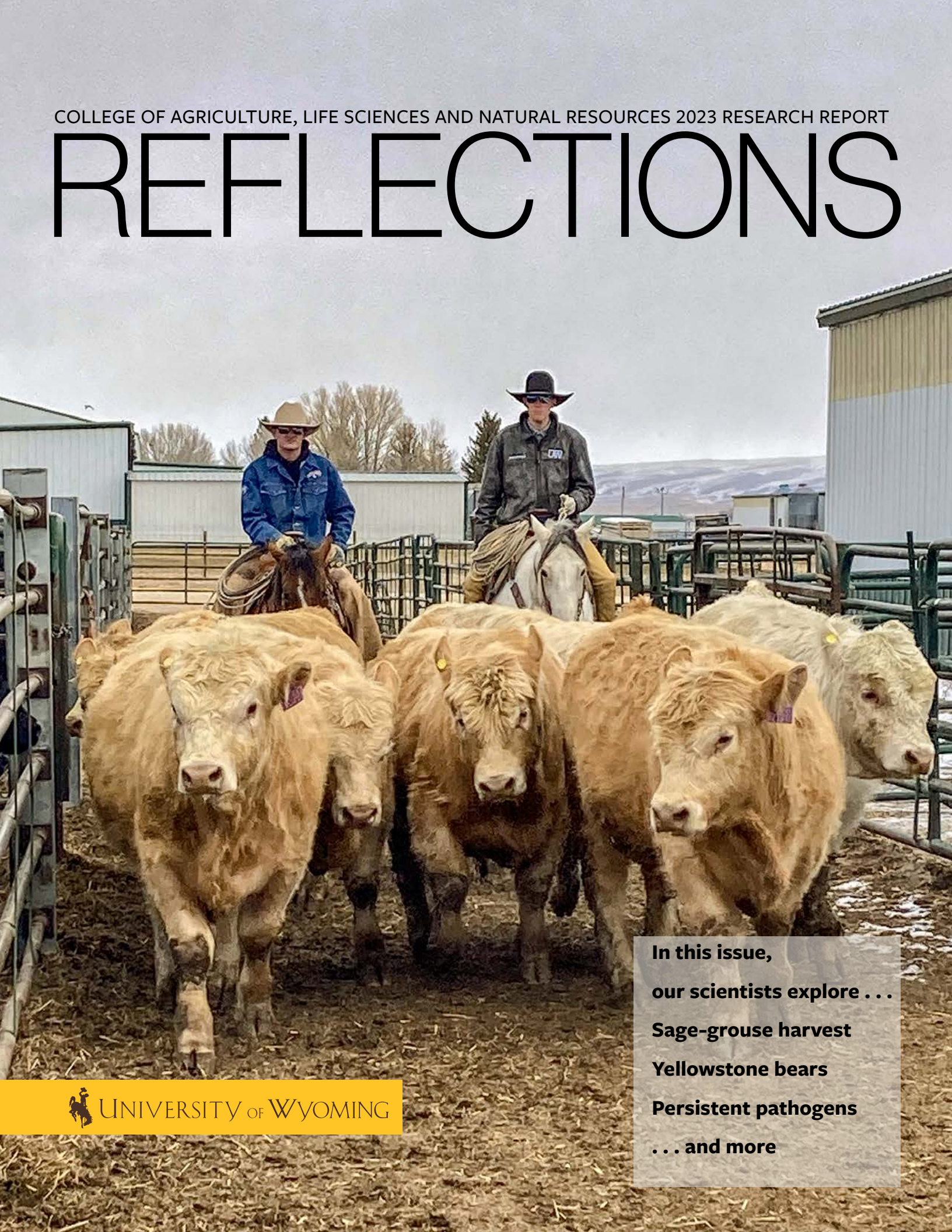
COLLEGE OF AGRICULTURE, LIFE SCIENCES AND NATURAL RESOURCES 2023 RESEARCH REPORT

REFLECTIONS



In this issue,

our scientists explore . . .

Sage-grouse harvest

Yellowstone bears

Persistent pathogens

. . . and more

UNIVERSITY OF WYOMING

University of Wyoming | College of Agriculture, Life Sciences and Natural Resources

REFLECTIONS

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Cover photo courtesy Ben Hollinger, University of Wyoming

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FROM THE DIRECTOR


Eric Webster

The past year has been a busy and productive 12 months for the College of Agriculture, Life Sciences and Natural Resources. The process of moving the Department of Zoology and Physiology, the Department of Botany, and the UW Life Sciences Program into the College is almost complete. These changes bring new opportunities and challenges. One of the many changes is the new name for the College with the addition of Life Sciences. We believe the addition of faculty, graduate students, and staff from these new departments will increase collaboration and develop new opportunities for research, extension, and teaching.

Readers of *Reflections* will also notice a big change. The magazine has taken on a new look! The Wyoming Agricultural Experiment Station, along with the UW Extension Office of Communications and Technology, decided to redesign *Reflections* with a new way of presenting research conducted in the College of Agriculture, Life Sciences and Natural Resources. Readers will find the expanded research articles are gone and replaced with a short informative format that reflects the broad range of our research programs around the state.

This edition of *Reflections* has something for everyone. The research highlighted inside the covers discusses livestock, the gender wage gap issue, sage-grouse hunting, diabetic wound healing, cover crops, Yellowstone bears, the new bison facility at the Wyoming State Vet Lab, the UW High Altitude Bull Test, and much more. The faculty across campus conduct research that will eventually be used in extension and teaching programs at UW. Our scientists are making an economic impact in Wyoming, and our research makes a difference around the globe.

In the past two years since my arrival at UW, the Wyoming Agricultural Experiment Station has invested in new field and laboratory equipment to allow our scientists to be more productive and efficient. It is important we stay on the cutting edge with new technology and facilities so we can make a significant impact on the Wyoming economy. Our goal is to allow our producers to remain sustainable and profitable, now and in the future, and we hope to positively impact every citizen of the state.

I hope you enjoy the new format of *Reflections*, and please let us know what you think. I like to say we are "7,220 feet and growing" and this edition of *Reflections* exemplifies that tagline.

Eric Webster
Associate Dean and Director
Wyoming Agricultural Experiment Station

WORRIED ABOUT

New study quantifies the benefits of early

Judith collects pre-harvest samples to estimate alfalfa weevil densities prior to first cutting in a producer field.

WEEVILS?
alfalfa harvest

Early harvest is often touted as an effective solution to Wyoming's weevil problem. But recommendations are usually vague at best, lacking specificity and rigorous scientific testing.

"Oftentimes producers have been told to cut early to decrease alfalfa weevil, but there's not a lot of work backing up why cutting early is good or how early you should be cutting," says Judith Herreid, a Ph.D. student in the UW Department of Plant Sciences.

To develop more specific, evidence-based suggestions, Herreid and associate professor Randa Jabbour set out to quantify how harvest timing and insecticide use affects harvest quality, yield, and alfalfa weevil density.

In a two-year study[1] conducted at the James C. Hageman Sustainable Agriculture Research and Extension Center (SAREC) near Lingle, Herreid and Jabbour compared three harvest timings differentiated by growth stage: early bud, late bud, and bloom. Half of each research plot was treated with insecticide, allowing the researchers to test how insecticide application influenced outcomes relative to harvest timing.

Weevil density was recorded immediately before and after harvest. Herreid also worked with forage agronomist Anowar Islam to analyze forage quality and determine relative feed value, metrics that were used to compare the economic impacts of different treatments.

CHALLENGING THE 20% BLOOM RULE

As predicted, early harvest resulted in higher quality forage and later harvest resulted in higher yield. The difference in quality was more dramatic than the difference in yield, Herreid notes. She and Jabbour did not observe any differences in yield or quality in later cuttings of plots that were initially harvested early.

Their results suggest that early harvest is the most effective way to prevent weevil damage. While harvesting at 20 percent bloom is common practice, "Our work shows that if you're really worried about alfalfa weevil, you should not wait that long," Jabbour says. "We have strong evidence to support that this is an effective method if it fits in with someone's operation."

The early harvest approach might not work for everyone, she acknowledges. For producers growing high-quality hay to sell to dairies, harvesting early might be the obvious choice. But for someone growing alfalfa to feed their own beef cattle, getting the highest possible yield is likely of more concern than quality. Not to mention, what if the weather conditions are terrible and logistics don't go according to plan?

Sweep net samples help estimate alfalfa weevil densities. All of these green larvae are alfalfa weevils!

"I think that's the trickiest part of this—you have to have so many other things fall into place to be able to do it," she comments.

ARE INSECTICIDES REALLY WORTH IT?

It depends.

If you're planning to cut early anyway, Herreid and Jabbour's research suggests you might as well save some time, labor, and money by skipping insecticide application altogether.

In crops harvested later, insecticide use *did* appear to reduce alfalfa weevil damage. "But compared to just cutting early, it definitely didn't look like insecticide use was a better method. You still had damage on your alfalfa. If you cut later, your quality still went down—insecticide use doesn't impact that at all," Herreid notes.

Grad student Samantha Nobes (M.S., 2021) vacuums sample insects in a recently harvested experimental plot at SAREC using a modified leaf blower.

If a producer plans to cut late and it's a bad year for weevils, insecticide application may be worthwhile. But for those planning on an early harvest, insecticide use is likely of little benefit. Paired with the looming issue of insecticide resistance, this finding makes a strong case for harvesting early and forgoing insecticide use.

RETHINKING THE INSURANCE APPROACH

Insecticides provide an insurance policy—for now. As insecticide resistance spreads across the West, alfalfa producers may have to consider other options.

"Unfortunately, it's an insurance approach that will ultimately lead to more resistance, faster development of resistance, and killing a bunch of beneficial insects," says Jabbour.

To help prevent resistance, she recommends harvesting early without applying insecticides when possible. "If you have a year that's lower pressure and you can do early harvest instead, then that's definitely going to help maintain susceptibility in that population," she notes. "The more frequently people are spraying the same area, the faster the rates of development—anything that helps preserve that susceptibility, either in space or time, is good."

Maintaining susceptibility is also important from an economic perspective as alternatives to widely used insecticides are often more expensive and less effective.

WHAT ABOUT MY BOTTOM LINE?

Using Herreid's forage quality results and data from the USDA Agricultural Marketing Service, UW economists Brian Lee and John Ritten analyzed the economic consequences of harvest timing and insecticide use.

In 2019, a water-limited year, different treatments resulted in minimal changes in revenue. Ritten suggests that under such conditions, it may be best to forgo insecticide use and rely on early harvest if weevil infestations are a concern.

In 2021, the second year of the study, Ritten and Lee found that on average, across all harvest timings, crops treated with insecticides resulted in slightly higher revenues. This was likely because insecticide usage increased yield in middle harvest timing and/or increased quality in late harvest timing. However, increases in revenue were approximately equal to the estimated cost of insecticide.

Overall, revenue was affected more by harvest timing than insecticide use. Even though quality decreased somewhat with later harvest timings, the increase in quantity tended to more than offset the decrease in quality.

The economists predict that, in the near term, insecticide resistance will eliminate the slight revenue boost associated with insecticide application.

"In Wyoming, alfalfa is the most economically valuable crop we have," says Herreid. "Finding different ways of controlling alfalfa weevil, especially through non-chemical methods, is important, especially now that insecticide resistance is becoming a problem in our state."

Considering early harvest might be a good place to start.

To learn more, contact Jabbour at rjabbour@uwyo.edu *or* (307) 766-3439.

1 Field experiments were conducted in summer 2019 and summer 2021. Funding was provided by the USDA Crop Protection and Pest Management Applied Research Program.

A persistent parasite and trip to Portugal offer clues to disease tolerance and immunity

Iron is one of those things you—and most life forms on the planet—can't do without. But how does this essential nutrient help your body fight off pathogens like the foodborne parasite *Toxoplasma gondii*?

Through consumption of undercooked meat or other contaminated food, *T. gondii* infects approximately one-third of the world's human population.

It's one of the most successful pathogens on the planet, says Jason Gigley, Fulbright scholar and UW associate professor of molecular biology. Once a host contracts *T. gondii*, the parasite cannot be cleared, instead remaining latent inside neurons and other cells. For people who are immunocompromised, the lurking parasite can cause serious illness, especially if it re-activates in the brain.

While *T. gondii* is highly sensitive to iron availability, how this sensitivity affects immune responses is not clear.

"Iron is well established in what's called innate nutritional immunity. Pathogens are stealing iron from the host, the host is trying to steal it back—there's this tug of war going on," Gigley explains. "But when you look at fundamental immunology—understanding how iron can regulate immune responses—not much is known."

In spring 2022, Gigley traveled to Portugal to collaborate with disease tolerance experts in the Instituto Gulbenkian de Ciencia outside Lisbon. With the help of his colleagues, Gigley conducted a series of experiments investigating the role of iron in nutritional immunity and disease tolerance in mice infected with *T. gondii*.[1]

Photo courtesy Jason Gigley

Preparing to enter the bio-safety containment 2 animal facility at the Instituto Gulbenkian de Ciencia.

Disease tolerance is what Gigley describes as "the other side of the immune response." While immune responses target the pathogen, disease tolerance helps you tolerate inflammation, minimize tissue damage, and survive the infection.

To test the effects of iron availability on immune responses and disease tolerance, researchers genetically modified mice to manipulate how their cells processed iron. The first round of experiments focused on mice lacking a gene required for iron export in cells that support early immune responses. A second set of experiments examined mice lacking a gene required for iron import.

Performance was tracked using daily body weight, body temperature, blood glucose level, disease score (rated on a scale of 1–5), and survival rate.

Using these metrics to compare the modified mice to unmodified mice, the researchers concluded that iron import and export are important in establishing nutritional immunity to *T. gondii*.

Specifically, they found that mice unable to export iron fared worse compared to the control group, which could still import iron. Mice that could not import iron at all fared even better than the control group.

Whether iron import and export influence disease tolerance during *T. gondii* infection is still unclear, and Gigley notes that these experiments were the first to assess disease tolerance during *T. gondii* infection.

Back in Laramie, Gigley has continued his research on immunity. He looks forward to expanding the research partnership with the Instituto Gulbenkian de Ciencia and facilitating opportunities for student exchange programs.

To learn more, contact Gigley at jgigley@uwyo.edu *or* (307) 766-6151.

1 Gigley's research in Portugal was funded by a Global Perspectives grant from the UW College of Agriculture, Life Sciences and Natural Resources and a Fulbright Scholarship.

Pigs at the Laramie Research and Extension Center played a critical role in research that may ultimately help prevent amputation in diabetics with non-healing wounds.

PIGS TO THE RESCUE:

How a familiar barnyard animal has helped advance wound treatment for diabetics

For a person with diabetes, even a small, seemingly innocuous bedsore can lead to amputation.

Non-healing wounds disproportionately affect diabetics due to the decreased blood flow, chronic inflammation, and impaired healing processes associated with diabetes. If the wound is located on a foot or another peripheral region of the body, a diabetic person is at increased risk of amputation compared to non-diabetic peers.

In the U.S., more than 34 million people have diabetes and another 88 million are considered pre-diabetic. Yet currently there is just *one* FDA-approved treatment available for patients suffering from diabetic foot ulcers, a common type of non-healing wound. "Isn't that crazy? There's hardly anything to treat these wounds with," comments Brenda Alexander, a professor in the UW Department of Animal Science.

She hopes to remedy this situation. In collaboration with Sreejayan Nair, a professor in UW's School of Pharmacy, Alexander recently helped test a promising new treatment for diabetics suffering from non-healing wounds.

HOW IT WORKS

Non-healing wounds are associated with increased activity by proteases, enzymes that break down proteins.

Nair's novel treatment relies on what's known as a protease inhibitor. If a protease is inhibited, protein synthesis increases. "It's a balance between breaking down proteins and synthesizing proteins," Alexander explains. "What we are going for is an increase in protein synthesis."

Specifically, the treatment is designed to increase production of collagen, a protein that facilitates wound repair. The idea is to inhibit a protease called cathepsin K to promote increased production of collagen and boost the healing process.

Previous studies have shown that increased cathepsin K and decreased collagen are associated with impaired wound healing in humans. Nair and Alexander's latest study involved testing whether a protease inhibitor targeting cathepsin K would accelerate diabetic wound healing in pigs.

WHY PIGS?

The treatment was first tried in mice, with successful results. Accelerated wound healing was observed in diabetic mice genetically modified to eliminate cathepsin K.

The next step was to test the new treatment in a larger vertebrate animal with skin anatomy similar to that of humans. "You can make a mouse diabetic but the way they heal is different than the way a human heals," Alexander explains.

The solution? Pigs. Unlike mice, whose skin contracts to heal a wound, pigs and humans form new skin via cell migration and proliferation across the wound.

As larger animals with greater skin surface, pigs also offer another experimental advantage: responses to multiple treatments, including the control, can be compared using the skin of the same individual. This both reduces the number of animals required for the study and strengthens experimental integrity.

THE EXPERIMENT

For their research, Alexander and Nair studied small groups of young Yorkshire pigs at the Laramie Research and Extension Center. To induce a diabetic state, the pigs were anesthetized and intravenously injected with a drug that kills the insulin-creating beta cells of the pancreas.

Within 24 to 48 hours of the injection, the pigs were considered diabetic, meaning they had higher than normal blood glucose levels and experienced disease processes similar to humans with diabetes. The pigs were monitored to ensure that their glucose levels were not so high that they couldn't gain weight at an acceptable rate.

After a month with elevated blood glucose levels, the pigs received surgical wounds, which were promptly treated and dressed. To mitigate pain, they were also treated with opioid patches. Researchers tended to the animals every day, ensuring a high level of cleanliness and allowing for careful documentation of wound healing.

Treatments included the one drug currently available for treatment of diabetic foot ulcers as well as different

Photos courtesy Anne Chenchar

dosages and application methods (gel versus injection, for example) of the novel drug.

Healing was measured by wound size and appearance (documented with photos) as well as by tissue samples taken after the animal was euthanized. The researchers also performed toxicology analyses to ensure the treatment didn't cause harmful side effects to other tissues and bodily systems.

PROMISING RESULTS

The investigation is ongoing, but so far the results are promising. The diabetic pigs' wounds consistently healed better and faster with the new treatment, Alexander reports.

Not only did the novel treatment accelerate healing compared to the control, but it also outperformed the only drug currently available on the market. The toxicology results did not indicate any potential harmful side effects. Together, these findings make the new treatment a strong candidate to be approved for future clinical trials.

Alexander notes that the study's success would not be possible without the pig studies conducted at the Laramie Research and Extension Center. "I think it is important to recognize that these agriculture animals are playing a really important role in research and potentially benefiting many people," she comments.

Interdisciplinary collaboration is also key. Though Alexander modestly insists that she's "just the pig person," it is the combination of her animal science expertise and Nair's pharmaceutical ingenuity that made the study feasible. "Dr. Nair's work is really important, and he made contact with me to be able to expand his research and expand the good to the whole population," says Alexander.

To learn more, contact Alexander at balex@uwyo.edu *or* (307) 766-6278.

Maternal microbiomes may influence cattle health, reproductive efficiency

Don't underestimate a mother's influence. Especially when it comes to the microbiomes of her reproductive tract and rumen.

A new study in the UW Department of Animal Science suggests that investigation of maternal microbiomes in cattle may yield promising results for producers looking to improve herd health, reproductive efficiency, and even feed efficiency.

In November 2020, graduate student Madison Shults and assistant professor Hannah Cunningham-Hollinger took vaginal swabs and rumen fluid samples from a group of cows and heifers at the Laramie Research and Extension Center. Open (not bred) cows also received uterine swabs.

This was the first step in a study targeting two questions:

1. Does the reproductive tract microbiome differ based on parity (heifer versus cow) and pregnancy status (bred versus open)?

2. Are there measurable changes in the reproductive tract microbiome and rumen microbiome based on parity, pregnancy status, or stage of gestation (early, middle, late)?

Shults and Cunningham-Hollinger observed minor differences between bred and open cows in the initial comparison.

Bred females were also monitored throughout gestation, with vaginal swab and rumen fluid samples taken monthly. Differences in the microbiomes of heifers and cows were also tracked throughout pregnancy.

The uterine environment of open cows appeared to have a closely related group of microbes that were different from those present in the vaginal canal of both bred and open cows, Shults reports. This finding was consistent with previous studies and may indicate that specific groups of bacteria interfere with or promote the establishment and maintenance of a pregnancy.

Shults and Cunningham-Hollinger also observed shifts in both the rumen and reproductive tract microbiomes throughout pregnancy. Their results showed an increase in the abundance and diversity of microbes present through late gestation, at which point a significant decrease in both abundance and diversity occurred. The reduced microbial abundance and diversity persisted until calving.

It's not clear why this was the case or what mechanisms caused the shift, says Shults, but it may be an important step in preparation for healthy calving. Understanding the role of microbiomes in a healthy pregnancy could ultimately improve herd health and reproductive efficiency.

So could investigating the relationship between a mother's microbiomes and the microbiomes of her developing calf. Researchers in Cunningham-Hollinger's lab have already identified a close connection between maternal microbiomes and the microbiomes of calves in utero. The long-term goal is to determine how to positively influence a developing calf's microbiome by influencing its mother's microbiomes during gestation.

"If we could truly link a more desirable maternal microbiome to the developing rumen microbiome in the calf and then see if that more advantageous microbiome helps calves be more efficient at the bunk, we could produce cattle that convert feed more efficiently, finish faster, and go to the line with less days consuming feed," says Shults.

To learn more, contact Cunningham-Hollinger at hcunnin6@uwyo.edu *or* (307) 766-6530.

Photo courtesy Madison Shults

Shults takes a sample of amniotic fluid.

Finding profitability in cover crops

Cover crops and their potential benefits have created widespread interest among producers across the state, yet little data exists to show if diverse cover crops could serve as a successful and profitable renovation tool for hayfields.

With this question in mind, UW researchers Brian Mealor and Tyler Jones set out in search of an answer.

"The goal of our study was to take a deteriorated hayfield, terminate it with tillage or chemicals, plant a year or two of cover crops, and see if we observed any of the benefits cover crops are commonly reported to provide," says Jones, assistant manager for research, outreach, and production at the Sheridan Research and Extension Center.

Hayfields were planted with a 14-species cover crop mix in accordance with recommendations from the Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP). One of the benefits of EQIP is that it provides producers with cost-share incentives to help pay for the implementation of cover cropping, Jones explains.

"One of the challenges with cover crops is that they are not managed to obtain income, because unlike other cash crops, there is really no end product," he says. "While it is hard to justify the expense of cover cropping, we found that positive returns can be had if cost sharing is available and cover crops are utilized as a forage resource for livestock."

Mealor and Jones examined the soil and environmental benefits of cover cropping, including building organic matter and improving soil nutrient retention and water infiltration. Using these metrics, they compared cover cropping systems to typical hayfield management in the region, which typically involves terminating alfalfa, planting a year of small grains, and then going back to alfalfa.

"Cover crops in our study in both dryland and irrigated systems were able to produce a substantial amount of high-quality forage," says Jones. "That's great for someone who is approaching cover crops from the perspective of wanting to graze them."

Cover crops did not provide noticeable soil and nutrient benefits in the short-term; however, soil water infiltration did improve when no-till soil practices were used instead of conventional tillage.

"In both environments cover crops suppressed weeds and provided adequate ground cover even after they were grazed," Jones reports. "From the perspective of arming the soil and reducing erosion potential our data suggests that cover crops achieved their purpose."

Approaching diverse crop mixes as alternative forages rather than cover crops may provide greater value in hay production systems where rotational windows are short and profitability is key, the researchers concluded.

To learn more, contact Jones at tjones38@uwyo.edu *or* (307) 673-2856.

Photo courtesy Tyler Jones

Six-foot tall irrigated cover crop stand in Sheridan County, Wyoming. Plots yielded approximately 3 tons per acre of dry matter biomass.

Cover crop mixtures yield promising results

The low, sporadic precipitation and cold, windy climate of the Northern High Plains present a problem for dryland and irrigated producers in large- and small-scale crop production.

Cover crops may be key to addressing these issues, says Elizabeth Moore, assistant lecturer in plant sciences, but not all cover crop species are created equal.

Soils in this region are typically alkaline and low in soil organic matter and soil moisture. The shorter growing season and heavy weed competition often threaten crop yields.

Producers in southeast Wyoming have often planted a cover crop mix of peas and oats to mitigate these challenges, but results are mixed due to poor germination and low biomass production.

Over the course of the 2020 growing season, Moore experimented with different cover crop mixes in dryland research plots in Pine Bluffs, Chugwater, and Lingle. She found that cover crop mixes containing high-performing grasses (such as cereal rye or oats) and legume species in equal proportions performed better than mixes dominated by high percentages of legumes.

Legumes establish a beneficial relationship with nitrogen-fixing soil bacteria that provide atmospheric nitrogen to the legume plant. However, legumes can also be more costly than other cover crop species. Adding a high-performing legume, such as a vetch or clover, to a mix with a grass and a brassica (a turnip or radish, for example) and a broadleaf, such as a sunflower, may improve soil health and keep costs down.

"Each plant brings something unique to the cover crop mix and they work in a symbiotic relationship," says Moore. The live roots of cover crops also deposit photosynthates (carbohydrates) into surrounding soils, providing fuel for soil microbes, which benefits the soil ecosystem.

One of the farmer collaborators involved in the project designed a four-species cover crop mix that performed well in a dryland setting. "If cover crop mixes will perform well under dryland settings, then we can just about guarantee they will perform even better under irrigated conditions," Moore comments.

A smaller irrigated plot in Laramie for specialty crop production showed promising results for *Phacelia tanacetifolia*, a broadleaf species with high biomass production. This small-seeded plant grew well in early spring and flowered early in the growing season, potentially benefiting pollinator insects.

"Hopefully with this research we have provided some additional cover crop species for farmers to consider," says Moore. "Whenever we ask them to limit tillage, we want to provide some good alternatives to try. We aren't saying cover crops are the golden key, we are saying it's a good tool in our tool bag that helps us be good stewards of the land."

To learn more, contact Moore at emoore24@uwyo.edu *or* (307) 766-3111.

Photo courtesy Elizabeth Moore

Farmer collaborator cover crop field in Chugwater, Wyoming. The cover crop mix consisted of four species with legumes dominating.

Hunting a declining species—

WHAT DOES SCIENCE SAY ABOUT SAGE-GROUSE HARVEST?

The answer may be surprising

To hunt, or not to hunt? When it comes to a declining species like the greater sage-grouse, the answer may appear obvious, especially from a conservationist perspective. But what do the numbers say?

The question took Jeff Beck all the way back to the 1870s in a series of unique, range-wide studies that analyzed hunting season regulations and other factors impacting sage-grouse populations.

Beck, a professor in UW's Department of Ecosystem Science and Management, is a scientist, hunter, and sage-grouse expert. "They fascinate me like nothing else," he says. "They live in these really tough landscapes, and they do quite well if we conserve good habitat. They're an indicator of the health of the sagebrush ecosystem, so we want to understand what's driving population trends and what we can do to help increase populations."

Sage-grouse populations tend to oscillate over time in response to seasonal weather, but have been slowly declining for decades. They are extremely sensitive to surface disturbance caused by human activity (such as oil and gas infrastructure), precipitation, wildfire, and other environmental factors.

Previous studies have shown that ongoing loss and degradation of sagebrush habitat presents the greatest threat to sage-grouse populations. The impact of sport hunting is less clear.

HOW HAVE HUNTING REGULATIONS CHANGED OVER THE PAST 150 YEARS?

State and provincial management agencies are tasked with balancing two competing interests: maintaining viable wildlife populations and providing hunting opportunities for the public.

In the early morning light, a male sage-grouse struts on a lek outside Casper, Wyoming. Each spring, male sage-grouse do a dance during sunrise at leks to attract females. Leks are often found in open areas where males can be better seen and heard by potential mates.

Photo courtesy Wyoming Game and Fish Department

Using data from the 1870s–2019, Beck and former UW postdoc Jonathan Dinkins[1] compiled data tracking changes in harvest management in 11 western states and two Canadian provinces. Early regulations were minimal, but in the 1930s and 1940s many wildlife agencies drastically reduced hunting seasons in response to declining populations. The trend has continued, with increasingly conservative approaches favored.

Common strategies included reducing bag limits, possession limits, and season lengths as well as setting later opening dates and changing permit types. When populations showed signs of decline, agencies typically responded by tightening hunting restrictions, in some cases eliminating all hunting exposure through seasonal or permanent closures.

However, "disentangling the effects of hunting closure on population growth from expected growth, especially in low populations, is challenging," the researchers concluded. Even when hunting closures were implemented, small populations of the Gunnison sage-grouse in Colorado and Utah did not experience growth. Similar results were observed in small populations of greater sage-grouse in Alberta, Canada, and the western U.S.

In general, reductions continue to be more widespread than closures. Maintaining hunting seasons, albeit with restrictions, has allowed agencies to fund conservation efforts through hunting permits while limiting harvest to less than 5 or 10 percent of the fall population. Data collected from hunters also helps wildlife managers make more informed conservation decisions.

While further study is needed to assess the impacts of hunting closures, the researchers advise against using the total area of closed land as a measure of effective management. A total closed area may appear deceptively large if areas most important to sage-grouse populations (within 8 kilometers of a lek) don't fall completely within the closure.

A young hunter keeps his eye out for upland game birds outside of Lander, Wyoming, during his first bird hunting experience.

ARE HUNTING REGULATIONS EFFECTIVE?

In a second paper, Beck and Dinkins investigated how population trends in specific leks did—or did not—correlate to changes in human activities and environmental factors. Using lek counts provided by state and provincial agencies, the researchers analyzed population trends from 1995–2013 relative to hunting exposure, energy development, wildfire, precipitation, and the percentage of land covered by crops and trees.

The study examined 20 small sage-grouse populations and one relatively large sage-grouse population located in nine western states and two Canadian provinces. As predicted, not all populations

were influenced by the same factors. Overall, impacts related to human activity, habitat changes, wildfires, and precipitation yielded similar results to previous studies.

The researchers found mixed results regarding the effects of hunting season regulations on sage-grouse populations. Data suggested that discontinuing hunting in the largest population, where hunting levels were experimentally manipulated, resulted in greater population growth rates. However, for smaller populations, this was not necessarily the case.

"Probably because of the great effort by states that manage sage-grouse to lower the impact of hunting, we don't see hunting showing up in most places as an impact on populations," Beck says. "Our research seems to show that really low hunting levels are probably compatible, as long as populations don't get too low."

In some cases, sage-grouse populations continued to decline years after hunting was discontinued, suggesting that hunting was not the primary cause for decline. "It could be a contributing factor, especially at low population levels, but states won't let hunting occur when populations get that low. Science says that hunting is probably okay as long as we're really careful," Beck concludes.

Still, hunting remains a potential contributing factor to population decline, he cautions. Scientists and managers must continue to monitor and analyze the effects of hunting and hunters must recognize that there's a level at which populations can no longer tolerate harvest.

WHAT'S NEXT?

Using data sets compiled during these initial studies,[2] Beck plans to investigate how implementing later hunting season start dates influences population ratios of males to juveniles and females.

In some states, including Wyoming, sage-grouse season now opens later in the fall, a practice intended to lessen the potential impacts of hunting. Earlier in the hunting season, females and juveniles tend to be easier to find and more vulnerable than males and older birds.

Beck predicts that earlier hunting seasons are likely biased toward the harvest of younger birds. Understanding the relationship between season start dates and population ratios would allow managers to adjust season timing to optimize population viability and continue providing hunting opportunities to the public.

Beck also intends to examine the effectiveness of different reporting systems, with the ultimate goal of providing recommendations for improvement. "If you're going to keep on hunting sage-grouse, you have to have a better system for reporting the estimated harvest," he notes.

With careful reporting, rigorous monitoring, and science-based evaluation of management strategies, hunting may not be incompatible with the preservation of a declining species.

To learn more, contact Beck at jlbeck@uwyo.edu *or* (307) 766-6683.

Photo courtesy Patrick Wing, Wyoming Game and Fish Department

For more information

See below for links to the full text of the sage-grouse studies referenced in this article.

Changes in hunting season regulations (1870s–2019): https://bit.ly/sg-hunting-regulation

Influence of environmental change, harvest exposure, and human disturbance: https://bit.ly/sg-population-trends

Two male sage-grouse congregate at their lekking site on a spring day in Wyoming. Since most of the male sage-grouse in an area can be found at a lek, it gives wildlife biologists an opportunity to count males and log the count into databases each spring. Lek counts have been conducted in some parts of Wyoming since the late 1940s.

1 Dinkins is now an associate professor at Oregon State University. Dinkins and Beck co-authored both studies referenced in this article, with support from colleagues at Oregon State University and University of Wyoming.

2 Both studies were funded by Anadarko Petroleum Corporation.

Is herbivory stressful for Yellowstone bears?

Examining the correlation between low-energy diets and stress responses

Vegetarian bears are stressed?

Well, it's not quite that simple, but a study led by associate professor David Christianson suggests a positive correlation between stress hormones and herbivory in Yellowstone bears.

Researchers already knew that the number one food source for grizzlies in Yellowstone is grass. But how does grazing correlate to stress levels?

Christianson has discovered that for grizzlies and black bears in Yellowstone, higher stress levels coincide with increased grazing.

In Christianson's study, stress is defined by cortisol levels, as measured in fecal samples. All mammals secrete cortisol in response to triggers that threaten their growth, reproduction, and survival. Stress isn't necessarily a bad thing, Christianson notes—in fact, physiological responses to stress benefit bears (and people) in the long run by inspiring more effective solutions to tricky situations.

Higher concentrations of chlorophyll in fecal samples indicate that a greater proportion of the bear's recent diet included grasses, sedges, and wildflowers. These food sources, while more widespread, do not provide the nutrient-dense calories found in berries, seeds, and meat.

Through analysis of fecal chlorophyll concentration, Christianson determined that diets higher in graminoids and forbs (grasses) generally correlated to higher fecal cortisol levels. However, these results don't fully explain why consumption of lower-energy herbivorous food coincides with stress.

"What we don't know yet is whether the reason we find more stress hormones in fecal samples from bears that are doing more grazing is because the grass is the least nutritious thing they're eating and their body is exhibiting a stress response to reduced calorie intake—or whether the act of grazing itself is associated with something else we're not measuring," Christianson explains.

For example, if the most desirable grazing sites are located near roads or trails, bears with a higher proportion of grass in their diet may experience increased cortisol levels in response to their proximity to human activity. However, without a more robust data set clearly showing differences in cortisol levels based on grazing location, it's impossible to rule out other potential explanations.

Interestingly, Christianson's results also suggest that in Yellowstone, the correlation between grazing behavior and fecal cortisol levels is much greater than differences in cortisol levels between grizzlies and black bears. "What we found is when you take into account how much grazing the bear is doing, the differences between species become insignificant," he explains.

Other studies have detected significant differences in dietary habits and stress levels between the two species, but Yellowstone bears appear to defy the trend.

Christianson notes that in the future, Yellowstone bears may shift to a greater reliance on herbivory due to the loss of traditional food sources, such as whitebark pine seeds. While green vegetation remains readily available, it may not provide adequate nutrition.

"Whether it's a suitable replacement or not is still an open question," he explains. "If foods like grasses and sedges and flowers become a bigger part of their diet in the future, we want to know whether they can actually survive on those things."

To learn more, contact Christianson at david.christianson@uwyo.edu.

Photo courtesy Diego Gomez, stockadobe.com

This plot from the study shows good weed control.

Saving money and reducing herbicide use in edible dry bean production

Edible dry bean production in Wyoming typically relies on the use of herbicides to fight pesky weeds. However, cover crops may allow producers to both reduce the application of herbicides and ultimately save money.

Cover crops may prove especially valuable to producers who have encountered Roundup®-resistant weeds in their fields, a phenomenon that is becoming more prevalent. These herbicide-resistant weeds are the result of repeated application of the same or similar herbicides and a lack of crop rotation.

Using different chemicals with different modes of action and rotating crops can help break up the life cycle of weeds, says Ryan Johnson, UW graduate student in plant sciences. Cover crops can provide direct competition to weed seedlings, hindering their emergence.

Johnson's research shows that cover crops may be a viable option for weed suppression in edible dry bean production. "I would suggest producers could possibly consider using cover crops as an alternative for weed control rather than dumping more herbicides, which could cost them more money in the long run," he says. Producers can also consider implementing mechanical control methods, such as plowing and discing.

In a comparison of weed management strategies, Johnson and Andrew Kniss, UW professor of plant sciences, applied various pre- and post-herbicide treatments to winter wheat cover crops in Lingle and Powell. The winter wheat crops were planted in research plots used for edible dry bean production and examined over the course of two growing seasons in 2021 and 2022.

Each site, one in Lingle and one in Powell, was divided into 72 plots. At least three times during the growing season, Johnson and others counted individual weeds by species in a square meter quadrant in each plot to determine the effectiveness of the different application methods.

Researchers also used visual weed control to rate each plot. Ratings were given on a scale of 0–100, with 100 indicating there was 100% control (no weeds remained) and 0 representing zero control (many weeds were present).

Cover crop biomass, which helps with weed suppression, was measured once in each site before it was terminated to allow for planting of the edible dry bean crop. Johnson and Kniss noticed less cover crop biomass in Powell, which has a drier climate than the study area in Lingle. They are not entirely certain that the differences in climate were responsible for the differences in biomass.

"The best results produced were when we had a cover crop treatment and then pre- and post- herbicide application," Johnson reports. "But I would say at least having the cover crop and then one herbicide application, whether it is pre- or post-emergence, would work well."

To learn more, contact Kniss at akniss@uwyo.edu *or* (307) 766-3104.

Photos courtesy Ryan Johnson

Applying a treatment of herbicide using a handheld backpack sprayer (Powell, 2021).

32 countries, 90 research sites, 1 groundbreaking experiment:

How do grasslands respond to disturbance?

What does a retirement community of plants look like?

In a groundbreaking international study that spans 90 sites—including one near Lingle, Wyoming—and 32 countries, scientists are searching for answers.

More specifically, they're examining how the species composition of grassland plant communities changes over time when former agricultural fields are abandoned (no longer fertilized and tilled).

This grassroots project is known as the Disturbance and Recovery Across Global Grasslands, or DRAGNet.

Local data collection will offer clues as to how changing land use may affect forage quality and the prevalence of native Wyoming species versus invasive annual grasses, says Lauren Shoemaker, UW assistant professor of botany and a DRAGNet project lead.

"Many people in the state are invested in maintaining biodiversity and biomass production of grasslands for range systems," she notes. "If we're switching how a land is being used and the human impacts on it, can we make general predictions of what will happen, both in terms of the recovery of species diversity and the production of quality forage?"

While the study relies on a relatively simple experimental design, DRAGNet is unusual not only in its geographic reach, but also in its approach, which standardizes treatments and data collection procedures across all sites. This allows researchers to detect global patterns as well as local trends—without the frustration of trying to compare results from studies following similar, but slightly different, research protocols.

Scientists at each site have committed to three years of disturbance treatments and a minimum of five years of monitoring.

In 2022, Shoemaker and her team completed "year zero" at the James C. Hageman Sustainable Agriculture Research and Extension Center. Pre-treatment results revealed substantial hidden diversity in the seedbank; approximately 67 percent of the species waiting patiently underground to germinate were not present aboveground. Surprisingly, the dominant species aboveground (needle and thread grass) was rare in the seedbank.

For the next three years, Shoemaker's team will till, rake, and add nutrients (nitrogen, phosphorus, and potassium) to the test plots, returning twice during the growing season to painstakingly identify plants by species in 1 meter × 1 meter squares, estimate percent coverage, and collect biomass for lab analysis.

"Our plan is to collect data as long as possible because a lot of these changes are slow to emerge," she explains. "Oftentimes it's 10 to 20 years before you really see where the community settles."

Disturbing the test plots.

Photo courtesy Melissa DeSiervo

In addition to recording DRAGNet-specific measurements, Shoemaker is also collecting seed dispersal data and working with UW colleague Linda van Diepen to analyze changes in microbial communities.

It's one of her favorite aspects of the project: Only one-quarter of the area of each research plot is designated for specific tests. The rest is available for other projects dreamed up by students and faculty members.

"It's really exciting because it means we can add new experiments in areas that have already received treatments and even propose new experiments across multiple sites," she says.

To learn more, visit nutnet.org/dragnet *or contact Shoemaker at* lshoema1@uwyo.edu.

Wyoming's gender wage gap—What it means and why it matters

It's probably not surprising to learn that in Wyoming and the U.S. overall, women earn less on average than men. This phenomenon is called the gender wage gap, and it exists in every county in Wyoming.

It's not just an issue that affects women—it's an issue that affects families, explains Chian Jones Ritten, an associate professor in the UW Department of Agricultural and Applied Economics. Especially in an economic climate where skyrocketing living costs outpace wage increases, the gender wage gap can directly impact families' abilities to pay the bills and plan for the future.

A recent study led by Jones Ritten and Anne Alexander, director of outreach and engagement for the Center for Business and Economic Analysis, showed that women in Wyoming earn only 75 cents for every $1 earned by men. In other words, Wyoming has a 25 percent gender wage gap.

According to the American Community Survey, this wage gap results in an estimated loss of $1.5 billion to the Wyoming economy annually.

"The gender wage gap reduces Wyoming's economic potential, reduces people's chances of escaping poverty, increases reliance on public support programs, and reduces the ability of Wyoming's families to be self-reliant, gain wealth, and have retirement security," Alexander and Jones Ritten wrote in the 2022 report.

Although wages generally increase as a worker's level of education increases, women's wages still lag behind those of men with similar educational qualifications. On average, Wyoming women attain higher levels of education than men, but the overall wage gap persists. These findings track with national trends.

In most occupations, men receive higher wages than women, aside from those working in food service and other industries with traditionally low pay rates. In Wyoming, the gender wage gap is greatest at the stage of life when earnings are typically highest (ages 45–54).

The gender wage gap coincides with other troubling financial discrepancies between female wage-earners and their male counterparts, including differences in poverty rates, retirement savings, and retirement income.

Women are more likely to work part-time jobs and receive lower pay than men; they are also less likely to access employee-sponsored retirement plans and be able to save for retirement. Because Social Security benefits are proportional to monthly earnings, the cycle perpetuates even after women exit the workforce.

"The continuing wage gap for Wyoming women has real and enduring consequences for them and their families in lost long-term wealth and income," the UW researchers conclude.

Quantifying the gap is one step toward addressing the problem, but the question remains: How do we close that gap?

Unsurprisingly, there is no magic bullet. Suggestions from Jones Ritten and her colleagues include providing training to help women negotiate better starting pay; helping businesses conduct internal audits and adopt best practices for hiring; supporting legislation to increase economic diversification and raise the minimum wage; and improving access to affordable childcare.

One thing is clear: Positive change will require thoughtful participation from a wide range of stakeholders, including employees, employers, and public officials.

To view the 2022 report, visit https://bit.ly/wy-gender-wage-gap.

To learn more, contact Jones Ritten at chian.jonesritten@uwyo.edu *or* (307) 766-3788.

Photo courtesy Hyejin Kang, stock.adobe.com, and Tanya Engel

NEW CLUES MAY SOLVE A FOOD CONTAMINATION MYSTERY—
AND HELP PREVENT DEADLY OUTBREAKS

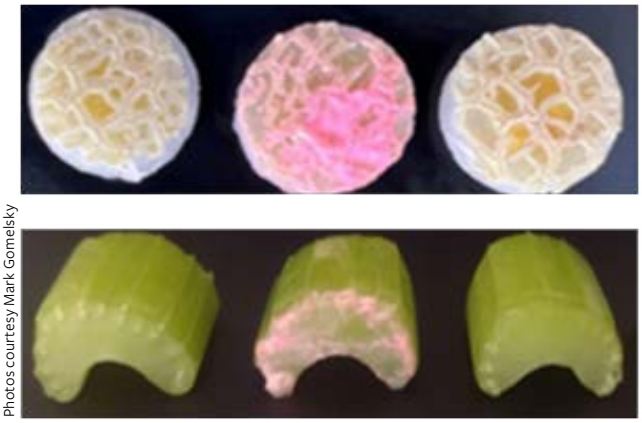
In 2011, one of the deadliest outbreaks of food poisoning in recent U.S. history erupted. The culprit? Cantaloupes contaminated by the foodborne bacterial pathogen *Listeria monocytogenes*.

Listeriosis, the disease caused by this bacteria, disproportionately affects the elderly, people with compromised immune systems, pregnant women, and newborns. For people in these subgroups, the mortality rate remains a shocking 15 to 20 percent.

THE CANTALOUPE CONUNDRUM

The USDA has a zero-tolerance policy for listeria contamination in food products, regularly recalling items that test positive for the pathogen. Yet listeriosis outbreaks persist, seemingly unaffected.

Meanwhile, consumption of raw fruit and vegetables continues to grow in the U.S., coinciding with a worrisome new trend: Listeriosis outbreaks are now increasingly associated with fresh produce. Previously, most outbreaks were traced to ready-to-eat meat, seafood, and unpasteurized dairy products.



Photos courtesy Mark Gomelsky

Listeria synthesizes an exopolysaccharide (EPS) coat that strongly promotes its colonization of the surfaces of fruits and vegetables, as seen on the round pieces of cantaloupe rind (top) and cut celery (bottom). EPS also increases survival of dehydration during produce storage and exposure to strong acids. Listerial biofilms appear pink due to the fluorescent protein made by listeria. Addition of maple syrup inhibits listerial colonization of fresh produce. Left to right: No EPS coat, with EPS coat, with EPS coat + maple syrup.

In the catastrophic 2011 outbreak, more than 100 people from 28 states, including Wyoming, contracted listeriosis after consuming contaminated cantaloupe. Thirty-three died. The contaminated fruit was traced to a storage and sorting facility in Colorado, but questions remained.

From a scientific perspective, the situation was not only troubling, but downright baffling—how did the bacteria survive for days, likely weeks, on the surfaces of cantaloupes? Unlike some types of bacteria, listeria does not form spores that would allow it to withstand dehydration.

Something just didn't add up.

A COAT WITH SUPERPOWERS

Mark Gomelsky, UW professor of molecular microbiology, wasn't trying to solve the listeria mystery. Instead, he and fellow researchers Alex Fulano and Ahmed Elbakush serendipitously stumbled upon a likely explanation—and possible solution.

Gomelsky was studying molecular pathways that control the formation of biofilms, communities of bacteria that adhere to external surfaces and surround themselves with self-made protective coats.

Most bacteria form protective layers when they grow on a surface. The composition of those layers differs depending on the type of bacteria, the surface on which they grow, and their environment. "Just like humans change clothes depending on the season and the places they go, so do bacteria," Gomelsky explains.

During their ongoing study of biofilms, Gomelsky and his colleagues observed listeria forming a protective exopolysaccharide coat—which was strange, because no one else had seen this particular coat before.

Previous research on listerial biofilms focused primarily on food processing equipment, testing listeria's ability to colonize metal and plastic surfaces. Exopolysaccharide coats were not observed on those surfaces.

The exopolysaccharide coat discovered by Gomelsky's team seems to help listeria thrive on plant

matter rather than manmade materials. The newly discovered coat greatly improves listeria's ability to attach to fruits and vegetables like cantaloupe, peaches, celery, and lettuce—all of which have been associated with listeriosis.

Listeria with the exopolysaccharide coat have also demonstrated a startling ability to survive harsh conditions, including dehydration and exposure to hydrochloric acid. When protected by the coat, listeria are up to 100 times more resistant to hydrochloric acid exposure. This may improve their ability to pass through the acidic environment of the human stomach to the small intestine, where they cause disease.

Listeria protected by the coat are also up to 10 times more tolerant of dehydration, which may allow them to survive during storage of fresh produce. If this holds true outside the lab, Gomelsky's team may have uncovered an explanation for the deadly 2011 outbreak linked to the cantaloupe storage facility.

But, Gomelsky cautions, the hypothesis has not yet been tested on samples of contaminated fruits and vegetables. To close the loop, the researchers must verify that the exopolysaccharide coat is indeed present on fresh produce contaminated with listeria in produce storage facilities, not just in the lab.

Gomelsky's team is currently developing a probe designed specifically to detect the coat. Obtaining contaminated samples may be challenging but, "Even if the exopolysaccharide coat contributed to only a fraction of produce contamination,

Maple wood, sap, and syrup are abundant sources of the compounds that inhibit listerial colonization of the surfaces of fruits and vegetables.

implementing preventive measures against it would be worthwhile, especially if these measures are not cumbersome or expensive," Gomelsky notes.

MAPLE: AN UNLIKELY HERO

Gomelsky's team modified the usual lab procedures for studying listerial survival on produce surfaces. Instead of growing listeria in liquid culture and then spotting them on the surfaces of fresh produce, which would cause the bacteria to die before forming a biofilm, the researchers incubated pieces of wood or fresh produce in the liquid cultures.

As Fulano and Elbakush tested how well listeria colonized different materials, they quickly learned that listeria thrived on wooden surfaces—for the most part. Maple was an exception. While listeria happily colonized maple wood surfaces upon initial contact, they soon dispersed, as though running from an inhospitable host.

Continuing the inquiry, the researchers determined that the specific compounds listeria dislike are water soluble and present in all kinds of maple trees: red, silver, and boxelder. The compounds are known to be stable and nontoxic because they are also present in maple syrup.

When maple sap, maple syrup, or a purified form of these compounds were applied to the surface of fresh produce, the ability of the exopolysaccharide-making listeria to colonize fruits and vegetables decreased dramatically.

Gomelsky hypothesizes that adding small amounts of maple extract to water used to wash fresh produce could potentially generate a listeria-repellent layer. Due to the lower sugar content in their sap, maple varieties in the Rocky Mountain region would likely be preferable to sugar maples of the Northeast.

The listeria-deterring compounds can be found in other plants as well, including Chinese jasmine, hickory, and pecan. In 2022, UW filed a patent application for the use of maple and other plants containing the compounds.

Purifying the active compounds is expensive, but Gomelsky is hopeful that partially purified maple products may offer viable alternatives. In addition to this applied research, his team continues to investigate how the compounds function at a molecular level.

Gomelsky is pleased that what started as a basic science inquiry may eventually help prevent deadly listeriosis outbreaks. "Initially, this was a curiosity-driven project into a molecular pathway. Just like with most basic science projects, it is all but impossible to predict their potential applied value," he explains. "You never know where science will bring you."

To learn more, contact Gomelsky at gomelsky@uwyo.edu *or* (307) 766-3522.

New bison facility enables

There's no vaccine, no effective treatment—and the disease is uniformly fatal. That's the current reality for bison producers whose animals contract malignant catarrhal fever (MCF).

Luckily, researchers in UW's Department of Veterinary Sciences are working on solutions. Pathologist Brett Webb is testing the safety and efficacy of several experimental vaccines in bison, using vaccine candidates developed by collaborators at the USDA Agricultural Research Service's Animal Disease Research Unit.

MCF cases have been documented worldwide and the disease is an important cause of bison mortality.

"It's a Wyoming issue, it's a national issue—and it affects animal welfare as well as the financial viability of a lot of operations," Webb comments. "We're hoping the vaccine is going to be impactful in the industry."

In 2022, Webb spearheaded the construction of a new bison holding and handling facility at the Wyoming State Veterinary Laboratory in Laramie. An empty pasture has been transformed into a 15-acre space designed to comfortably accommodate 25–30 bison.

In North America, MCF is most commonly caused by ovine herpesvirus-2, a herpes virus shed by domestic sheep.

Young female bison at the Wyoming State Veterinary Laboratory in Laramie.

researchers to test vaccines for malignant catarrhal fever

While sheep are asymptomatic and do not suffer ill effects from carrying the virus, bison become severely ill when exposed. Cattle can contract the disease and exhibit clinical symptoms, but are far less susceptible than bison.

In bison, ovine herpesvirus-2 causes a proliferation of specific cells that in turn attack blood vessels, leading to symptoms such as ocular edema (swelling in the cornea), ulcerations and lesions (sometimes in the mouth), bloody diarrhea, and other symptoms.

Lambs ages 6–9 months pose the greatest source of risk to nearby bison. While transmission most often occurs via relatively close contact, such as across a fence or road, in some cases bison have been infected by sheep located more than a mile away. This significantly limits areas where bison producers can safely operate.

"Even if you're losing a small number of animals to this disease, say 5 percent, that really affects your bottom line in terms of economic viability and utilization of certain pastures," Webb notes.

Currently, he and his collaborators are the only group working on MCF vaccines targeting ovine herpesvirus-2.

These vaccines are classified as modified live vaccines, which means the bison are exposed to an attenuated (modified) version of the virus that replicates but does not cause clinical symptoms. Upon receiving a dose of the vaccine, animals contract the modified virus, develop an immune response, and then clear it from their system.

Vaccine trials in Laramie began in spring 2023. The first round of testing focuses on experimental challenges, in which bison receive specific vaccine treatments and then are exposed to the virus in a controlled environment. Round two will involve mimicking natural exposure by bringing lambs into a pen adjacent to the vaccinated bison and observing their response.

While the four-year study is still in its early days, "The hope is that eventually a vaccine, if it is safe and efficacious, will be available for bison producers," says Webb.

To learn more, contact Webb at bwebb9@uwyo.edu *or* (307) 766-9971.

Photo courtesy Tanya Engel

Photo courtesy Lindsay-Conley Stewart

NEWS FROM THE WYOMING AGRICULTURAL EXPERIMENT STATION

LARAMIE RESEARCH AND EXTENSION CENTER (LREC)

An update from Director Scott Lake

What are the main areas of current research at LREC?

At 7,220 feet above sea level, LREC is located at the highest elevation of all land-grant university research stations in the U.S. The center emphasizes high elevation research in cattle, and UW researchers are currently investigating how nutrition and diet may help combat brisket disease. This ailment is a huge problem in Wyoming and LREC is perfectly situated to study it. Another growing area of research at the LREC beef unit focuses on the impact of microbiomes on production systems.

As the first university research station to adapt GrowSafe boxes for sheep, LREC continues to advance feed efficiency research in sheep and cattle. The center also runs an annual ram test for state and regional sheep producers.

What new projects are you especially excited about?

In 2023, LREC and the UW Department of Animal Science partnered to launch the inaugural UW High Altitude Bull Test and Sale. Bulls were on test from January through mid-March and the program culminated in an educational field day at LREC in April.

In addition to serving Wyoming producers, the program offers UW students an opportunity to learn about bull development, management, and marketing. The ultimate goal of the High Altitude Bull Test and Sale is to aid cattle producers in improving herd genetics.

The Wyoming Wool Initiative, formerly known as the Wool Blanket Project, is taking off as well. Wyoming producers donated a total of 143 lambs to the initiative's first Lamb-a-Year program, allowing students to learn firsthand about the feeding, finishing, and harvesting stages of lamb production. Faculty and graduate students in the Department of Animal Science and LREC staff helped facilitate this program.

◀*Feeding time for Lamb-a-Year lambs at* LREC.

In another exciting and timely new project, associate professor Derek Scasta has received funding to build new water and fencing infrastructure at UW's McGuire Ranch. Located on Highway 34, the ranch serves as the summer range for the UW cowherd. The new infrastructure will support sustainability research assessing the impacts of cattle grazing pressure on soil carbon flux.

What recent infrastructure and/or equipment upgrades have helped advance research at LREC?

LREC is currently in the planning stages of constructing a new feed mill to better meet research needs at the center. The new mill will be located in a different location on the property and will replace the current overhead bin system with a more efficient design. More details will be released once the planning process is complete.

To accommodate expansion of the wool program, LREC recently converted a storage room on site to a classroom primarily used for sheep production classes and the wool judging program.

What else should Wyomingites know about LREC?

LREC is a diverse R&E center. There are always opportunities to conduct new research and provide extension programming for the citizens of Wyoming and surrounding mountain states. With the new bull test and sale, the center is in the beginning stages of developing purebred Hereford and Red Angus herds.

Traditionally, most LREC livestock was sold at weaning age, but now the center is feeding out more and more calves and lambs to a finished product, offering students additional educational opportunities.

To contact LREC, *call* (307) 766-2315 *or email* lrec@uwyo.edu.

POWELL RESEARCH AND EXTENSION CENTER (PREC)

An update from Director Jim Heitholt

What are the main areas of current research at PREC?

Historically, PREC has sought to be the premier irrigated row crop research site for the Intermountain West. Our primary focus is to serve barley, corn, sugar beet, and dry bean producers. Our stakeholders seek information about variety performance, fertility, irrigation, and weed management and we have projects addressing each of those needs.

Research trials conducted at PREC include breeding varieties of dry beans to develop new lines with desirable qualities like drought tolerance, reduced input requirements, and upright stature.

PREC researchers work with units on UW's Laramie campus as well. An ongoing project conducted in collaboration with researchers in the Department of Family and Consumer Sciences, for example, is investigating new lines of popping beans.

PREC also works closely with two other agricultural experiment station units located at Powell: the UW Seed Analysis Lab, which offers seed testing services, and Wyoming Seed Certification Service, which performs field inspections and produces foundation seed.

What new projects are you especially excited about?

We communicate frequently with local producers and ag industry stakeholders to address near-term challenges such as which varieties to use, what fertilizer rates will optimize profit, and when deficit irrigation might work.

Ongoing dry bean and sugar beet research led by our colleague Andrew Kniss, professor of plant sciences, addresses the most commonly discussed producer challenge: weed management.

Long-term projects include our partnership with Donna Harris, a UW plant breeder based in Sheridan. Her research has allowed us to identify lines of dry bean and field pea with drought tolerance.

What recent infrastructure and/or equipment upgrades have helped advance research at PREC?

During the past three years, the center has been lucky but also persistent in finding ways to upgrade field equipment. Wyoming Agricultural Experiment Station leadership, past and present, has been successful in helping obtain modern field plot equipment as well as larger scale equipment. Our time windows for planting, corrugating, spraying, and harvesting 25 field research projects each year are very narrow and access to this modern equipment allows faculty and staff to mimic field operations of regional producers.

What else should Wyomingites know about PREC?

In summer 2022, we welcomed a new office associate, Wendy Files, and four student interns. Two new graduate students joined us in summer 2023. PREC is also hoping to partner more closely with seed producers in the Bighorn Basin in an effort to help them identify yield-limiting factors.

To contact PREC, call (307) 754-2223 or email uwprec@uwyo.edu.

Photo courtesy Jim Heitholt

Planting of chickpea plots at PREC, spring 2022.

JAMES C. HAGEMAN SUSTAINABLE AGRICULTURE RESEARCH AND EXTENSION CENTER (SAREC)

An update from Director Steve Paisley

What are the main areas of current research at SAREC?

SAREC offers research opportunities in rainfed and irrigated cropland as well as grazing and confinement livestock systems. The center continues to expand precision agriculture research and extension programs.

Faculty in the UW Department of Animal Science regularly conduct feeding trials using a newly updated GrowSafe system. The GrowSafe units help faculty and staff monitor individual animal intake of feed and/or supplements.

Typically, three feeding studies are conducted each year, providing data on daily feed intake, daily weight gain, feed efficiency, and residual feed intake. Researchers also use ultrasound technology to collect data used to estimate retail yield and meat quality.

Other areas of research at SAREC include grass and legume forage production, weed management in irrigated cropping systems, and forage-based crop rotation studies.

What new projects are you especially excited about?

We are developing a new cooperative precision agriculture program with Eastern Wyoming College. The program, currently in the planning phase, will expand the center's existing partnership with EWC, supporting both UW researchers and community college students.

A joint internship program will provide applied learning opportunities for EWC students throughout the year. Students will also participate in precision ag labs and collect irrigation, soil fertility, and yield data from SAREC fields as part of their coursework.

EWC students will be encouraged to participate in SAREC field day events and UW Extension events.

What recent infrastructure and/or equipment upgrades have helped advance research at SAREC?

An ongoing priority at SAREC is to update the center's precision agriculture equipment and there has been significant progress in that area.

SAREC's GrowSafe system was recently upgraded to include 16 nodes equipped with load cells and radio frequency identification (RFID) readers. All of the center's cattle are fitted with RFID tags, employing software to monitor feed inventory and better manage individual herd health records.

SAREC also recently acquired two C-Lock supplement feeders. These units are self contained, solar powered, and managed remotely by mobile phone. This allows researchers to regulate feed intake, allow or deny access to individual animals, and feed up to four different supplements to a single herd.

Additional equipment upgrades include tractors with GPS and autosteer as well as updated spraying and planting equipment.

Three of SAREC's pivot irrigation systems are now equipped with variable rate irrigation, allowing researchers to program watering schedules and conduct studies that simulate drought stress.

What else should Wyomingites know about SAREC?

Faculty and staff work extensively with individual producers. This spring, for example, local producers entered 130 bulls into the SAREC bull test. SAREC faculty and staff continue to build active relationships with Wyoming residents and we encourage people to reach out with any questions they may have.

To contact SAREC, call (307) 837-2000 or email sarec@uwyo.edu.

Photo courtesy Steve Paisley

SAREC's new C-lock supplement feeders are self-contained units powered by solar panels and managed via cellular signal.

SHERIDAN RESEARCH AND EXTENSION CENTER (SHREC)

An update from Director Brian Mealor

What are the main areas of current research at ShREC?

ShREC supports both dryland agricultural research at its original site near Wyarno and irrigated land at Adams Ranch, a secondary location.

One of the center's main focus areas is evaluating and improving plant materials for use in Wyoming. These materials include edible beans, field peas, and popping beans; forage crops such as sunn hemp and perennial warm and cool season grasses; and native plants for wildlife habitat and restoration.

Researchers are also investigating invasive weed management and restoration with an emphasis on invasive grasses in rangeland systems. ShREC is a hub for IMAGINE, the Institute for Managing Annual Grasses Invading Natural Ecosystems. Visit wyagresearch.org/imagine to learn more about this collaborative statewide initiative.

What new projects are you especially excited about?

Some of the forage improvement work is very promising. With input costs and stressors such as insect pests increasing, using species and varieties that can provide high-quality forage under local conditions continues to be a high priority.

By evaluating a wide variety of plant materials under multiple production systems, researchers at ShREC are working to find forage solutions that can meet livestock nutritional demands while potentially reducing input costs and preserving important site and soil characteristics. Multiple projects are in early stages of evaluation, but I'm excited to see what comes from these programs.

What recent infrastructure and/or equipment upgrades have helped advance research at ShREC?

The center was fortunate to obtain a new research combine recently. While it might not seem like a big deal, research combines dramatically increase the efficiency of harvesting seed-producing crops, which in turn improves the efficiency of data harvest. Thanks to this equipment upgrade, faculty and staff were able to reduce the number of hours spent harvesting while also reducing the likelihood of data collection errors. The new combine will continue to add value to ShREC's operations as assistant professor Donna Harris' plant breeding program continues to expand.

What else should Wyomingites know about ShREC?

Each year, the center employs a good-sized group of undergraduate students who help with research at the center. As director, I cannot emphasize enough how much help these individuals provide and how great these young people have been. These students come from a wide variety of study areas and backgrounds, but they all roll up their sleeves, learn about agricultural research, accomplish a lot of important work, and have fun at the same time. For college students who are interested in research opportunities, please look us up.

To contact ShREC, call (307) 673-2856 or email shrec@uwyo.edu.

Photo courtesy UW Institutional Marketing

Dr. Donna Harris and Cassie Hengel (Buffalo) train dry bean plants as part of a greenhouse trial.

COLLEGE NOTES

UW'S MCGUIRE RANCH A TEST SITE FOR INTERNATIONAL RANGELAND STUDY

UW's McGuire Ranch, located outside Laramie, is now a hub for an international research project on rangeland soil health.

The five-year study, launched in 2022, will use quantitative data from sites across the U.S. to determine how rangeland management decisions affect soil health, carbon storage, and socioeconomic conditions. Researchers from 11 nonprofit organizations, private research organizations, and public universities in the United States and United Kingdom are involved in the project.

At the McGuire Ranch, ten new pastures have been outfitted with solar-powered water sensors that track infiltration and moisture content and towers that monitor carbon dioxide flux and meteorological conditions. Grazing research begins in summer 2023.

In addition to gathering data at the McGuire Ranch, researchers will work with Wyoming cattle producers willing to allow data collection on their properties. For those interested in participating in the project or touring McGuire, contact UW Rangeland Management Specialist Derek Scasta at jscasta@uwyo.edu or (307) 766-2337.

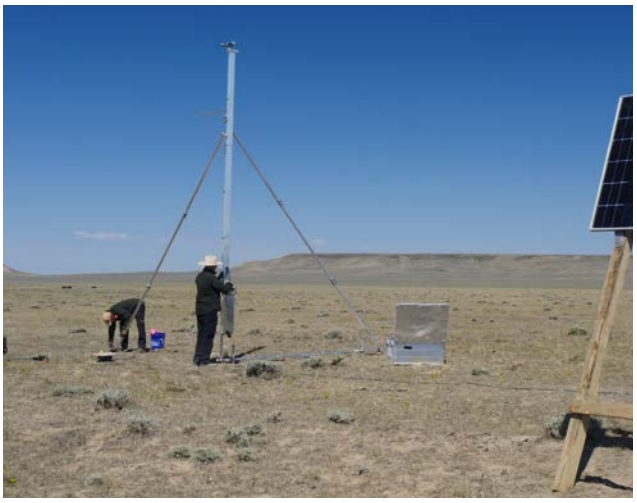


Photo courtesy David Keto

Researchers from Quanterra Systems install instruments that monitor carbon exchange between the ecosystem and atmosphere. The equipment will remain in place at the McGuire Ranch throughout the five years of the Metrics, Management, and Monitoring rangeland project.

SUMMER INTERNS TAKE THE LEAD ON UNIQUE COVER CROP STUDIES

Photo courtesy Randa Jabbour

In summer 2022, two UW interns working in associate professor Randa Jabbour's lab conducted self-guided research projects focused on plant-animal interactions.

Jake Rastatter, then an undergraduate student in zoology, investigated an item previously up for debate: Who eats cover crop seeds? He observed a diversity of birds and mammals feeding on seeds, with a preference for bird seed compared to crop seed. His research, conducted at the LREC Greenhouse and ACRES Student Farm in Laramie, also indicated that hedgerows were the most popular location for seed predation.

Shae Milne, a UW research associate, studied whether alfalfa weevils consume yellow sweet clover. Her research questions were two-fold: First, given the option, would alfalfa weevils exhibit a preference for alfalfa versus sweet clover? Second, in a no-choice situation, would weevils consume sweet clover? Using plant samples from Chugwater, Lingle, and Sybille Canyon, she determined that although weevil larvae will eat yellow sweet clover, they prefer alfalfa.

To learn more about internship opportunities in the College of Ag, contact Hunter Bruce at hbruce1@uwyo.edu or (307) 223-2249.

Summer interns Shae Milne and Jake Rastatter set up a lab experiment testing whether alfalfa weevils eat yellow sweet clover.

Photo courtesy Emma Meese

Research associate Jacob Loeffelholz finds tardigrades in a sample of algae.

UW SCIENTIST CO-FOUNDS INTERNATIONAL WATER AND LIFE INTERFACE INSTITUTE

In 2022, UW faculty member Thomas Boothby co-founded the Water and Life Interface Institute (WALII), a research partnership funded by the National Science Foundation.

WALII brings together an international team of scientists who study how organisms survive in conditions with reduced water. Their research interests range from the molecular level to the organismal level and span all kingdoms of life.

In most cases, the adage "water is life" holds up, says Boothby, an assistant professor of molecular biology, "Yet there are some organisms that can persist in the state of suspended animation when they dry out…then days, weeks, even years later, they can spring back to life when rehydrated."

His current research focuses on tardigrades, nicknamed "water bears"—microscopic animals that defy extreme temperatures, exposure to radiation, and even conditions in outer space, by entering a state of suspended animation.

To learn more about WALII, visit www.walii.science.

UW BIOCONTAINMENT FACILITY'S BSL-3 ENABLES INVESTIGATION OF HIGHLY INFECTIOUS PATHOGENS

Photo courtesy David Kerfo

Dr. Elizabeth Case, UW Biocontainment Facility Scientific Director, demonstrates some of the new tools available at the facility.

Managed by the UW Department of Veterinary Sciences, the UW Biocontainment Facility (UWBF) allows researchers to safely study federally regulated microbes, also known as select agents. The recent addition of a Biosafety Level-3 laboratory space enables new research on bacterial pathogens relevant to Wyoming residents, including brucellosis, Q-fever, plague, and tularemia.

"The UWBF is designed to support the interests of the state of Wyoming and the people who live here," says Elizabeth Case, assistant professor of veterinary sciences and UWBF scientific director. Using the BSL-3 facility, she is currently investigating whether specific strains of *Brucella abortus* have evolved to more effectively infect elk.

In addition to three laboratory spaces and an animal holding room, the BSL-3 certified space includes a large animal necropsy lab used for diagnosis of suspected cases of brucellosis, plague, and other highly infectious diseases. Security and procedures in the BSL-3 facility are regulated by the CDC and FBI to prevent the spread of select agents and to combat bioterrorism threats.

For more information, contact Elizabeth Case, ecase2@uwyo.edu.

UW LAUNCHES INAUGURAL HIGH-ALTITUDE BULL TEST AND SALE

In January 2023, the University of Wyoming Department of Animal Science partnered with the Laramie Research and Extension Center (LREC) to launch the university's first high-altitude bull test and private treaty sale.

The testing component of the program serves Wyoming producers by assessing bulls for their risk of brisket disease and evaluating potential sires on their ability to thrive at high altitude. The program also connects university researchers, students, and producers in a unique opportunity for engagement and applied learning.

Under the supervision of UW faculty and staff, students are responsible for bull development, management, and marketing. In 2023, 41 bulls were on test from mid-January through the end of March. Events culminated in an educational field day at LREC in April.

Photo courtesy Ben Hollinger

L-R: Nick Wade, Tyler Anderson, and Crue Chivers move a group of Angus bulls at LREC.

For more information about the UW High Altitude Bull Test and Sale, contact UW Extension Beef Specialist Shelby Rosasco at srosasco@uwyo.edu or (307) 766-2329.

WYSCI OFFERS TRAINING AND RESOURCES FOR SCIENTISTS AND COMMUNICATORS

The University of Wyoming Science Communication Initiative (WySCI) helps people effectively share science with the state and the world. A grassroots effort launched by faculty, staff, and students in 2017, the initiative strives to make science meaningful, accessible, and inclusive. It also supports researchers seeking funding and recognition for their efforts.

Photo courtesy WySCI

Poster session from a 2019 science communication course .

WySCI offers an online certification program, training and networking opportunities, weekly office hours with experienced mentors, and an e-newsletter.

The online certification is free and open to the public as well as faculty, staff, and students. Through this self-paced program, people with a wide variety of careers and backgrounds can hone their science communication skills and receive credentials for their work.

WySCI is supported by advisory board members representing 16+ units on campus, including departments in the College of Agriculture, Life Sciences and Natural Resources. For more information, visit www.uwyo.edu/wysci or contact WySCI Director Bethann Garramon Merkle at bmerkle@uwyo.edu.

HONORS

Andrew Kniss

UW PROFESSOR HONORED AS WESTERN SOCIETY OF WEED SCIENCE FELLOW

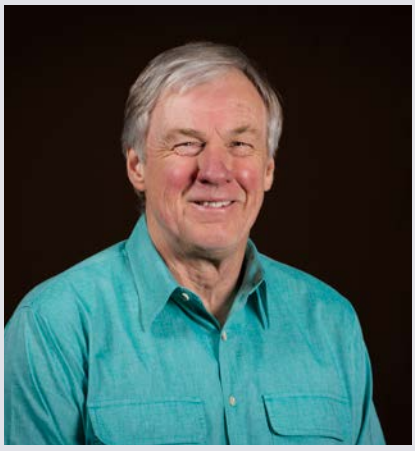
Professor **Andrew Kniss**, head of the UW Department of Plant Sciences, was named a 2022 Western Society of Weed Science Fellow for his meritorious service to the organization.

"I'm pleased to see Andrew receive one of the highest honors awarded by WSWS, to which he has committed significant effort and time through the years," comments Brian Mealor, director of the Sheridan Research and Extension Center.

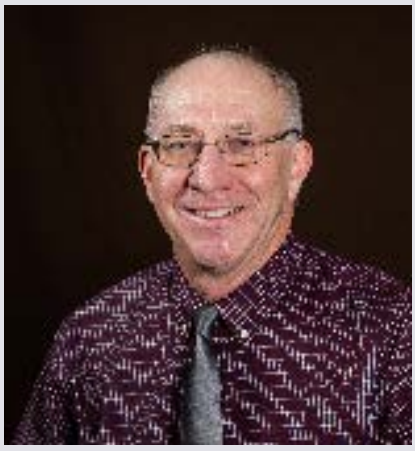
Kniss' research focuses on sustainable weed management programs, especially in agronomic crops like sugar beets, winter wheat, corn, and dry beans.

JARVIS AND WALL NAMED AAAS FELLOWS

In 2023, two distinguished faculty members in the UW Department of Molecular Biology were named fellows of the American Association for the Advancement of Science (AAAS), the world's largest general scientific society. AAAS fellows are selected annually in a tradition that dates back to 1874 and includes prominent historical figures like W.E.B. DuBois and Thomas Edison.



Don Jarvis



Dan Wall

Professor **Don Jarvis** has achieved international recognition for his research on the use of genetically engineered insect cells for manufacturing vaccines, diagnostics, or therapeutics in human and veterinary medicine. He holds 15 patents and founded GlycoBac, a UW spin-out biotechnology company.

Jarvis' colleague **Dan Wall** is best known for his work on the molecular mechanisms of social interactions in microbes. Wall's current research focuses on kin recognition in myxobacteria, organisms that engage in complex social interactions and serve as models for understanding how multicellularity may have evolved.

Photos courtesy Tanya Engel

Whit Stewart

WESTERN SECTION OF THE AMERICAN SOCIETY OF ANIMAL SCIENCE RECOGNIZES UW FACULTY

Whit Stewart, associate professor of animal science, earned the 2022 WSASAS Extension Award for his outstanding outreach and education efforts as UW Extension sheep specialist.

Derek Scasta

UW EXTENSION SPECIALIST NAMED 2022 WSGA OUTSTANDING RANGE PROFESSIONAL

In recognition of his valuable contributions to the livestock industry, the Wyoming Stock Growers Association awarded **Derek Scasta**, UW Extension rangeland specialist and associate professor of ecosystem science and management, the 2022 Outstanding Range Professional Award.


Frank Rahel

RAHEL EARNS REGIONAL HONORS FROM THE AMERICAN FISHERIES SOCIETY

Frank Rahel, UW professor of zoology and physiology, received the 2022 Award of Excellence from the Western Division of the American Fisheries Society in recognition of his outstanding sustained achievement in fisheries biology and management. Rahel also earned the 2022 Award of Excellence from the organization's Colorado-Wyoming chapter.


Cody Gifford

WYOMING AGRICULTURAL EXPERIMENT STATION RECOGNIZES OUTSTANDING RESEARCHERS

Cody Gifford, assistant professor of meat science and meat lab supervisor in the UW Department of Animal Science, earned the 2022 WAES Early Career Research Award. "Dr. Gifford exemplifies the highest quality of faculty at UW," says WAES Director Eric Webster.

In recognition of his world-renowned research contributions, **Dan Wall**, professor of molecular biology, received the 2022 WAES Outstanding Research Award.

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