, economists could evaluate which genomic advancements offer the most promise in terms of both net economic benefits and successful development," according to the authors. Such economic analyses could help prioritize genomics research funding and help producers decide which tests might be worth the cost.

"This is an area where more economic analyses could really help those deciding on how to invest in genomics research and using genomics tools," says Bastian.

The article can be read online at bit.ly/beefdnatests.

bit.ly/beefdnatests

Christopher Boswell, Shutterstock.com

OUTSTANDING ALUMNI

Cattleman contributes knowledge, energy, innovation to community, industry

A Pine Bluffs farmer, rancher, feedlot owner-operator and a man of many hats in Wyoming agriculture has received an Outstanding Alumni Award from the College of Agriculture and Natural Resources.

William Gross graduated in 1961 from the University of Wyoming with a bachelor's degree in animal science. Upon his return home, he set about doubling the Gross-Wilkinson Ranch cow-calf/stocker operation. He added a feedlot, which now has an 8,500-head capacity. Irrigated and dry land cropping are also part of the mix. Gross and his wife, Phyllis, contributed five children to the Gross-Wilkinson Ranch legacy. They are Greg, Pat, Paula, Mary, and Jennifer. Sons Greg and Pat have joined the daily running and overall direction of the enterprise.

"Bill has utilized the formal education he received at UW to build an outstanding farming and ranching operation," says nominator Paul Lowham of Jackson. "He has grown it financially and has included family members who will ensure its sustainability."

The Gross-Wilkinson Ranch, established by Gross's grandfather in 1890, was honored as a Centennial Ranch by the state of Wyoming in 1990.

"I had the good fortune of working closely with the Gross-Wilkinson Ranch in the 1990s when they agreed to feed cattle for the Wyoming Beef Cattle Improvement Association's Feedlot Test and Carcass Evaluation Program," says Doug Hixon, then a UW Extension beef cattle specialist. "Since I was active in administering that extension program, I saw 'up close and personal' the high level of expertise and professional approach that Bill's leadership stamped on the Gross-Wilkinson operation. It is first-class in every sense of the word."

Lives by the Code

"Bill and his family have lived by the principles contained in the 'Code of the West' ever since I have known them and long before that became a formal program adopted by the state of Wyoming," says Hixon, now UW Professor Emeritus in animal science.

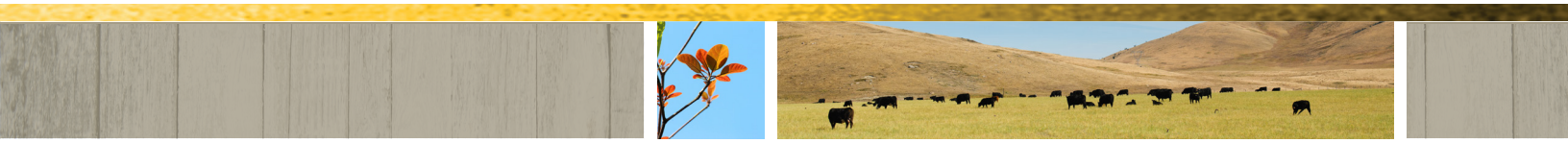
Among the code's principles are Always Finish What You Start; Do What Has to Be Done; Be Tough But Fair; and When You Make a Promise, Keep It.

William Gross

Gary Darnall of the Darnall Ranch in Harrisburg, Nebraska, has owned a yearlings operation with Gross for 20 years. "I could not ask for a better business partner," he says. "Bill is fair, honest, and a good businessman."

Of the family ranch and feedlot, Lex Madden, owner of Torrington Livestock Markets, says, "He has a vision for improvement and is willing to see it through to completion." He notes with enthusiasm, "Bill and Phyllis have shown their family and others what dedication and hard work means."

Gross opens his gates to groups who want to learn about farming and ranching. He readily shares his



knowledge with young people and producers across the region. Says Madden, "Many times people call me and I forward them on to Bill, because he is so well-versed in all areas of agriculture."

Gross has developed a thorough understanding of integrated resource management, as well as beef production systems and best management practices, Hixon notes. "He has studied marketing to the extent he is one of the sharpest individuals I know in relation to buying and selling cattle."

Gross was born in Kimball, Nebraska, and attended elementary and high school in Pine Bluffs.

He is a shareholder and director of the Farmers State Bank in Pine Bluffs. Founded in 1915, the bank serves agricultural producers, businesses, and community members in southeastern Wyoming, western Nebraska, and northern Colorado.

He has served as a board member of Farm Bureau; Laramie County Agriculture, Soil and Conservation Service; and Pine Bluffs Co-op Grocery Store, and is a member of St. Paul's Catholic Church and Laramie County Stock Growers.

Gives UW the Boot, Plus Yaks and Steer-A-Year

In 2004, Bill and Phyllis Gross and Gary and Emilie Darnall gave UW the boot – the decorative 5-foot-high cowboy boot that greets visitors in the lobby of the Animal Science/ Molecular Biology Building north of the stadium.

Yaks? Yes. Gross is working with associate professors Mark Stayton and Scott Lake of the Department of Animal Science on a program to breed yak-cow crosses. The yaks are from the Tibetan Plateau, where the average elevation is 14,800 feet. The goal is to introduce genes from yaks into cattle to bolster altitude resistance and reduce incidence of brisket disease and bovine respiratory complex, which is the single most common cause of death among feedlot cattle.

In the end, altitude resistance is only useful to Wyoming ranchers if the animals have the traits necessary for efficient beef production, says Stayton. With his eye for beef cattle, Gross evaluates the hybrids for their commercial potential.

Gross at the Gross-Wilkinson Ranch

> "I had the good fortune of meeting Bill and his fine family shortly after arriving in Wyoming as beef cattle extension specialist in 1982. Phil Rosenlund, the Laramie County educator at that time, took me on a tour of one of the best operations in his county, the one operated by Bill and Phyllis Gross and their family. I soon became aware that it was not only one of the most outstanding and progressive operations in Laramie County, but also in the state of Wyoming and the Rocky Mountain West."
>
> —Doug Hixon, Professor Emeritus of Animal Science

The Gross-Wilkinson Ranch has participated in the Steer-A-Year Program. Their gift of a live steer, along with those of other producers, raises money for in-state student-athlete scholarships, the UW rodeo club, and the animal science judging teams.

"Bill Gross has worked his entire life to help agriculture stay strong – and the university in the process. His heart is truly in Wyoming and with the university," says Madden.

Hixon says, "He's everything we always strived for in students who graduate from the University of Wyoming."

OUTSTANDING ALUMNI

Graduate keeps Wyoming agriculture going strong

A member of the governor's Cabinet who was a four-year varsity letter winner in NCAA Division One swimming is a recipient of the Outstanding Alumni Award from the College of Agriculture and Natural Resources.

Douglas Miyamoto, who earned BS (1996) and MS (2001) degrees in rangeland ecology and watershed management, now works on behalf of producers on Wyoming's 11,000 farms and ranches as director of the Wyoming Department of Agriculture.

"It is without question that Doug Miyamoto has distinguished himself in his professional life and put his degrees to good use," wrote nominator John Tanaka, associate director of the Wyoming Agricultural Experiment Station. "He exhibits the highest levels of integrity, stature, and demonstrated ability."

Service to State Runs Deep

Born and raised in Rawlins, Miyamoto is a second-generation Wyoming native. His family came to the state during World War II, having been "relocated" to the Heart Mountain Relocation Center between Cody and Powell. His grandfather, Tom Miyamoto, attended the University of Wyoming on baseball and wrestling scholarships. He later served in Governor Ed Herschler's Cabinet as director of the Wyoming Health Department.

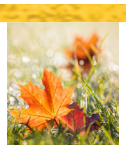
Doug Miyamoto at the Wyoming State Fair and Rodeo in August.

His father, Marty Miyamoto, taught biology at Rawlins High School for more than 30 years. His mother, Karen Miyamoto, served as a swimming teacher and coach in Rawlins for almost three decades. Like Miyamoto (who is the middle child), his two sisters attended college on swimming scholarships.

His wife, Heather, a UW graduate, is a kindergarten teacher at Saddle Ridge Elementary School in Cheyenne. She has taught 5- and 6-year-olds for more than 14 years.

Works Collaboratively, Garners Appreciation

Miyamoto first earned the respect of USDA Agricultural Research Service soil scientist and adjunct professor Gerald Schuman (retired) when Schuman was his thesis adviser. Says Schuman, "Every time I visit with a producer, commodity representative, agency head, or agriculture producer group, I hear great things about Doug and his management skills, influence,




and enthusiasm about Wyoming agriculture and its programs.

"Whether it's the stock growers, the ranch managers, cultivation farmers, environmental groups, or the public, Doug has been successful in working with these varied groups because of his integrity and the trust he has developed," says Schuman.

Bret Hess, Agricultural Experiment Station (AES) director and UW professor, notes Miyamoto's engaging style and mastery of complex subject matter. "I have witnessed him provide meaningful testimony to a variety of audiences on subjects ranging from public safety and health to domestic/wild sheep interactions."

Hess adds, "I have heard him brag about being a UW graduate in personal conversation and when delivering public speeches. He is a strong supporter of many of the college's programs and events."

The College of Agriculture and Natural Resources Dean's Advisory Board is one of many boards and commissions on which Miyamoto serves at both state and federal levels.

Students at UW's ACRES Student Farm appreciate the 2000 GMC Sierra pickup Doug and Heather Miyamoto donated to help them manage their large-scale composting efforts and other farm work.

"Without the truck, we wouldn't be able to haul our produce to the farmers markets or deliver to restaurants in Laramie," says Betsy Trana, ACRES farm president. "It also gives students experience driving a large truck, which is a pretty important skill for any aspiring farmer."

Gets Along, Gets Things Done

As director of the Wyoming Department of Agriculture, Miyamoto oversees the Wyoming State Fair Park and facilities and ensures agriculture and youth remain at the center of a fun and affordable experience. During his tenure as deputy director of the Department of Agriculture in 2011-2014, he reviewed every aspect of the annual fair and collaborated on a vision to revive the park and reinforce appreciation for Wyoming's agricultural heritage.

Miyamoto manages an annual budget of almost $20 million and oversees operations that touch the lives and well-being of almost every person in the state.

- He oversees quality assurance for food, animal feed, fertilizer, and fuels sold within the state and inspections for meat plants, grocery stores, restaurants, pools, and daycare facilities.
- Coordinates weed and pest and predator and rabies control activities with local and federal government.
- Works with constituents to develop policies aimed at keeping Wyoming's third-largest industry strong and enhancing natural resources and quality of life.

From 1999 to 2014, Miyamoto served in multiple capacities with the USDA Natural Resources Conservation Service. He gained familiarity with natural resource and agriculture issues and policies, including Farm Bill legislation, Endangered Species Act reform, Clean Water Act and Clean Air Act issues, renewable energy strategies, and regional conservation strategies.

On the other side of issues and policies are always people: he has empowered citizens to write their own plans to address water quality impairments. He helped producers reduce agricultural runoff and determine and implement conservation practices to benefit their resource base and profitability.

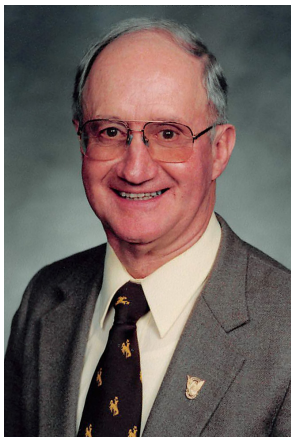
Before heading the Department of Agriculture, Miyamoto served as director and CEO of the Wyoming Livestock Board. This governor-appointed board and 120-employee state agency is responsible for protecting livestock interests from disease and theft. Its law enforcement, brand recording and inspection, and disease tracing and monitoring components support the economic vigor and marketability of Wyoming's livestock industry.

Through all his positions, Miyamoto has worked tirelessly to increase public awareness of the importance of agriculture, says Tanaka.

Professor Emeritus in ecosystem science and management Michael Smith has known Miyamoto since he was a student in his range soils undergraduate class. "I am pleased to add my support," says Smith. "That he has accomplished this in a relatively few years is a testament to his ability to get along with people and get things done. He will continue to be an asset to Wyoming."

LEGACY AWARD

Legacy Award recipient has long record of service to UW, state



John Hines

Tragedy, a lukewarm college record, and an uninspiring (early) performance managing the family ranch threw some sharp turns in John Hines' life – but those roads brought him back to where he was probably meant to be – on the ranch and in Wyoming.

Third-generation Gillette sheep and cattle rancher, Hines is recipient of this year's Legacy Award, presented to those who have benefitted the college through scholarships, donations, and service.

Through his efforts on behalf of the college and his 30-year tenure in the Wyoming Legislature, UW students and Wyoming citizens have benefitted.

"I was in a position I could afford to do a few things," says Hines. "I'm single, so I didn't have a spouse or children. I felt they were all good programs."

Benefits Agricultural Students

He took advantage of the endowment gift matching funds program and created the Hines Family Scholarship in 2005. Hines was appointed to serve by then-Governor Dave Freudenthal on the first Wyoming Brucellosis Coordination Team. He's made donations to the UW veterinary diagnostic laboratory to help purchase diagnostic equipment, and a charitable gift fund benefits the Wildlife-Livestock Health Program and UW athletics.

The Hines Family Scholarship has a caveat – only those returning for a second year of school are eligible.

"I think those are the ones who are really interested in getting a degree and acquiring an education," Hines says.

Third-Generation Rancher

Hines' grandfather (Hines) and grandmother (McKenzie) had both come from Scotland, and his grandfather started herding sheep in 1904. The Hines ranch and the McKenzie ranch were side by side. His father, Dwight, was born on the ranch and his mother, Annie, was a McKenzie.

Hines' early years started hard – his father died of heart problems at age 49 when Hines was a high schooler, and he helped his mother run the ranch.

After a year and a half or so, "I got to thinking things over," he says. "I wasn't doing that good at the university or at the ranch, so my mother leased the ranch, and I joined the Army."

He worked for the veterinary services, something that would later prompt his benefitting UW's wildlife-livestock disease efforts. Hines was discharged in 1960 and returned to run the ranch.

Hines was looking into agricultural programs through extension to help him as a producer.

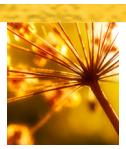
"The people (at UW) who knew me pretty well said I didn't need the extension courses," Hines says. "They were more for beginning ranchers."

He did take advantage of the local extension office and extension programs offered around the state, saying he believed keeping up on information and learning was important. Hines had not graduated from UW.

"So I always thought I would someday get a degree," he says, laughs, and adds, "Looks doubtful now."

Ranch Management Skills Sought After

Still, he says an economics course on bookkeeping and planning is probably the most helpful class he ever took while attending the college.




"I kept extensive ranch records, and different people came to the university and asked if they could come up and see my operation and learn from it," he says.

One was from New Zealand. He stayed at the ranch a few days and invited Hines to stay with his family if he were ever in New Zealand.

"A year or two later I did," says Hines. "He was director of a research station, and he took me to see several sheep farmers there. Those families were kind of like the families I knew while I was growing up."

Later, two of the New Zealander's sons ended up on the Hines ranch for a time as they traveled the world.

Ranching was only part of Hines' life. The other was his service in the legislature, serving on almost every committee. He adds he never could have been in the legislature were it not for his hired hand of 25 years on the ranch, freeing time for service to the state.

"It's a lot more than two months in the wintertime," Hines notes, "particularly when you are on so many committees."

Hines served in the House from 1985-2002 and in the Senate 2003-2014. He was Senate president 2009-2010, Senate majority floor leader 2007-2008, and Senate vice president 2005-2006.

He decided not to run again in 2014.

Ranching and the legislature demanded most of his time, and the only other things he really liked doing – and still does – were attending UW football games and other sporting events at UW.

"I like to travel," he adds. "I had a high school teacher who traveled all over the world. He was such an interesting person, I thought, 'Boy, when I get out of school, I'm going to do that.'

"Things didn't quite work out that way," he says. "One day I was collecting Social Security checks and I hadn't been anywhere."

He's since traveled to almost 30 countries and says, "I found out Wyoming is the best place to be anyway."

OUTSTANDING RESEARCH PARTNER

State's wool growers suggest more producers, smaller herds boosting industry

Visit with Wyoming wool growers and you'll soon come away as optimistic as they are when talking about the health of their industry.

Sheep numbers increased more than 10,000 head from last year, and members of the Wyoming Wool Growers Association board of directors suggest the increase comes from more people getting into the business with smaller flocks.

The association is this year's Outstanding Research/Outreach Partner of the Year Award recipient.

"We've been a player in Wyoming history as an association since 1905, and when the university comes to us with an idea, and if it's a good idea, I think we've been a strong supporter of the university," says board member Regan Smith of Powell.

Weaves through Wyoming History

The sheep industry (many sheep producers raise cattle and many cattle producers raise sheep) and Wyoming history are closely entwined, painting an early landscape of the state. There were 5 million sheep in the state in 1900, and by 2011 the figure was 275,000 – about the same number of sheep as on three early Wyoming operations – John Okie, Frances Warren, and brothers Thomas, James, and John Cosgriff.

Numbers have increased to 355,000 on January 1, 2016.

Producers like what they see.

"You're not going to see 10,000-head herds, that's history," says Peter John Camino of Buffalo. "But you are going to see people starting to figure out there is money in the sheep

Long-time sheep rancher Jewell Reed of Douglas at the mid-year membership meeting in Casper. She and her husband, Earl, served as the wool show superintendents for many years at the Wyoming State Fair and Rodeo.

business. They are going to start out small and eventually get bigger. Especially with the decline in the cattle market, if you put dollar signs on the sheep side and beef side, you're going to figure out which one is going to make you money."

Wool growers and the University of Wyoming have collaborated with ram tests since 1961 in the animal science department. The association partners with the Mountain States Lamb Cooperative to conduct a black face ram sire test, and a white face ram sire test with the University of Wyoming. Both are at the Laramie Research and Extension Center (LREC). Fleece characteristics are measured and combined with gain data to create an overall index.

Seek Sheep Specialist

The board members have a unanimous answer to how the university could best serve them: hire a sheep specialist.

But they're aware of the shrinking budgets.

Anyone who has lived in Wyoming knows the peaks and valleys of mineral revenues, says Smith.

"I don't think any businessman, whether sheep man or anyone else, would want the university to not balance the budget," he says.

But having a sheep specialist is still important, he notes. Progress is limited without the leadership a sheep specialist could provide.

Members of the Wyoming Wool Growers Board of Directors include, from left, Vance Broadbent, executive director Amy Hendrickson, Jim Dona, Kay Neves, Lisa Keeler, Peter John Camino, Regan Smith, John Marton, and Bob Harlan.

"I think it's paramount to get someone who can point UW in a direction, whether animal health or genetic research, whatever," he says. "There are a multitude of things that can get done at the university, but you have to have someone spearhead it."

Research center trials are also important. Producers don't want to be the first to try something new and fail.

"If UW could (test), then all the producers and taxpayers could benefit from it," says Smith. "That's certainly a place the university can help."

Education, Information Keys to Producer Strength

Sheep producers face the same issues they've always had: predators, funding, marketing, weather, the government, and public lands, says producer Lisa Keeler of Kaycee.

"I think the university could help us by joining forces and assist us with education," she says. "I think part of it is giving the producers more tools with which to help us survive."

She also suggests fresh information to help those already established as well as information for those just starting out.

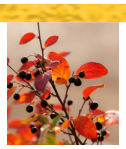
Management tool information is needed, as is information about genetics, says Camino.

"There is a lot of technology out there we should be able to use and can't," he says, also noting the lack of a sheep specialist and the benefits of providing information through meetings.

"Education is probably the number-one thing (to help producers)," says Camino, a third-generation sheep rancher.

Big Horn Basin producer Kay Neves of Emblem has seen quality improvement in sheep, which also improves lamb and wool quality.

"I think producers are working hard to improve their sheep, and



they're looking at a scientific basis for that," says Neves.

International Forces Influence Industry

Other issues are out of producer hands.

"The labor problem is probably one of the biggest we have," Camino says. "If you don't have labor, you can't do your business. The Labor Department is putting on so many restrictions, it's just about impossible to get outside help to come into the United States, and you cannot find American workers who will do sheep industry work. It's just not there."

Markets are at the mercy of international forces. Currently, the high dollar boosts wool prices but prompts imports of lamb at lower prices.

Says Camino, whose Basque grandfather came to America in 1904, "People see the future of the sheep industry as down. I don't believe that."

Neither does Amy Hendrickson, association executive director.

"We have a vibrant sheep industry, despite all the pressures," she notes. "It is not easy. Any ranching these days isn't particularly easy," but points out the rising sheep numbers in the state.

She also notes the need for a sheep specialist.

"The sheep industry is very supportive of the university, and they've done a number of things for us, but it is disappointing we have to go outside the state to get expertise on some things," says Hendrickson.

"They do everything they can to help us, but a sheep specialist would help. I think they do a great job at the (LREC) sheep farm. They do the best they can, and we are very, very appreciative."

Lambs in the "Rumen Microbes Associated with Feed Efficiency in Lambs" study at the Laramie Research and Extension Center.

COLLEGE OF AGRICULTURE AND NATURAL RESOURCES SHEEP-RELATED RESEARCH

There are nine active sheep-related research projects in the College of Agriculture and Natural Resources, in addition to the annual black face and white face ram sire tests.

They include:

1. Valuation of Residual Feed Intake as a Selection Tool for Northeast Wyoming Range Sheep Producers
2. Influence of Ewe Breed and Age on Sheep Ked (*Melophagus ovinus* [L.]) Infestations
3. Strategic Sheep Grazing Effects on Yellow Sweetclover (*Melilotus officinalis* [L.] Lam.)
4. Targeted Sheep Grazing for Dalmatian Toadflax and Geyer's Larkspur Management
5. Economics of Vaccinating Sheep against Bluetongue Disease
6. Optimization of a Non-Surgical Artificial Insemination Technique Utilizing Estrous Synchronization and Frozen/Thawed Ram Semen
7. Rumen Microbes Associated with Response to High-sulfate Drinking Water in Lambs
8. Rumen Microbes Associated with Feed Efficiency in Lambs
9. Prevalence of *Brucella ovis* in Wyoming Domestic Sheep

A brief synopsis of each research project is available in the 2016 Field Days Bulletin, available at research and extension centers and online at bit.ly/2016bulletin.

Efforts by former agricultural economics faculty member leave imprint on students, faculty members

Having former faculty members and graduate students praise your work – or even remembering you – 25 years after exiting a building shows seeds planted in the College of Agriculture and Natural Resources took root and grew.

Former agricultural economics faculty member and long-time department head Andrew Vanvig retired from the college in 1991 and died last February at age 93 in his beloved North Dakota.

His faculty work in the College of Agriculture and Natural Resources from 1957 to 1991, how he managed the department from 1957-1982, and his emphasis on graduate student success left lasting impressions.

"I have nothing but high praise for Andrew Vanvig for the way he ran the department and the friendship and goodwill he provided to graduate students while there," notes former graduate student Richard Zink, who graduated in 1980.

Zink, of North Dakota, was Professor Emeritus Larry Held's first graduate student. Held retired in 2011, was hired by Vanvig and has a lasting impression.

"He was probably one of the most straight up, stand up honest people I've ever met," relates Held. "He was quiet at first. But once you got to know him, he was a very warm and caring person."

Held regrets not having contact with his friend before Vanvig's death.

"He was a personal friend to me and had been my supervisor and boss for many years," says Held, also a North Dakota native. "I respected him very much, and he was highly respected in the profession."

Immigrant Son

Vanvig was the son of immigrant parents from Norway who homesteaded in North Dakota. He began his academic career as assistant professor of agricultural economics at the University of Arizona-Tucson in 1952 and joined UW in 1957.

Vanvig and his wife, Connie, established the Andrew and Connie Vanvig scholarships for undergraduate and graduate students, awarded each year during the College of Agriculture and Natural Resources scholarship banquet. Recipients must be majoring in agricultural economics and be sophomores, juniors, or seniors. Connie Vanvig died in July. The Andrew Vanvig Lifetime Distinguished Faculty Achievement Award was created in 2012.

Vanvig also hired Professor Emeritus Dale Menkhaus, who received the Andrew Vanvig Lifetime Distinguished Faculty Achievement Award in 2013.

"He was very personable, and his North Dakota farmer background served him well here," says Menkhaus, who received his Ph.D. from Purdue and joined UW as an assistant professor in 1973. He retired last year.

Andrew Vanvig

Vanvig established the Western Agricultural Lenders Institute in cooperation with the Wyoming Bankers Association. The association helped loan officers in the state stay abreast of developments in the agricultural finance field.

"He built a really strong rapport with the banking community and others in the state and had a strong outreach to the people in Wyoming," says Menkhaus. "All that served him well as department head."

His farming didn't hurt, either.

"Andy was a successful wheat farmer in North Dakota," says Held, who joined the department in 1977 from the University of Nebraska-Lincoln. "I think that's why he struck so well with producers. He knew the first-hand perils of being a farmer and rancher. People around him knew that."

Student Success

His outreach helped with his emphasis for student success.

"There is little question he was instrumental in the hiring of a lot of our students by ag credit groups just because of his connections with the banking community in the state," says Menkhaus.

Vanvig's outreach was also international. In the summer of 1965 he served as a consultant to the Minister of Agriculture in Afghanistan regarding irrigation and other agricultural developments. He also helped establish the agricultural economics department at Kabul University and facilitated the ability of Afghan students to pursue graduate study at universities in the United States.

Zink was the subject of Vanvig's drive and interest in student success right out of the gate.

Zink had applied to Colorado State University but the person he was supposed to meet had to leave unexpectedly. He was sent to see someone else and was then passed from person to person, he says. The last one introduced him to graduate students and sat him in the front row of a class where the professor lectured an hour while Zink's friends were waiting in the car.

"Not to pick on CSU," he says. "I left feeling bad about the whole thing."

University of Wyoming Visit

Zink and friends left to ski at Steamboat. He decided to stop at UW on his return trip. He didn't have an appointment. He introduced himself to Vanvig, department head at the time.

"He gave me a tour of campus, introduced me to the faculty and graduate students," says Zink. "He said he couldn't 100 percent offer me an assistantship but said he could do 98 percent sure and could be 100 percent sure in seven days.

"I left feeling very good."

He later received a call from a CSU respresentative, who apologized for the visit and offered an assistantship.

"I asked if I could have a week to decide," says Zink. "I wanted to wait for Andy Vanvig to call. He did the next day and said they would love for me to come to UW and they had an assistantship for me. I got off on a really good foot with him. He was even on my graduate committee."

Zink returned to North Dakota with graduate degree in hand just in time to start farming.

"The year 1980 was tough," he says, then, with humor, "I got back in time to lose $10,000 my first year."

He would farm another six years before starting Wholesale Ag Products in Carrington, North Dakota. In 2002, the company established Whole Ag Products West in Underwood. The company celebrated its 30th anniversary this year.

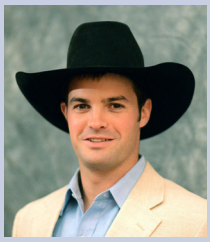
SUPPORTS STUDENT ADVANCEMENT

Andrew Vanvig was a strong advocate of student success, and he and his wife, Connie, established undergraduate and graduate scholarships in the college.

Those receiving undergraduate scholarships in 2015 were Jessica Orton of Steamboat Springs, Colorado; Kaila Willis of Wheatland; and Halle Brake of Aurora, Colorado.

Receiving graduate scholarships were Thadchaigeni Panchalingam of Jaffna, Sri Lanka; and Tristam Munsick of Sheridan.

Jessica Orton

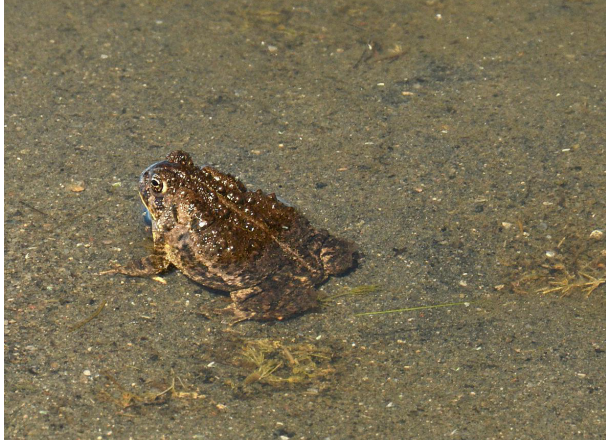


Tristam Munsick

Thadchaigeni Panchalingam, left, and her adviser, Assistant Professor Chian Jones Ritten, in the Department of Agricultural and Applied Economics, at last year's scholarship program

Toad Trials

Researchers investigate what management techniques could boost Wyoming toad numbers



Wyoming toad soaking in warmth.

Water glistened off the half-submerged back of the Wyoming toad sitting along the southeastern shore of Mortenson Lake southwest of Laramie.

Looking north this mid-July day, the toad was indifferent to the efforts of three humans behind it on the shore near water enclosures, dormitories for Wyoming toad tadpoles – tweens – those not yet having completely morphed into adults, still displaying the youthful but cumbersome tadpole tail.

Associate Professor Melanie Murphy, master's student Jay Vance, and technician Shelby Sutton had finished feeding insects to metamorphs in grass enclosures on the other side of the lake. The three had walked through the tall grass flicking insect nets back and forth. Metamorphs are fed brunch every day.

Mortenson Lake – nestled in the Mortenson Lake Wildlife Refuge – is home to the Wyoming toad out of all the floodplains, marshlands, and lakes on earth. The morning scene of the Wyoming toad looking northward could have been the same 10,000 years ago as the last of the Pleistocene glaciers retreated from the eastern flanks of the Medicine Bow Mountains. Spring snowmelt flooded the plains then – stream channels or ponds or lakes were few if nonexistent.

Troubling Times

Something changed in the Wyoming toad's very little corner of the world, tripping a population plunge in the 1960s and 1970s and its recorded extinction in the wild in 1984.

A fisherman spotted a toad in 1987 at the lake on the land owned by rancher Charlie Swanson, who later sold the ground to The Nature Conservancy, which in turn sold it to the U.S. Fish and Wildlife Service a few years later. Swanson is credited in large part for survival of the species. The refuge is comprised of Mortenson, Garber, Gibbs, and Soda lakes and is closed to the public.

Master's student Jay Vance sprays collected insects with water for easier handling.

Recovery efforts were launched in the mid-1990s, and Murphy, who joined the University of Wyoming in 2010, is in her fifth year of Wyoming toad research. She often includes "we don't know" in answers because there just isn't much information about Wyoming toads. The Wyoming toad went "extinct" before a lot was known about the species' needs.

> The USFWS says the Wyoming toad is considered one of the four most endangered amphibian species in North America.

"There is a massive information gap," Murphy says. Making effective management decisions is difficult without knowing what is preventing the toad from recovering.

"The Wyoming toad is a fantastic example where scientific research is critically needed to inform management decisions on the ground," says Murphy, in the Department of Ecosystem Science and Management (ESM). "Conducting research that is both scientifically interesting and a critical need for species recovery is at the core of what my research group aspires to do."

The USFWS says the Wyoming toad is considered one of the four most endangered amphibian

Ecosystem science and management Associate Professor Melanie Murphy

species in North America and is classified as "extinct in the wild" by the International Union for Conservation of Nature.

National Effort

About 500 toads are kept in captivity for breeding and reintroduction efforts at seven zoos in the U.S., one river museum and aquarium, and two USFWS facilities: the Saratoga National Fish Hatchery and the Red Buttes Environmental Lab south of Laramie.

Some metamorphs are released from the tadpole enclosures and many are placed in grass enclosures near the lake shore under several grass treatments: control area, burned, and simulated grazing.

The data landscape is not entirely bleak. There have been insights over the last five years that have tweaked aside the curtain at least a little, providing insight into the toad-environment interaction.

Murphy, with former ESM graduate student Julia Polasik, reported in 2015 that toadlets in enclosures with vegetation heights of 4-8 inches grew larger, possibly because mid-grass heights allow more insects to be accessible to the toads and increase warm areas so toads can grow more quickly. Master's student Vance last year found that toads in the enclosures with fire treatment were larger.

Observers now frequently see toads while at the lake. That wasn't always the case.

Those first tadpoles brought to Mortenson Lake years ago were acclimated briefly then entered into the environmental fray. "There was essentially no evidence of any adults that came from those tadpoles," says Murphy.

The tadpoles are now brought to the enclosures at the lake to identify management that can meet toad needs. Once large enough, they are measured and a florescent tag placed on a toe prior to release to a management enclosure. The tag corresponds to that toad's particular vegetation treatment area.

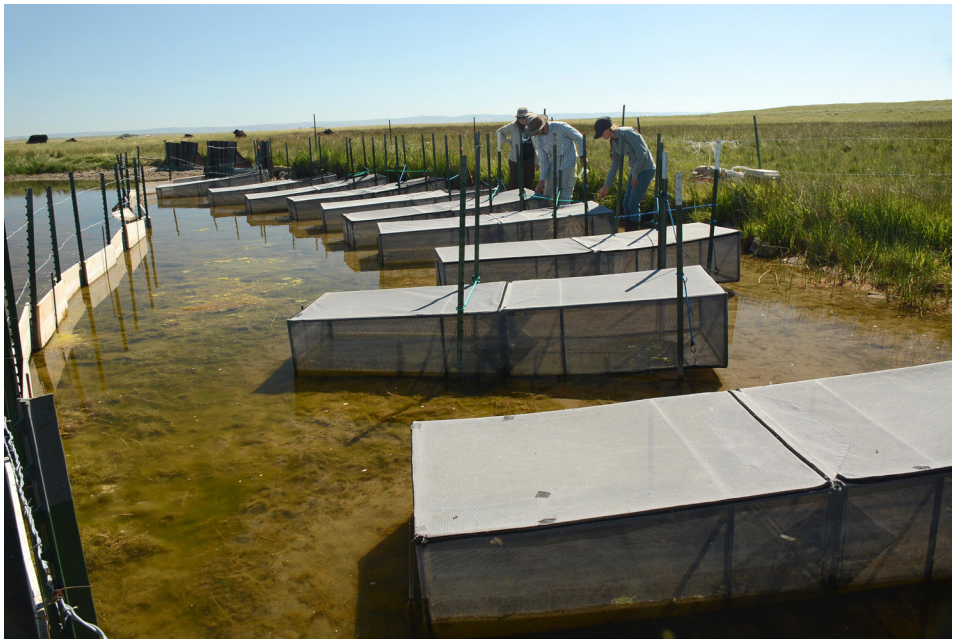
"Early work (Polasik's research) suggested vegetation treatments could help the toad," says Murphy. "We next wanted to test if grazing or fire could replicate the effects observed in Julie's study. Jay is testing the effects of using fire or grazing on metamorph growth. Preliminary data from last year suggests fire has a positive effect on size."

Change May be Good

Data also suggest the toad needs changes in its environment to survive, such as minimizing the tall and thick bullrushes crowding Mortenson that prevent insects from getting nearer the ground and also limiting insect production. The tall bullrushes also prohibit sunlight from reaching the ground.

"Adults and tadpoles need heat to turn up their metabolism," says Murphy. "The warmer they are, the more quickly they will grow. One of the things we are trying to figure out is what types of vegetation management would be best for the toad and simulate a more natural condition. The bullrushes are invasive and got really thick around the lake. It's not a natural condition."

The idea the Wyoming toad depended upon disturbance intrigued Vance, looking for a graduate position. He had helped with marten research in northwest California and



Water enclosure for tadpoles

inventoried wetland plants at Great Smoky Mountains National Park, assisting in developing a model to predict wetland occurrence. He had also conducted invasive plant control at the Wichita Mountains Wildlife Refuge in southwest Oklahoma.

"Wyoming intrigued me because the people and the environment are both very different, for the better, than what I was accustomed to having grown up in suburban Atlanta," he says. "I've always had a passion for reptiles and amphibians."

Many amphibians are thought of as needing environments with little disturbance. "So the idea the Wyoming toad may not just tolerate but depend upon disturbance seemed new and intriguing," he notes.

He also wanted to broaden his experience with endangered species. "So the opportunity to work with one of the most endangered amphibians in North America made this a better opportunity."

This summer is his final field season. This fall, Vance will analyze summer data and write the results and reports.

Positive Landowner-Research Relationship

While the three were sweeping nets and feeding metamorphs, rancher Mark Swanson drove by on a four-wheeler a ways away.

Swanson waved at the researchers and continued on.

There's a positive relationship between the researchers and the landowners, says Murphy.

"This refuge is a really cool example of ranchers and conservation working together," she notes. "This was privately owned by the Swansons – they still graze cattle here. They sold the property to the Nature Conservancy with the idea it would be donated to the Fish and Wildlife Service. They have a long-term investment in the Wyoming toad and are excited about toad conservation and what's going on here."

Technician Shelby Sutton observing Wyoming toadlets.

UW Professor George Baxter discovered the toad in 1946. What caused the population to fall to near-extinction levels is not known, but after wrestling environmental changes and the deadly fungus *Batrachochytrium* dendrobatidis, there's always surviving stark Wyoming winters.

Baxter found a correlation between lots of successful breeding and having at least six days over 80 degrees in June.

Toads individually take to burrows and hibernate until May, perhaps April if a warm winter and early spring. But if winter lingers, the toads may not survive the extra time.

"But we don't know a lot," says Murphy. "We don't know what governs their overwinter survival or what kinds of habitats they really need."

Scientists think the toads use natural burrows other animals have dug and that they hibernate alone.

"But you would suspect that if you have a winter with lots of days where the highs were minus 30, some of those toads in burrows wouldn't make it," notes Murphy.

And if a toad survives all that – it can become a snack to sustain those higher in the food chain.

Losing amphibians would have a disproportionate effect on the overall number of animals that can be supported up the food chain.

"Amphibians are often indicator species – they can tell us that something has changed or is wrong in the environment," Murphy says. "If amphibians like the Wyoming toad are in trouble on the Laramie plain, that can indicate the system is unhealthy."

Additional photos bit.ly/WyoToad.

Jay Vance, Mortenson Lake

BIG DATA, BIG LANDSCAPES

Capturing the genome and journeys of Wyoming's evolutionary ghosts

The American cheetah is an oft-cited reason pronghorn run fast. Pronghorns' long legs, light body, and oversized heart, lungs, and eyes evolved about 19,000 years ago to help them evade predators that today no longer exist.

They are, in fact, the only surviving species of the family Antilocapridae – remnants of a Pleistocene Jungle Book that included mammoths, mastodons, giant sloths, short-faced bears, and more than 18 antilocaprid genera.

"It's incredible to see this animal that can run 60 miles per hour, and at this point we're definitely its main threat," says Melanie LaCava, a Ph.D. student in the Department of Veterinary Sciences.

And its main hope. LaCava is using next-generation genome sequencing tools and big data techniques to correlate the genetics of pronghorn populations and individuals with their movements across Wyoming.

From tens of millions of pronghorn in North America historically, its numbers dropped to around 13,000 worldwide. With only around 2,000 left in Wyoming by 1906, the pronghorn was going the way of the bison. An eleventh-hour commitment to hunting regulation and management reversed its fate. By 1984, the pronghorn population in Wyoming peaked at 600,000. Today, that number is around 371,000.

"I wanted to do hands-on work that involved state wildlife agencies," LaCava says of her decision to come to the University of Wyoming in 2015.

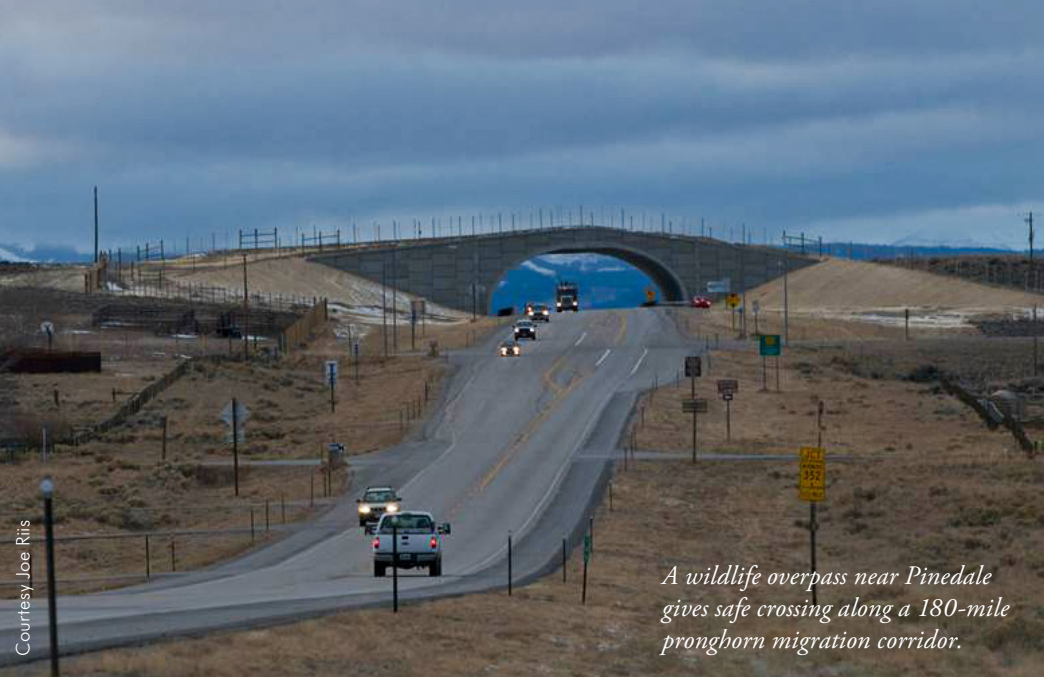
LaCava earned a Bachelor of Science degree in wildlife, fish, and conservation biology from the University of California, Davis, which is where Holly Ernest first established her Wildlife Genomics and Disease Ecology Laboratory.

The two never met in California. Ernest (and the lab) made the move in 2014 to UW, where she holds the Wyoming Excellence Chair in Disease Ecology in the Department of Veterinary Sciences. Now LaCava's adviser, Ernest became enthralled by pronghorn when they showed up in her backyard.

"Evolutionary ghosts," Ernest calls them.

The pronghorn is a close second to the cheetah as the fastest land animal on earth.

Wildpix 4415, Shutterstock.com



Courtesy Joe Riis

A wildlife overpass near Pinedale gives safe crossing along a 180-mile pronghorn migration corridor.

Evolutionary Ghosts along the Highway

Last October, LaCava joined Wyoming Game and Fish Department biologists at a hunter check station at the junction of U.S. Highway 287 and Wyoming 487 in Medicine Bow. With the hunters' permission, she took muscle samples the size of a pencil eraser from pronghorn carcasses. She recorded the hunt area and stream or river drainage where each animal was taken.

"The hunters were really interested in the research project," she says. "We share the same goals of learning about and preserving the species."

Wyoming's borders encompass more than half the world's pronghorn population, yet there is a dearth of genetic information available. LaCava aims to genetically identify distinct population units throughout the state and provide research that can be used in management and conservation of the species.

By the end of hunting season, Wyoming Game and Fish biologists had mailed her approximately 500 muscle tissue samples collected at check stations. The Wyoming State Veterinary Laboratory in Laramie donated samples from necropsies it performed, and more came from the Wyoming Game and Fish Department's Wildlife Health Laboratory, also in Laramie.

With these collaborations, she amassed over a thousand samples in her first year and plans to collect more in 2016. Her goals are to establish a baseline for future genetic monitoring, quantify genetic diversity, and identify major barriers to gene flow.

For example, if pronghorn are stopped by a river, mountain, or human-made structure, does the barrier show up in genetic differences between groups? To find out, she overlays genetics and geography.

She explains a theoretical scenario:

"If we find that one group of say 100 pronghorn are very genetically similar (and therefore have lots of gene flow) and another group of 100 are similar to each other but very different from the first group, we might identify these as two different populations.

"Then, if we look at where each animal's DNA was collected (perhaps where the pronghorn was harvested), we can see if the split between the two groups correlates with any landscape features.

"If we find all the pronghorn in group 1 were from the north side of the I-80 corridor while all the pronghorn in group 2 were from the south side that would suggest the I-80 corridor is a major barrier to gene flow for pronghorn in the sampled area."

Recent recognition of migration corridors for mule deer, elk, and pronghorn has led to multi-partner strategies to ensure safe passage for ungulates. In 2008, the Forest Service designated 45 miles of a route from Grand Teton National Park to the Upper Green River Valley as the first federally protected migration corridor.

In the fall of 2012, pronghorn immediately took to a Wyoming Department of Transportation wildlife overpass on Highway 191 west of Pinedale that eliminated a deadly crossing from their ancient course. LaCava and Ernest say genetics can shed light on such adaptive behaviors.

Homebodies and Migrators

If pronghorn migrations had a British punk soundtrack, it might be The Clash pounding out "Should I Stay or Should I Go?" Within a herd, some pronghorn might migrate, while others stay put. Last year's migrators might be this year's homebodies. The term for this is partial migration. Early evidence from a University of Idaho study points to genetic distinctions in those who stay and those who go.

The path they take could be a fixed seasonal route (an ancient migration) or a new turn. "With pronghorn, it's very flexible," says LaCava.

Add mating to the questions about stay/go and migration paths. Pronghorn populations generally winter together. In the spring, some move away. In the fall, they migrate back to their winter ranges.

"Are they migrating first and returning to breed, or are they breeding first then coming back together?" asks LaCava. The answers could have huge implications for gene flow, which is one way to measure species health.

Again, genetics are only half.

LaCava is relying on the help of Adele Reinking, a UW ecosystem science and management graduate student, and Hall Sawyer, a research biologist with Western Ecosystems Technology (WEST) Inc. and research associate with the Wyoming Migration Initiative. Both are tracking collared pronghorn and supplying blood samples, movement data, and GPS coordinates that elucidate location and timing on the landscape.


Courtesy Melanie LaCava

GPS tracking data allows researchers to correlate migration behaviors with population genomics.

Ghosts and the Machine

In a laboratory on the sixth floor of the College of Agriculture Building, LaCava extracts the DNA and prepares samples for DNA sequencing. It is long work, and in July, she sent the first set of 48 samples to a facility in Oregon to be sequenced.

From here, the numbers become mind-blowingly large – and small. The Oregon lab returned 25 gigabytes of pure sequence data, or letters of DNA, for 85 million DNA sequences from 40 females.

What does it take to tackle data of such magnitude? The staff of the UW Advanced Research Computing Center has been a great help, she points out. "This is way beyond the laptop!" she says.

From her desktop, LaCava accesses the Mount Moran supercomputer, which can run hundreds of trillions of calculations per second. Nevertheless, the analytical territory remains relatively uncharted. Forget cozy software, pop-up menus, and buttons. LaCava types out lines of computer code, searching for single-letter changes in the genetic sequences that represent variation among individual animals.

A point of data, a moment in time. LaCava's passion is not for ghosts of the past, but for living animals that move, linger, converge, solve problems, and produce offspring. High genetic diversity contributes to the species' ability to adapt to changing environments and selective pressures.

By uncovering the otherwise undetectable mysteries of the pronghorn's genome, LaCava is shedding light on its evolutionary potential.


Courtesy Adele Reinking

Melanie LaCava takes a tissue sample from which she will extract DNA. To learn more visit wildlifegeneticheath.org.

SELECTION PRESSURE

The extent to which organisms possessing a particular characteristic are either eliminated or favored by environmental demands. It indicates the degree of intensity of natural selection.

—A Dictionary of Biology, 2004.

STATE FAIR 2016

Bailey Fitzwater and Curley before the cat show.

At the 4-H Livestock Judging Reasons event.

Hunter Petsch, Melanie Stoll, and Cara Carper of the Laramie County Community College market lamb judging team.

Dawson Butler of Devil's Tower 4-H makes final touches with the blow dryer.

At the other breeds cattle show.

Lillian Wright with her grand champion Saanen goat.

Beef Extension Specialist Brent Buckley of the University of Hawaii Manoa, UW Extension Associate Director Mary Kay Wardlaw, and UW Extension Associate Director Kelly Crane stop in to see the Wyoming Agricultural Experiment Station exhibits.

Whip, a Charolais mix, gets a trim from Riley Hopkins of Carbon County 4-H.

AES YEAR OF CELEBRATION RECOGNIZES PUBLIC SUPPORT ACROSS STATE

By Bret Hess, Associate Dean and Director, Wyoming Agricultural Experiment Station

This has been a summer to remember celebrating the Wyoming Agricultural Experiment Station's 125th anniversary.

Laramie Research and Extension Center (LREC) director Doug Zalesky and his team of our two Haflinger mascots, Pistol and Pete, were traversing the state to pull the college's newly refurbished sheep wagon at numerous events. Pistol and Pete were greeted with enthusiasm everywhere they appeared (visit Pistol and Pete's Wyoming tour dates at www.uwyo.edu/uwexpstn to see their schedule).

We received nothing but positive feedback for representing the University of Wyoming and the College of Agriculture and Natural Resources in the communities the team visited.

And just as we thought we had reached record attendance at our field days and open houses, we eclipsed last year's overall attendance with record attendance at our field days in Powell and Sheridan. The open house at SAREC had higher-than-average attendance as well. This was not surprising considering each of the centers also celebrated providing service to Wyoming for over 65 years in the case of Powell and 101 years in Sheridan and Goshen County (SAREC). The Family Farm Day hosted by LREC was a huge success again this year.

Seeing exuberance in persons of all ages as they enjoy everything the centers have to offer is encouraging. This included a tremendous presentation from agricultural liaison librarian David Kruger about the book he wrote on the 125 years of the WAES. Extension director Glen Whipple's impression pretty well sums up how well David's presentation was received. "David made the history interesting. I was left thinking 'I want to learn the rest of the story' when he finished."

We also had an opportunity to share our history at the Wyoming State Fair and Rodeo. Thanks to Dennis Sun and the *Wyoming Livestock Roundup* for helping secure a booth and a spot to park the college's wagon near the *Roundup* tent.

Fair week culminated with sharing the Wyoming Department of Agriculture's Excellence in Agriculture awards program (see story page 6). I offer many thanks to WDA director Doug Miyamoto and his staff for making the awards reception an event to remember.

The WAES teamed with the UW Foundation to host "Friends of AES" in September. Many major contributors and long-term supporters of the AES visited Laramie to help celebrate the milestone. UW president Laurie Nichols welcomed the group then found time to stay to learn more about the history and how we've been celebrating our anniversary. We could not be more proud of the tremendous support we realize from our Friends of AES.

Senator John Barrasso wrote, "We have all benefitted from the collaborative partnerships fostered by the station. Thank you to the dedicated folks at the Wyoming Agricultural Experiment Station. You are fostering a legacy of service to ag producers, ranchers, and farmers around the state."

I can think of no better way to conclude than with the dedication in the "125 years of the Wyoming Agricultural Experiment Station" book by Kruger.

"Dedicated to the hardworking employees of the Wyoming Agricultural Experiment Station in times past, present, and future. And to all of the supporters who help us get the job done."

Please accept my/our gift to the University of Wyoming in the amount of:

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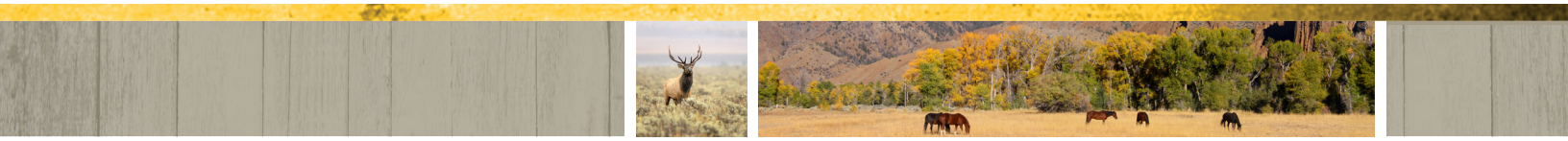

Emma Gonzalez of Laramie County with Hermes.

Wyoming Agricultural Experiment Station celebrates its 125th anniversary with a sheep wagon at the state fair.

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