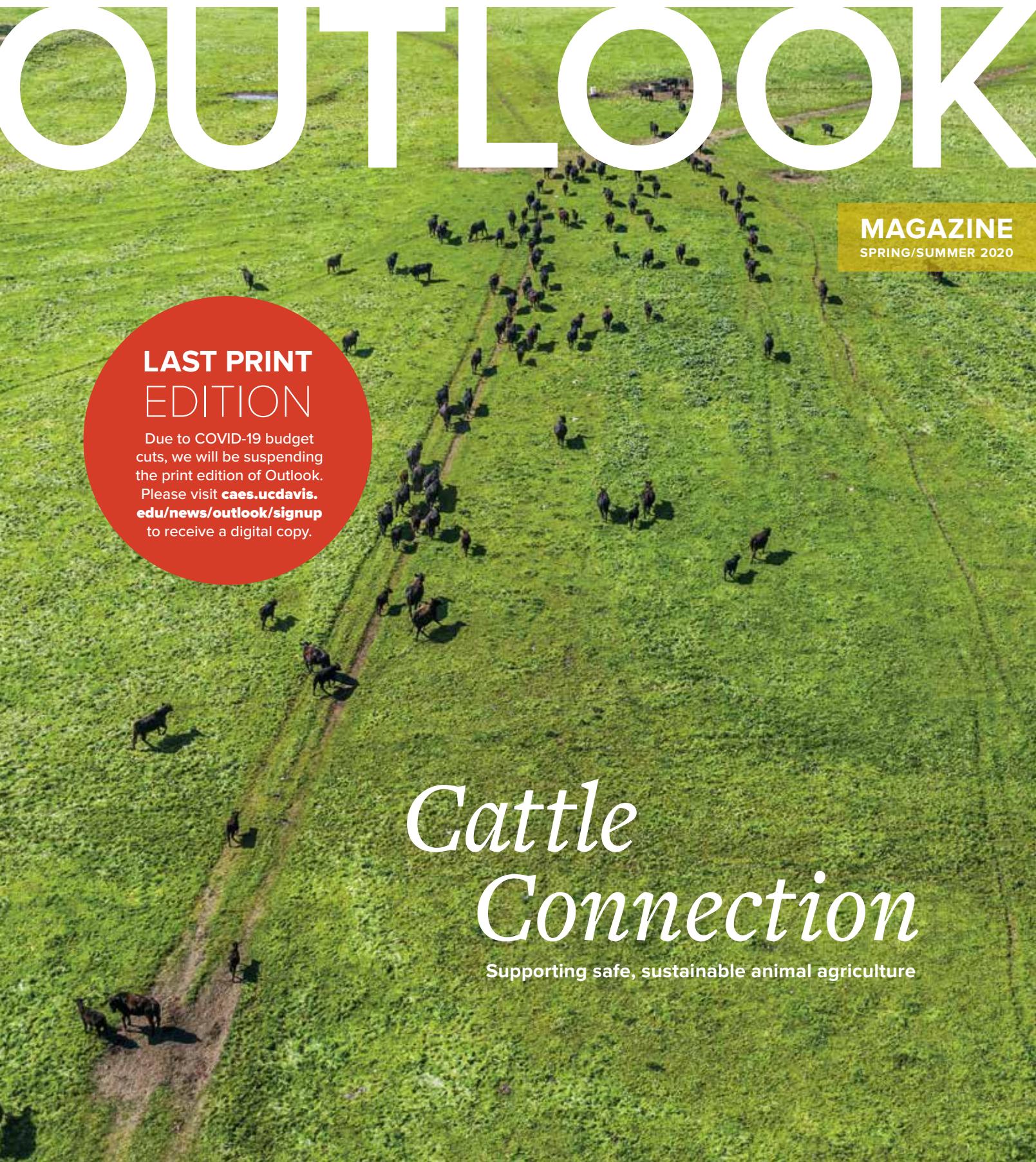


UCDAVIS

**COLLEGE OF AGRICULTURAL
AND ENVIRONMENTAL SCIENCES**

OUTLOOK

An aerial photograph showing a large herd of dark-colored cattle grazing in a vast, green, rolling pasture. The cattle are scattered across the field, with some forming small groups and others grazing individually. A dirt track or road cuts through the grass, creating a diagonal line across the scene.

MAGAZINE
SPRING/SUMMER 2020

LAST PRINT EDITION

Due to COVID-19 budget cuts, we will be suspending the print edition of Outlook. Please visit caes.ucdavis.edu/news/outlook/signup to receive a digital copy.

Cattle Connection

Supporting safe, sustainable animal agriculture

From the Dean

Uniting from afar to support safety, services and our college mission

THIS SPRING HAS BROUGHT ABOUT extraordinary changes for each of us as we do our part to slow the spread of COVID-19. I sincerely hope you and your families are safe and healthy and, like our CA&ES community, finding new ways to support each other and stay connected.

As of this writing in May, operations at UC Davis have been suspended in accordance with California's shelter-in-place mandate. And



Dean Helene Dillard
on one of many
conference calls while
sheltering in place.

yet our staff, students and faculty are working hard to care for animals, tend crops, conduct vital research and develop innovative ways to teach and learn.

Using strict safety protocols, an essential team of employees is planting and harvesting crops at several of our research facilities and at the Student Farm. Researchers are providing guidance on critical coronavirus-related topics, such as protecting food safety and assuring adequate food supply. Staff and students are making sure the animals in our many facilities have the food and care they need to thrive.

With help from our incredible team of IT professionals, our faculty, staff and students are striving to make online coursework as accessible, equitable and enlightening as possible. Zoom meetings have become a daily part of our lives as we gather electronically to embrace our CA&ES

mission to promote agricultural, environmental and social sustainability. Feeding the world, caring for the planet and protecting health and well-being has never been more urgent.

In this spring/summer issue of *Outlook*, we explore the collaborative work underway to support the sustainable management and production of beef and other animal-sourced proteins. The stories were planned and written long before California's stay-at-home order, but the topic of nutritious, environmentally friendly animal agriculture is as relevant as ever.

More than one third of California, 38 million acres, is rangeland managed for livestock. Grazing can provide many environmental benefits, such as capturing carbon, storing water, nourishing the soil, reducing weeds and other invasive species, controlling wildfire, and providing vital riparian habitat for plants, animals, insects and birds.

Sustainable grazing requires good rangeland management, and our researchers work closely with ranchers, regulators and other researchers to develop feasible plans.

CA&ES faculty are also discovering ways to dramatically reduce the amount of methane cows emit into the atmosphere as they digest their food. This research could pave the way for sustainable dairy and livestock production worldwide. Only a tiny fraction of the planet is fit for crop production. Much more land is suitable only for grazing livestock, which can convert inedible plant materials into high-quality nutrients for humans.

I have witnessed incredible courage and creativity as our CA&ES community develops new tools and technologies to adapt to these unprecedented times. Together with our many partners, we will emerge from this pandemic stronger, more resilient and even more able to meet society's needs. While the future is uncertain, we know that safe, sustainable animal agriculture will continue to play a vital role in supporting the environmental, economic and physical health of communities in California and around the world.

OUTLOOK MAGAZINE

SPRING/SUMMER 2020

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ON THE COVER

An aerial view of Chileno Creek Ranch in Petaluma shows cows enjoying the green grass of spring. CA&ES researchers collaborate with ranchers and colleagues to fence off creeks, provide off-site water, reduce erosion and manage rangeland to support profitable, environmentally friendly livestock production.

COVER PHOTO BY:
HECTOR AMEZCUA/UC Davis



Common Ground

One third of California is rangeland. Good grazing management improves rangeland productivity and provides many environmental benefits such as capturing carbon, nourishing soil and controlling wildfire. Our college studies topics like livestock breeding, animal-sourced nutrition, methane emissions and cattle personality, and works closely with industry stakeholders to promote sustainable grazing and livestock production here and abroad.

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Pioneering science could explain why some cattle roam

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Laboratory discoveries are leading to improved genetic selection

Pip the dog gathers with, from left, Nancy Scolari, executive director of the Marin Resource Conservation District; Ken Tate, CA&ES professor and Cooperative Extension specialist; Mike and Sally Gales, owners of Chileno Creek Ranch in Petaluma; and David Lewis, director of Cooperative Extension in Marin County.

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HECTOR AMEZCUA/UC Davis

Getting CLEAR on livestock and climate

What role can animal agriculture play in protecting the environment and nourishing our world? A new center based in the UC Davis Department of Animal Science is working to provide clarity around that important issue by conducting and communicating the latest research in livestock production and environmental sustainability.

The CLEAR Center, which stands for Clarity and Leadership for Environmental Awareness and Research, is under the direction of Frank Mitloehner, animal science professor and Cooperative Extension air quality specialist. Catch up on the CLEAR Center's latest news and research at clear.ucdavis.edu.



With an abundance of caution, a dedicated core of staff and students has kept the UC Davis Student Farm running safely throughout the pandemic.

Providing support during the **PANDEMIC**

Many operations at UC Davis were suspended this spring as Californians worked together to slow the spread of COVID-19. And yet, our CA&ES community was hard at work providing essential services like caring for animals, tending crops, conducting research and supporting medical efforts to combat the infectious disease. Here are a few examples:

CA&ES donated thousands of vital supplies to the UC Davis Health Center to help treat patients and protect staff. The donation included 2,400 face masks, 700 N95 respirators, 200 isolation gowns, 57,000 gloves and other items such as aprons, goggles and coveralls.

Researchers provided guidance on critical coronavirus-related issues, such as protecting food safety and assuring adequate food supply.

Using strict safety measures, a small, essential crew of staff and student employees continued harvesting crops at the Student Farm to feed the Davis community. Staff and students provided food and care for the many animals in our facilities.

A few personnel kept cleaning tanks and feeding fish at the UC Davis Center for Aquatic Biology and Aquaculture to care for the sturgeon, salmon, trout and other species our scientists study, as well as more than 100 Koi fish rescued from the Camp Fire and recent wildfires in the wine country.



HECTOR AMEZCUA/UC Davis

“Ribbon-butting” for the goat dairy and creamery

For more than 100 years, goats have played a starring role in CA&ES teaching, research and outreach. That connection grew stronger than ever in January with the formal opening of the UC Davis Noel-Nordfelt Animal Science Goat Dairy and Creamery.

“We’re really excited to see this come to fruition,” said Anita Oberbauer, animal science professor and associate dean of agricultural sciences. “At this new facility, we will be able to produce, market and sell Grade-A goat cheese while providing hands-on learning for students.”

Located off Old Davis Road, the 2,420-square-foot Noel-Nordfelt Animal Science Goat Dairy and Creamery includes a milking parlor, milk room, clean room, aged cheese room and packing room. The facility will help students model common animal husbandry issues facing production goat dairies and provide a space where students, staff, faculty and industry stakeholders can process milk and make cheese with state-of-the-art equipment.

The cheese produced there will eventually be sold at the UC Davis Meat Lab and used in some campus eateries.

ATMOSPHERIC SCIENTIST PAW U WINS TEACHING PRIZE

Atmospheric scientist Kyaw Tha Paw U is this year’s winner of the UC Davis Prize for Undergraduate Teaching and Scholarly Achievement. He has a reputation for knowing every student’s name and keeping them engaged. “Teaching is a social interaction,” said Paw U, a professor in the Department of Land, Air and Water Resources. “It’s a partnership. You’re facilitating their learning. As a teacher, you have to know who they are.”

Paw U teaches about four courses per year, including the popular class, “Severe and Unusual Weather.” His research focuses on interactions among ecosystems, the atmosphere, animals and plants. He also helped develop a tool for farmers to manage water use. The honor comes with a \$50,000 prize funded by philanthropic gifts managed by the UC Davis Foundation.



GREGORY URQUIAGA/UC Davis

Nomads and Commuters

Understanding cattle personality may help keep rangeland productive, sustainable

By Diane Nelson

DO YOU EVER WONDER WHY sometimes one, lone cow stands munching grass on a hillside while her fellow cattle graze in groups below?

Animal behavior experts at UC Davis do, and their curiosity may shed light on one of the most critical economic and ecological questions in rangeland management. How can we encourage more cattle to roam?

“Cattle distribution on ranches is a huge issue,” said Assistant Professor Kristina Horback, a CA&ES animal-cognition expert. “When cattle gather and graze by creeks, it can lead to overgrazing in riparian areas and let perfectly good forage go to waste. Tools like fencing can help, but could understanding animal behavior be part of the equation?”

Horback and a team of CA&ES researchers recently received \$110,000 from the Russell L. Rustici Rangeland and Cattle Research Endowment to examine how cow personality impacts cattle distribution. This pioneering science can support efforts to breed for hill-climbing cows by correlating personality traits with certain behaviors like the inclination to roam.

Horback has studied animal cognition in several species of mammals, including elephants, chimps, prairie dogs, dolphins and whales. She is currently one of the few scientists in the world exploring the role personality plays in the welfare and sustainable production of farm animals like cattle, sheep and pigs.

“There’s been a lot of work done with wildlife personality and foraging preference, but virtually nothing with cattle,” Horback said. “We know with deer, birds and even insects that their level of boldness can impact the risks they take and how far they range for food. Do those instincts still apply in animals like cows that have been domesticated and bred for other traits for thousands of years?”

First up: Designing tests

To assess a person’s personality, psychologists rely on self-reporting surveys like the Myers-Briggs Type indicator. Since Horback can’t interview cows, she and her team set up situations that let cattle show their true colors.

“We’ll conduct startle tests,” explained Maggie Creamer, a Ph.D. animal behavior student who is working with Horback. “We begin with cows in a complacent state by offering food and then startle



them with light, sound or vibration. We then measure their degree of recoil and latency to return to the food. Do they stay away from the spot or shake it off and continue eating?"

Because even cows can have a bad day, the researchers repeat the test at a later date.

"Maybe it was hot and the cow wasn't feeling well," Horback said. "We have to make sure the tests tell us something consistent about that animal."

With input from California ranchers, Creamer and Horback are weighing the most relevant way to startle a cow. Remote-control snakes? A blast of noise?

"We're playing with the idea of launching a drone," Creamer said.

Researchers are also looking at sociability. They will separate a cow from the herd and see how quickly she wants to return to the group. Some cows seem fine with spending time alone.

When designing animal-personality tests, there are always a few kinks to work out. For example, the team is also measuring cattle response to novel foods to see how willing they are to investigate. Creamer conducted a few trial runs with carrots.

"When we offered the cows carrots in a feed pan, they were so startled by the pan that they stayed away from what was inside," Creamer said. "So, we tried putting carrots directly on the ground in their pens, and they just trampled them."

The GPS connection

The team will begin tests with about 40 adult females this summer. The first tests will

be conducted at UC Davis and then move to the 5,700 rolling acres at the UC Sierra Foothill Research and Extension Center northeast of Sacramento.

"We'll attach GPS collars to see how certain personalities correlate to habits on the range, like how far cows travel from water and their elevation gain," Creamer explained.

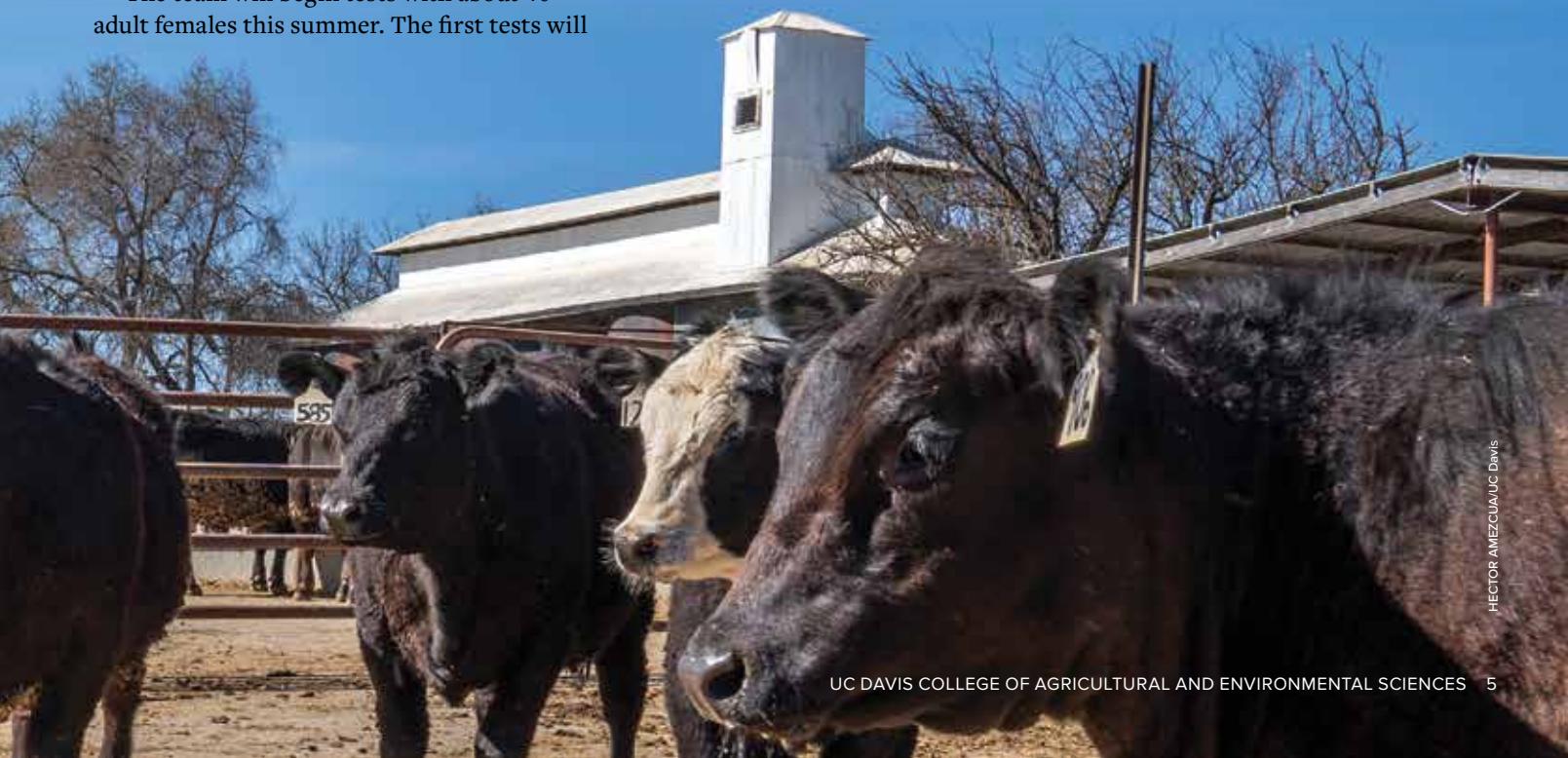
Call them nomads and commuters. The team predicts the bolder cows will tend to be "nomads," more willing to wander and take high risks for high rewards. The more cautious creatures may be "commuters" who prefer to dine closer to home.

Nomads might be a better match for ranches on steep, rugged terrain. Commuters may be fine for flat, open ranges. "Or maybe it's the mix of personalities that works best," Creamer said.

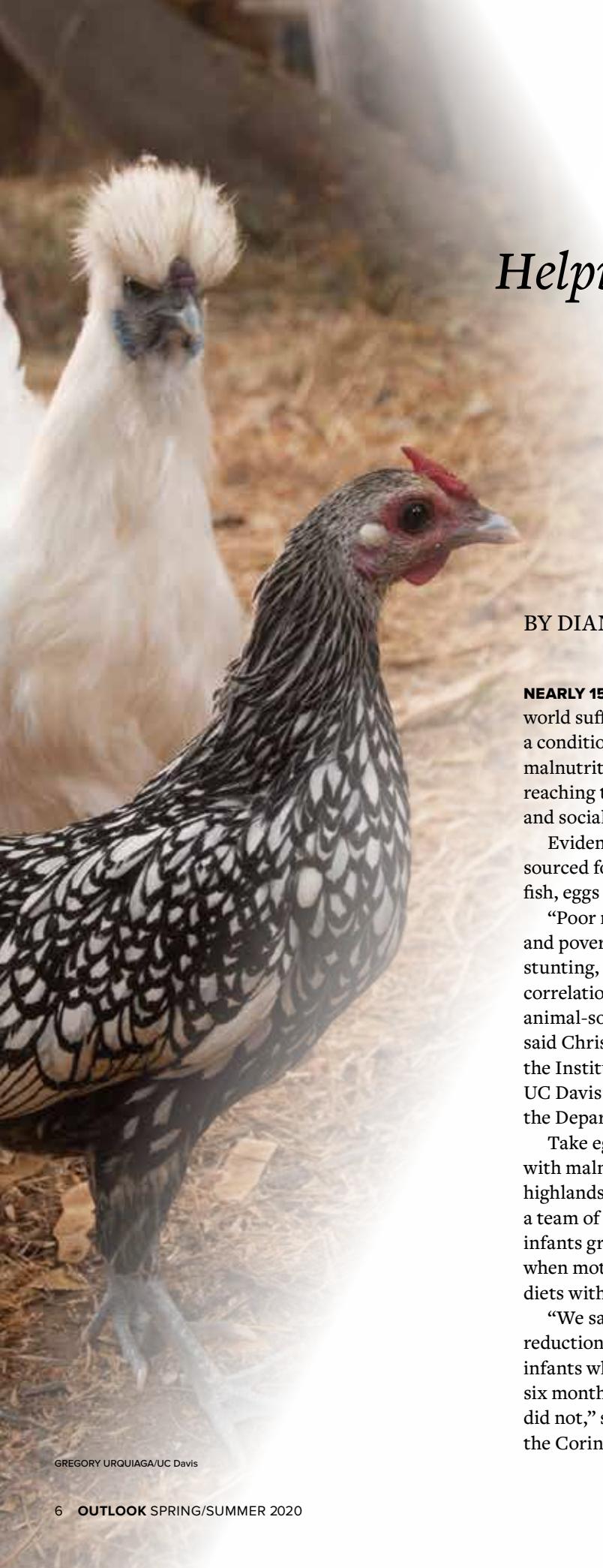
Horback and Creamer are working with several fellow researchers, including UC Davis Cooperative Extension Specialists Leslie Roche, Tina Saitone and Ken Tate, as well as UC Cooperative Extension Advisors Morgan Doran, David Lile and Tracy Schohr. The team is collaborating with California ranchers, who have volunteered their land for further tests.

"Ranchers are helping us make sure the tools we develop are useful," Horback said. "At the end of the day, we want to provide information that can support good rangeland management." •

Professor Kristina Horback tests whether props like colorful flags can help assess cattle personality traits like boldness.



HECTOR AMEZCUA/UC DAVIS



Helping families improve *nut*

BY DIANE NELSON

NEARLY 150 MILLION CHILDREN in the world suffer from stunted growth, a condition linked to chronic malnutrition that keeps people from reaching their full physical, mental and social potential.

Evidence shows that animal-sourced foods like meat, poultry, fish, eggs and dairy can help.

“Poor nutrition, infection, stress and poverty can contribute to stunting, and there is an important correlation between growth and animal-sourced food consumption,” said Christine Stewart, director of the Institute for Global Nutrition at UC Davis and associate professor in the Department of Nutrition.

Take eggs, for example. Working with malnourished children in the highlands of Ecuador, Stewart and a team of scientists discovered that infants grew significantly more when mothers supplemented their diets with an egg each day.

“We saw a nearly 50 percent reduction in stunting among the infants who received an egg daily for six months compared to those who did not,” said Stewart, who is also the Corinne L. Rustici Endowed

Chair in Applied Human Nutrition at UC Davis.

Egg yolks are rich in choline, an essential nutrient that supports liver function and healthy development of the brain, muscles and nervous system. Choline is lacking from the standard diet of many impoverished Ecuadorians who subsist mostly on rice, potatoes and thin soup.

Stewart’s team tried to replicate the results in a similar experiment with infants living in Malawi. The test site was near Lake Malawi, Africa’s second-largest lake with an enormous variety of freshwater fish. Interestingly, eating an egg a day had no impact on child growth.

“Fresh fish is such a nutritious food that the Malawian families we worked with were probably already getting more nutritional quality in their diet than was available in the highlands of Ecuador,” Stewart said.

Hidden hunger

Fish, eggs, meat and other animal-sourced foods are beneficial, but it’s not just because of the protein they provide. Most children

rition

with eggs, meat, poultry and more

get enough protein. Instead, stunted and other undernourished children experience what nutritionists call “hidden hunger”—chronic deficiencies in iron, iodine, zinc, choline, vitamin B-12 and other micronutrients needed for healthy growth and brain development.

For children in developing countries, animal-sourced foods provide many essential micronutrients that are hard to find in adequate supply from plants alone. Iron is a good example. Children need iron as their brains, muscles and blood cells grow. A 12-month-old infant requires 11 milligrams of iron each day, compared to 8 milligrams for adults. Gram per gram, you would need to eat eight times more spinach than liver and four times more spinach than beef to obtain the same amount of iron.

“That’s because iron and other micronutrients are more concentrated and more bioavailable in animal-sourced foods, which means our bodies can more easily absorb them,” Stewart explained. “What you absorb is just as important as what you consume.”

The meat connection

Fifteen years ago, CA&ES researchers led what is still considered the most formative experiment on the role livestock nutrition plays in improving children’s growth, physical activity and cognitive development. The Global Livestock Collaborative Research Support Program, directed by former CA&ES plant sciences professor Tag Demment, supported a five-year project in Kenya that tracked more than 1,000 children—some who received two ounces of beef on school days and some who did not. Lindsay Allen, research professor with the UC Davis Department of Nutrition, helped lead the study.

Over the course of five years, the kids who regularly ate meat scored 20 percent higher on cognitive tests, spent more time in leadership behaviors and were more physically active than the children who did not. The children’s muscle mass increased markedly and their vitamin B-12 deficiency was eliminated.

“This seminal study shows that the quality of food matters more than the quantity and illustrates the link

between animal-sourced food and child development,” Stewart said.

But beef isn’t easy to come by in some developing nations. It can be expensive to buy and difficult to transport and sell. “There are many food safety concerns when meat sits unrefrigerated in open-air markets,” Stewart explained. “If families are able to afford a cow, they’re more likely to keep it for milk or use it to help till the soil. Getting milk, eggs and fish into diets may be more feasible.”

That’s why Stewart and other international nutrition experts address world hunger with various nutritional interventions, including supplementing diets with a variety of animal-sourced foods.

“When children consume diets rich in vitamins, minerals and essential fatty acids, they have a greater opportunity to survive and thrive,” Stewart said. “Animal-sourced food is one important way to help provide children the nutrients they need.” •

Reducing Greenhouse Emissions

Seaweed in cattle feed could dramatically cut methane

By Diane Nelson

A BIT OF SEAWEED IN CATTLE FEED could reduce methane emissions from beef and dairy cows as much as 84 percent, according to new findings from researchers at the College of Agricultural and Environmental Sciences. The results could pave the way for the sustainable production of livestock throughout the world.

“We now have sound evidence that seaweed in cattle diet is effective at reducing greenhouse gases and that the efficacy does not diminish over time,” said Ermias Kebreab, professor and Sesnon Endowed Chair of the Department of Animal Science and director of the World Food Center. “This could help farmers sustainably produce the beef and dairy we need to feed the world.”

Over the course of five months last summer, Kebreab and his team added scant amounts of seaweed to the diet of 21 beef cattle and tracked their weight gain and methane emissions. Cattle that consumed doses of .05 percent seaweed gained as much weight as their herd mates while burping out 84 percent less methane into the

atmosphere. Kebreab is building on his earlier work with dairy cattle, which was the world’s first experiment with seaweed and cattle.

Less gassy, more sustainable

Greenhouse gases are a major cause of climate change, and methane is a potent greenhouse gas. Agriculture is responsible for 8 percent of greenhouse gas emissions in the U.S., and half of those come from cows and other ruminant animals that belch methane and other gases throughout the day as they digest food like grass and hay.

Since cattle are the top agricultural source of greenhouse gases, many have suggested people eat less meat to help address climate change. Kebreab looks to cattle nutrition instead.

“Only a tiny fraction of the earth is fit for crop production,” Kebreab explained. “Much more land is suitable only for grazing, so livestock plays a vital role in feeding the 10 billion people who will soon inhabit the planet. Since much of

livestock's methane emissions come from the animal itself, nutrition plays a big role in finding solutions."

In 2018, Kebreab and his team were able to reduce methane emissions from dairy cows by more than 50 percent by supplementing their diet with seaweed for two weeks. The seaweed inhibits an enzyme in the cow's digestive system that contributes to methane production.

In the new study, Kebreab tested whether those reductions were sustainable over time by feeding cows a touch of seaweed every day for five months, from the time they were calves on the range through their later days on the feedlot.

Four times a day, the cows ate a snack from an open-air contraption that measured the methane in their breath. The results were clear. Cattle that consumed seaweed emitted less methane, and there was no drop-off in efficacy over time.

Next steps

Kebreab is awaiting results from a taste-test panel to see if seaweed in feed affects the flavor of the beef. Similar tests with dairy cattle showed that seaweed had no impact on the taste of milk.

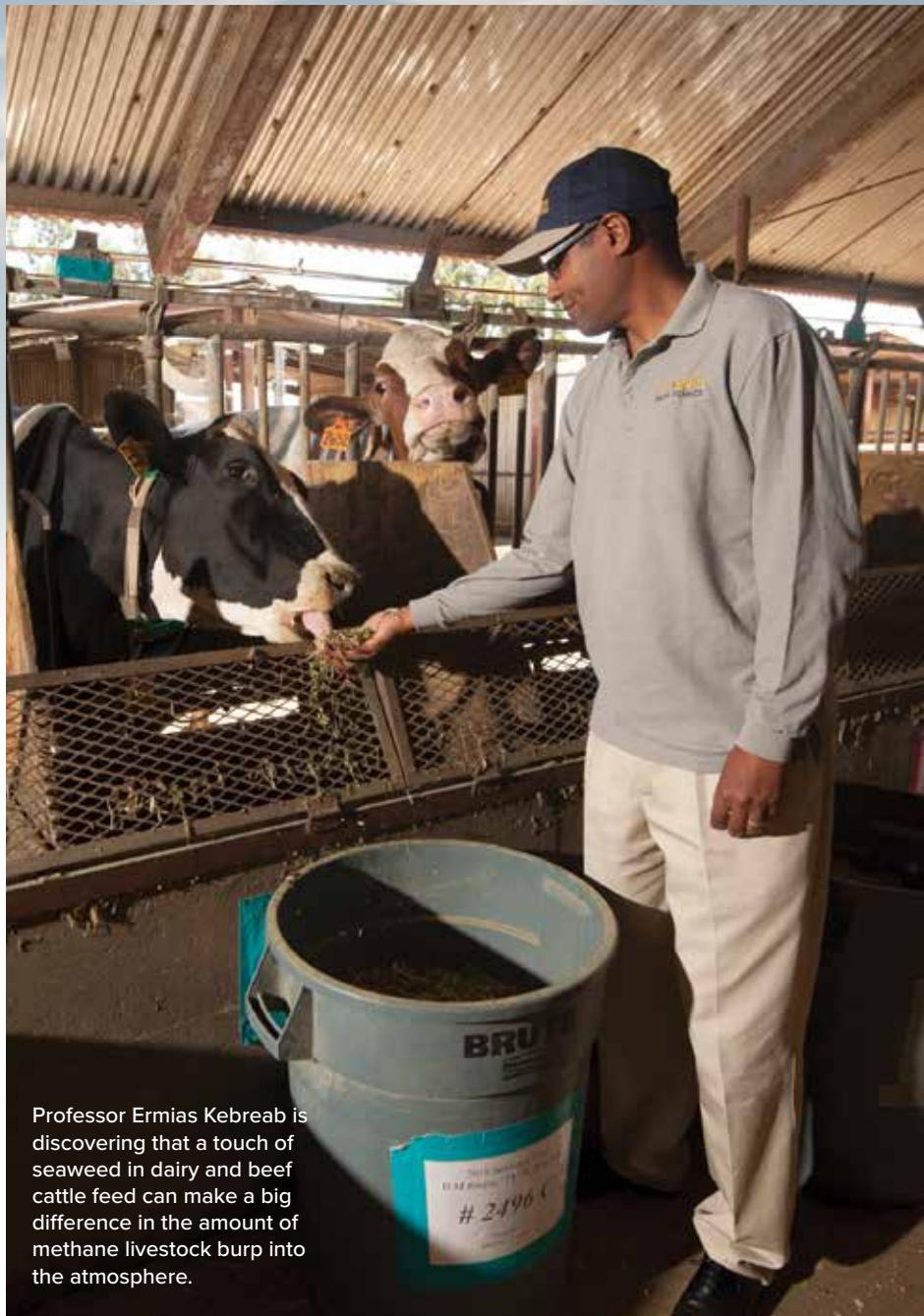
Also, scientists are studying ways to farm the type of seaweed—*Asparagopsis taxiformis*—that Kebreab's team used in the tests. There is not enough of it in the wild for broad application.

Another challenge: How do ranchers provide seaweed supplements to grazing cattle on the open range? That's the subject of Kebreab's next study.

Kebreab is collaborating with a federal scientific agency in Australia called the Commonwealth Scientific and Industrial Research Organization, James Cook University in Australia, Meat and Livestock Australia, and Blue Ocean Barns, a startup company that sources, processes, markets and certifies seaweed-based additives to cattle feed. Kebreab is a scientific adviser to Blue Ocean Barns.

"There is more work to be done, but we are very encouraged by these results," Kebreab said.

"We now have a clear answer to the question of whether seaweed supplements can sustainably reduce livestock methane emissions." •



Professor Ermias Kebreab is discovering that a touch of seaweed in dairy and beef cattle feed can make a big difference in the amount of methane livestock burp into the atmosphere.

GREGORY URQUIAGA/UC Davis

Finding Hope

in Rangeland Restoration

By Diane Nelson

See more about riparian restoration in our video available at caes.ucdavis.edu/news/petaluma.

HECTOR AMEZCUA/UC Davis

SPRING IS THE PERFECT SEASON to explore rangeland ecology in California. The grasslands are green, the skies are blue, and bright yellow monkey flowers dance in the breeze. Even metaphorically, spring is a good fit. Rangeland restoration brings new life.

A case in point: Chileno Creek, a waterway that winds through Chileno Valley Ranch outside of Petaluma, California. The 100-foot-wide restoration area is home to steelhead trout, coho salmon, egrets, deer, badgers, insects and other creatures that flourish in riparian zones like these. Willows, oaks and native shrubs multiply along the banks, reducing erosion, nourishing the soil and capturing carbon to help reduce climate change worldwide.

Twenty years ago, Chileno Creek was a wasteland.

"It looked like a moonscape," says Sally Gales, who owns and operates Chileno Valley Ranch with her husband, Mike. "The slopes were denuded and there were cows hanging out in the creek. We called UC researchers and the Marin Resource Conservation District, and their science and support helped us turn it around."

On a recent spring day, the Gales welcome us to see Chileno Creek, the first of many waterways they revegetated over the last few decades. CA&ES researchers have collaborated with thousands of ranchers and fellow scientists on rangeland restoration projects like these.

Sally leads the way through a lush meadow. The Gales' springer spaniels, Pup and Pip, romp ahead and the scent of fresh grass rises like mist.

Common ground

More than one-third of California, 38 million acres, is rangeland. Most of the land is privately owned and managed for livestock. Grazing offers many environmental benefits like keeping weeds and other invasive species in check, providing water storage and carbon sequestration, and supporting habitat for plants and animals found nowhere else in the world.

But problems arise, like erosion and downstream water-quality issues, if rangeland is overgrazed or cattle congregate in creeks and trample delicate riparian zones. Conditions vary in terms of soil, slope, climate

and vegetation, so researchers offer a suite of ideas for how to protect riparian areas and keep erosion in check. Examples include building strategic fencing, spreading gravel on creek crossings to help absorb hoof impact, rotating herds among pastures and maintaining a diversity of native grasses.

"We don't tell ranchers and regulators which tools to use," says CA&ES Professor and Cooperative Extension Specialist Ken Tate, who joins us on the day's tour. "We identify what works and what doesn't work so they can design a rangeland management plan that is feasible and sustainable."

Watching the water flow

To reclaim Chileno Creek, Sally and Mike first fenced off all the creeks and provided spring-fed water troughs so their herd of 100 cattle had what they needed away from running water.

Then Sally "planted" the creek.

"You start by poking a willow sprig in the creek bed, along with a lot of other native plants and shrubs," Sally says, her smile broad beneath her Chileno Valley Ranch cap. "You nurse it a little and then watch it grow."

As the creek grew, David Lewis, director of Cooperative Extension in Marin County, helped measure whether restoration projects like these could capture carbon as well as control erosion. It could.

"Revegetating riparian zones to control erosion provides a carbon sequestration service that is valuable and substantial," says Lewis, hiking alongside Tate to Chileno Creek. "Revegetation of streambanks helps ranchers control erosion and mitigates climate change, which benefits us all."

We arrive at the banks of Chileno Creek, which rolls in folds like the back of a dog's neck. Dragonflies dart across the surface and birds call from distant trees. The morning sun shines so gently on the water that the creek looks lit from within.

"It's amazing what you can build with teamwork and a little care," Sally says. "Chileno Creek supports people, animals, insects, birds, fish and plants that all deserve a place in this world. There's no telling what tomorrow will bring, but restoration gives us hope." •



Fencing out the cattle was the first step in restoring Chileno Creek.



FIRST DAY OF SPRING QUARTER 2020

The usual flurry of activity that accompanies the start of a new academic quarter was replaced this spring with a more subdued environment. The coronavirus pandemic has compelled the UC Davis community to dig deep and find new ways to deliver on our commitments. Faculty, staff and students now communicate through remote learning technology and will do so through spring quarter. A dedicated core of essential personnel is making sure the campus is well taken care of, including our plants and animals. We look forward to the day when this trying time has passed and we can return to campus. In the meantime, we are doing all we can to adapt and stay true to our mission to educate our students, conduct transformative research and provide the public with knowledge and tools to create a brighter future. Stay safe and be healthy!

HECTOR AMEZCUA/UC Davis





By John Stumbos

A new day is dawning for GENETIC IMPROVEMENT

THE FUTURE OF LIVESTOCK BREEDING is taking shape at UC Davis. In the laboratory of animal scientist Pablo Ross, groundbreaking discoveries are being made that will pave the way for raising healthier, more productive and better-adapted cattle, sheep and other species.

In 2018, the Ross lab reported the first successful effort to grow embryonic stem cells from cattle in a petri dish. This milestone is a crucial step in the development of faster and more focused breeding programs.

"After 40 years of attempts to do this, we finally found a way," Ross said. "We think that these cells hold huge potential for improved genetic selection in livestock."

THE GENETIC CHALLENGE

Humans have been shepherds of genetic selection for thousands of years through the domestication of livestock and crop species. But traditional methods of doing so can be inexact and time consuming. When crosses are made to

improve plants or animals with desirable traits, undesirable characteristics sometimes come with them.

For instance, modern dairy cows have been bred to produce milk in astonishing amounts—on average nearly 23,500 pounds per cow per year, according to the USDA. That's far more than what's needed for the calf, but it's provided a valuable source of animal protein for humans. However, selecting animals with higher milk production is linked to a loss of reproductive efficiency.

"In California we see a marked decrease in fertility during the summer months," Ross said. "We know that the high heat period is affecting the embryos in cattle. We need to understand the mechanisms of heat stress on early development so we can overcome or correct this fertility problem."

A particular focus of his research is the molecular changes that happen in connection with fertilization, especially in the first week after the union of

sperm and egg that transforms these cells into an embryo. "Embryonic cells have the role and responsibility to form all the different cell types in the body," Ross said. "By developing a better understanding of embryo development, we will be in a better position to identify potential problems and opportunities for improvement."

How life springs into form is something that's fascinated Ross since he was a child growing up in Argentina. He initially planned to follow in his father's footsteps as a livestock veterinarian. "In graduate school I got very interested in research and mostly interested in how a new individual gets made, so I started studying early development in cows," he said.

Improving technologies for assisted fertilization is one of the keys to faster genetic progress. Yet another fundamental challenge is in deciphering the genome, the genetic blueprint for each species.



Animal scientist Pablo Ross has successfully grown embryonic stem cells from cattle in the laboratory.

HECTOR AMEZCUA/UC Davis

MENT IN LIVESTOCK

CRACKING THE CODE

The cattle genome was first described in 2009. It contains about 3 billion “letters” of the DNA code.

“The problem is we only understand about 2 percent of those 3 billion letters—what they do, what’s their role in the genetic sequence,” Ross said.

He and colleagues have embarked on a massive undertaking with researchers at nine different academic institutions to understand the “functional” areas in the other 98 percent of the cattle genome. Ross is the

principal investigator for the project, which is funded by USDA’s National Institute of Food and Agriculture.

These scientists are analyzing the active regions of 60 different tissues with the use of genetic markers on DNA

sequences. There are about 20,000 genes contained within the genetic code of cattle. These genes are important because how they are expressed is what distinguishes one animal from the next. Much of the variation between animals arises in regions of the genome now under study.

“This work is giving meaning to the genome,” Ross said. “This is the difference between being able to read and being able to comprehend what you’re reading. If we’re able to do that, it will improve our capacity to identify individuals with

better traits.”

Ross likens it to building a dictionary, and that information will eventually give cattle breeders the tools to make genetic improvements resulting in animals with more efficient feed

conversion rates, better disease resistance, even behavioral differences and other desirable traits.

GAME-CHANGING TECHNOLOGY

The development of technology to harnesses the intrinsic power of embryonic stem cells could accelerate genetic improvement in livestock 10 times faster than what is possible today, according to Ross. Instead of growing individual animals to adulthood to assess desirable traits, observations could be made much more quickly with cellular samples of DNA.

This approach also holds the promise of being able to select traits for different environments and production systems—the right animal for the right condition. Imagine “customizing” a cow for the humid conditions of Florida, the cold weather in Wisconsin or the dry heat in California.

“This could be a real game-changer in terms of animal breeding and genetic selection,” Ross said. ●

**Imagine
“customizing” a
cow for the humid
conditions of Florida,
the cold weather in
Wisconsin or the dry
heat in California.**



Devoted graduating senior has helped keep FFA tradition and legacy alive

IN EARLY MARCH FOR THE PAST 44 YEARS, several thousand high school students from all over California arrive at UC Davis to test their skills in a variety of agricultural judging contests. The contestants are easy to recognize with their familiar blue jackets emblazoned with the FFA logo.

For many of them “Field Day” is their first experience of the campus, but it won’t be their last. It was that way for Caitlyn Chase, who grew up in the Trinity County community of Weaverville raising chickens, pigs, lambs and cows as an FFA member. Her first Field Day was in 2013.

“I absolutely fell in love with the campus and knew I wanted to be a student here someday,” she said. In 2015 and 2016, she came back and competed at Field Day with the forestry team from her region.

Chase entered UC Davis as a freshman in 2016 and was fairly certain she wanted to become a veterinarian. Then she joined Aggie Ambassadors, the student outreach club that promotes the college throughout the campus and beyond.

“This is where I realized my passion is helping people develop into better versions of themselves and discover strengths that maybe they didn’t know they had,” she said.

Chase changed her major from animal science to agricultural and environmental education. She graduates in June and plans to eventually become a high school teacher.

She’s kept her connection with FFA alive by helping organize Field Day each of her four years at UC Davis. In 2020, she coordinated with dozens of student volunteers in managing the nearly 4,000 FFA members who competed March 7 in everything from livestock and poultry judging to floriculture and agricultural mechanics.

It’s fitting that the largest Field Day in the nation is hosted by CA&ES, the number one agricultural college in the nation. “It’s an awesome opportunity for us to give back to these high school students who may also one day become our students,” she said.

Chase brims with gratitude for the many opportunities she’s had as a UC Davis student—and with FFA. “Those experiences have made me who I am today,” she said. “I think it’s so awesome that we get to run a large-scale event like Field Day. I hope this tradition and legacy continues for a long time to come because it teaches so many people so much.”

—John Stumbos

NO KIDDING

Livestock and teaching are in this student's future



HECTOR AMEZCUA/UC Davis

IT'S A SAFE BET THAT JACKSON SAWYER'S FUTURE will involve livestock and teaching. The clues aren't hard to find.

As a high school senior in 2016, he applied to only four colleges—Chico State, Cal Poly San Luis Obispo, UC Davis and Texas A&M. “I got into all of them, but knowing I got into Davis, with the nation’s number one animal science program, I thought that was the clear choice,” he said.

Over the course of his four years as an Aggie, he’s competed nationally with the UC Davis livestock judging team, lived and worked at the campus sheep facility and become president of the campus Young Cattlemen’s Association. For fun he goes home to Lodi when he has a chance to look after his herd of 150 goats.

“Raising animals is very therapeutic for me,” Sawyer said. “I go home and work with my own herd, and that keeps me sane.”

Sawyer is graduating in June with a degree in animal science and management and hopes to come back to UC Davis in a year to earn a teaching credential and a master’s degree. His goal is to share his enthusiasm for agriculture first at the high school level and then at a community college.

In the meantime, a typical day for him now starts at the crack of dawn feeding sheep. Then

fellow undergrads from a sheep handling and husbandry lab come by to help out with weaning, weighing and sorting. On one recent day, he and the students were busy shepherding 150 lambs through a chute.

“It takes quite a bit of work, so having a small team to do it together is great,” Sawyer said. “And it gives the students a lot of hands-on experience they wouldn’t get anywhere else.”

The UC Davis Young Cattlemen’s Association has about 120 members who network with people on campus, in industry, and throughout the state. As president, Sawyer helps plan meetings and events, and coordinates with advisors, undergrads and grad students.

Back in Lodi, he keeps busy with his much sought-after registered Boer goats. There’s a huge demand for his goats because he manages for out-of-season breeding so the kids are born in the fall. This is perfect timing for the 4-H’ers, FFA members and agriculture teachers who are looking to raise their kid goats for showing at the following year’s county fairs.

With Sawyer’s background and enthusiasm, he’ll be a great teacher someday. “I have a lot to share,” he said. “And the things I’ve learned here at UC Davis are very valuable and would be fun to implement in a classroom setting.”

—John Stumbos

Jackson is one of many essential workers who help keep UC Davis running. See more about his work during the pandemic at caes.ucdavis.edu/news/jackson.

“The things I’ve learned here at UC Davis are very valuable and would be fun to implement in a classroom setting.”



THE WHOLE GANG—
The Bengard clan got together for a family photo in 2005. Together with their children are from left to right Tom and Louise Bengard, Paul and Tracy Pezzini, parents Tom and Terry Bengard, and Bardin and Pam Bengard.

Path of Salinas Valley's pioneering **BENGARD FAMILY** *leads through UC Davis*

PEOPLE LIKE TO ASK FIFTH-GENERATION Salinas Valley farmer and rancher Bardin Bengard whether he likes raising cattle or growing fruits and vegetables more.

"I love both of them," he said. "They're different, but not that much different. You still need to tend to them, and you've got to water and feed them. I've got the best of both worlds. I get to supply the vegetarians and people who aren't vegetarians. We have you covered."

The family business, Bengard Ranch Inc., spans thousands of acres in the Salinas Valley and ranchland throughout central and northern California. As president, he runs the operation with his business partners—brother Tom and sister Tracy Pezzini. Two of his four adult children also work for the company, one of the largest grower-shippers in the Salinas Valley.

Cultivating Aggie connections

Bengard arrived at UC Davis as a freshman

in the fall of 1979. He chose to become an Aggie because he knew of the university's outstanding reputation for agriculture and believed he would acquire the advanced business management skills he was seeking.

"I already knew how to drive a tractor," he said. "At Davis, I learned a lot more about abstract problem solving. I especially enjoyed some of my upper division classes like ag appraisal and farm management. The vegetable industry is not just about growing lettuce. It's about the principles of economics and learning how to put things together."

Bengard graduated from UC Davis in 1984 with a degree in agricultural and managerial economics. He isn't the only Aggie in the family either. He met his wife, Pamela, on campus, and his brother is an Aggie, too. His parents, Tom and Terry, met while attending UC Davis in the 1950s. And two nephews are attending UC Davis today.

A rich family history

The family traces its roots to the Midwest in the 1850s, when their great, great grandparents—the Eades and the Bardins—left for California in covered wagons. Their descendants have had a huge impact on farming and ranching in the Salinas Valley and throughout the state. Wes Eade was a legendary cattle trader honored in the National Cowboy Hall of Fame. James Bardin was a pioneer in the lettuce business who was also known in his day as the “Potato King.”

Bengard’s father and uncle, Bruce Sconberg, began farming sugar beets, small white beans and lettuce not long after they graduated from UC Davis in the early 1960s and returned to the Salinas Valley. In the 1970s, his dad started selling produce under their own Bengard family label. The livestock tradition also continues to thrive.

“Both my mother and father were really passionate about the cattle business,” Bengard said.

From a relatively small herd of 150 Hereford and Angus cows at the family’s home ranch near Salinas, it has since expanded to a herd of 2,500 superior quality Black Angus cows on more than a dozen ranches located from Salinas to Southern Oregon. In 1997, Bengard and his wife moved for a time with their four young children to one of the family’s Northern California ranches located in Cottonwood, near Red Bluff.

“We had cattle up there, did some dryland farming and grew walnuts and prunes,” he said. “Then my dad called and asked me to come back and help run the vegetable business.”

Investing in the future

The tradition of supporting UC Davis began with parents Tom and Terry and continues to this day. Bardin and Pamela Bengard are have been annual donors to the UC Davis Chancellor’s Club for many years. He also is a trustee on the UC Davis Foundation. The entire Bengard family is proud of their rich agricultural heritage, appreciative of the many ways UC Davis has touched their lives and wanted to make a statement about both.

So in 2018, they established the Bengard Family Scholarship in the College of Agricultural and Environmental Sciences to support juniors or seniors with scholarships in one of 10 agriculturally focused majors and who are also from one of 10 counties in which the family does business—Monterey, San Benito, Tehama, Shasta, Plumas, Imperial, Ventura, Fresno, Kern and Merced.

*“I’ve got the best of both worlds.
I get to supply the vegetarians and
people who aren’t vegetarians.
We have you covered.”*

“We’re trying to support the agricultural roots of Davis,” Bengard said. “We especially want to help undergrads who are going to make agriculture a career choice. We chose the counties where we have operations because we wanted to give back to those mainly rural areas, but they don’t have to be rural kids to have a career in agriculture. We’re just trying to give back to those communities.”

Investing in young people interested in agriculture just makes sense to Bengard. “The things that are going to help us in the future haven’t been developed yet, but a lot of the practical knowledge we will need is going to come from Davis,” he said.

—John Stumbos

AN AGGIE TRADITION—
Terry and Tom Bengard met while attending UC Davis in the 1950s. Their two sons, Bardin and Tom also graduated from UC Davis. Two members of the next generation are current Aggies—Michael Bengard, a sophomore studying international relations, and Wesley Pezzini, a first-year vet student who wants to specialize in large animals.





HECTOR AMEZCUA/UC Davis

LIKE FATHER, LIKE SON

Dan Sehnert (left) and his son, Caleb, both found their calling at the UC Davis Meat Lab. Get a behind the scenes look into the UC Davis Meat Lab at caes.ucdavis.edu/news/meatlab.

WHEN CALEB SEHNERT was growing up, he naturally was curious about what his dad did for work. So, on his way to summer camp, he'd park his bicycle at the UC Davis Meat Lab and go inside to visit with his father, Dan.

What he got was a first-hand look at how beef cattle, hogs, sheep and goats are harvested, processed and packaged. Dan was manager of the lab for 14 years starting in 1981. Caleb, now 37, landed the same job in 2008 and still holds it.

Ironically, neither one of them envisioned themselves teaching students and working with UC Davis faculty on animal science projects. Fresh out of Cal Poly Pomona, Dan had other ideas.

"I'm from Nebraska and wanted to get back home," he said. "I already turned down two job offers and then this one came up. I figured I'd

stay for a couple of years."

Nearly 40 years later, Dan is a well-known staffer on campus. He has been the facilities coordinator for the Department of Animal Science since 1993.

Caleb studied agronomy at UC Davis and wanted to build a career in range management, but a terrible automobile accident derailed his plans. He'd always been around livestock and spent time on his grandparents' cattle ranch in Southern California. After recovering from the accident, he took a job at the UC Davis Center for Equine Health. Then the meat lab job opened up.

"I knew the potential of the meat lab," Caleb said. "It was something I knew I could do at that time in my life, so I figured it was worth a shot—one of the best decisions I've ever made."



HECTOR AMEZCUA/UC Davis

The UC Davis Meat Lab is located in the Harold Cole Facility, named after a former animal husbandry professor. Built in 1969 with a grant from the National Institutes of Health, it is the only such facility in the University of California system.

Caleb loves teaching animal science students and coaching them on how to make their award-winning sausages, hams, chorizo, jerky and other meat products. Every year students enter a competition with the other California colleges with meat labs—both Cal Poly campuses, Chico State and Fresno State—at the California Association of Meat Processors annual convention. Sometimes they compete in the commercial division, as well. They've won overall, nine out of the last 11 years.

"They can put that award on their resume and it looks really good when they go out and find a job in industry," he said. "They've already created one of the best products in California!"

The meat lab is also where many animal science students get their first look at the anatomy of different livestock species—comparing, for instance, the more complicated digestive tract of ruminants like sheep or cattle with the simple stomach of a pig.

Over a two-week period, Caleb typically teaches more than 15 labs with 20 students each. All animal science undergrads planning to go to vet school someday must take the meat lab, and for some of them it's a little much to see how an animal is harvested.

"There's always a few students out in the hallway who are rethinking their major and their life plans," he said. "Then there are three or four

asking a ton of questions and getting hands-on experience stretching out the small intestine. They will become good veterinarians."

A USDA inspector is always on hand to make sure the proper protocols for humane slaughter and sanitation are followed, such as making sure all animals are unconscious before being harvested.

"You're not going to learn an animal inside and out better anywhere else," Dan noted. "If you've never seen an animal harvested before, this is the place to see it because these animals are healthy."

The animals are typically involved in university research projects. For instance, a number of nutrition trials in recent years have focused on feeding cattle garlic, orange peels, even seaweed to reduce the burping of methane gas. Sensory panels are routinely held to find out how those feed additives affect the taste and tenderness of the meat.

"We harvest only UC Davis-raised animals," Caleb said. "We know their breeds, diets, age, medication history and average daily gain."

Dan wasn't part of the hiring committee and doesn't supervise Caleb. He didn't even know his son applied for the job. But he is very proud of Caleb's work. "You don't know how many times I've been told he's doing a way better job than I did," he jokes.

"I never thought when I was a little kid that I'd wind up working here," Caleb said. "Now I can't imagine working anywhere else."

—John Stumbos

Animal science students in the Principles of Meat Science Lab learn from manager Caleb Sehnert how to break down a front quarter of beef in the UC Davis Meat Lab.

Cajun Style Tri-Tip Rub

The rub recipe came from a book that Dan Sehnert gave as a gift to his son, when Caleb first started at the Meat Lab.

- 1 Tbsp Cracked black pepper
- 2 tsp Paprika
- 2 tsp Garlic powder
- 2 tsp Salt
- 1 tsp Dried thyme
- 1 tsp Dried oregano
- 1 tsp Mustard powder
- ½ tsp Cayenne pepper

Watch Caleb demonstrate how to cook a tri-tip at caes.ucdavis.edu/news/tritip.



Forging ahead with new faculty

One of the principal reasons the College of Agricultural and Environmental Sciences remains atop university rankings is the quality of our faculty. We continue to grow and evolve as we bring in new expertise through an intensive recruiting process designed to meet clearly established goals in different subject areas. New faculty establish innovative research and teaching programs to advance the frontiers of knowledge through multidisciplinary partnerships. They also address issues of equity and diversity in their programs. This deliberative process is intended to provide the public with the best talent to address society's many challenges. This latest group of recruits includes professors and specialists in areas such as animal science, human ecology and plant pathology.

**Maria Chondronikola**

Assistant Professor
Nutrition

Studies a range of human-health issues related to diet and nutrition, such as the prevention and treatment of obesity and metabolic diseases

**Eric Chu**

Assistant Professor
Human Ecology

Explores how local governments and communities plan for and adapt to the impacts of global environmental change

**Julien Delarue**

Assistant Professor
Food Science and
Technology

Works on the use of real-life settings to measure sensory perceptions and preferences with application to food design

**Christine Diepenbrock**

Assistant Professor
Plant Sciences

Conducts research on nutritional quality and abiotic stress tolerance of staple and specialty crops, and helps to train researchers in improvement of food/nutritional security

**Mason Earles**

Assistant Professor
Viticulture and Enology
Biological and Agricultural
Engineering

Leads the Plant AI and Biophysics Lab work on agricultural sensing and automation systems for more precise and sustainable agricultural practices



New and early career faculty met with deans and senior staff in November 2019 for an official welcome to the college. Gatherings like this help build camaraderie and provide our new faculty with knowledge to help them become effective members of the UC Davis community.

JOHN STUMBOS/UC Davis



Allison Ehrlich
Assistant Professor
Environmental Toxicology

Studies potential links between diet, microbiome, chemical contaminants, drugs and other environmental factors associated with immune-mediated diseases such as diabetes



Glen Fox
Anheuser-Busch Endowed
Professor of Malting and
Brewing Science
**Food Science and
Technology**

Researches starch structure and beer quality, as well as the complex biochemical changes during malting and brewing and the final compositional profile of beer



Brittney Goodrich
Assistant Cooperative
Extension Specialist
**Agricultural and Resource
Economics**

Explores how farm operations address uncertainty in agricultural markets and production through diversification, crop insurance, customized contracts, new technologies or alternative farming practices



Timothy Hackmann
Assistant Professor
Animal Science

Looks at improving ruminant nutrition through the study of microbes in the rumen, increasing microbial protein for digestion and discovering biochemical pathways microbes use in carbohydrate fermentation



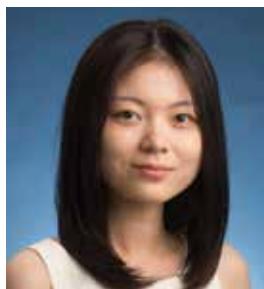
Jamie Hansen-Lewis
Assistant Professor
**Agricultural and
Resource Economics**

Combines tools from economics and the natural sciences to better understand the human health and economic implications of air pollution

(continues on page 24)

**Maciel Hernández**Assistant Professor
Human Ecology

Investigates the dynamic roles of context and culture in children's socioemotional and academic development to inform interventions that promote the well-being of children and families

**Meng Huo**Assistant Professor
Human Ecology

Studies how and why older adults help other people and how these helping behaviors may contribute to resilience and promote successful aging

**Cristina Lazcano**Assistant Professor
Land, Air and Water Resources

Works at finding connections between soil biota, soil health, environmental quality and human nutrition

**Tiffany Lowe-Power**Assistant Professor
Plant Pathology

Studies interactions between host plants and certain plant pathogens with a focus on molecular microbial ecology and host physiology

**Troy Magney**Assistant Professor
Plant Sciences

Develops instruments and methods for mapping vegetation structure and function at the leaf, tower, airborne and satellite scales to better understand plant systems

**Giulia Marino**Cooperative Extension Specialist
Plant Sciences

Studies tree physiology and its application to enhance the productivity, sustainability, and competitiveness of fruit orchard production systems in a changing global scenario

**Emily Meineke**Assistant Professor
Entomology and Nematology

Uses museum specimens and large-scale experiments to determine how insects respond to environmental change, with a focus on insects that eat and otherwise damage plants

**Grey Monroe**Assistant Professor
Plant Sciences

Connects genomes, traits and environments to discover the causes and consequences of climate adaptation in plants

**Kiva Oken**Assistant Professor
Wildlife, Fish and Conservation Biology

Uses cutting edge mathematical models and statistical tools to study the ecology, conservation and management of marine fisheries

**Cameron Pittelkow**Assistant Professor
Plant Sciences

Conducts integrated assessments of agroecosystem performance to balance food production and environmental sustainability

**Emily Schlickman**Assistant Professor
Landscape Architecture and Environmental Design

Focuses on technology, digital representation, urban futures and climate change adaptation to investigate climate-related vulnerabilities and opportunities

**Shahid Siddique**Assistant Professor
Entomology and Nematology

Conducts basic and applied research on parasitic nematodes and host plants with the goal of reducing the impact of nematodes on California crops

**Leigh Ann Simmons**Professor and Chair
Human Ecology

Brings expertise and leadership in interdisciplinary social sciences, conducts research on health disparities in medically underserved populations and works to improve health among childbearing women

**Justine Smith**Assistant Professor
Wildlife, Fish and Conservation Biology

Explores how best to preserve the ecological roles of carnivores and herbivores in shared landscapes by investigating human-wildlife interactions and risk effects in both predator and prey

**Payam Vahmani**Assistant Professor
Animal Science

Develops strategies to enhance the nutritional and health value of animal-sourced foods (meat, milk, poultry, fish and eggs), while promoting animal health and sustainable production

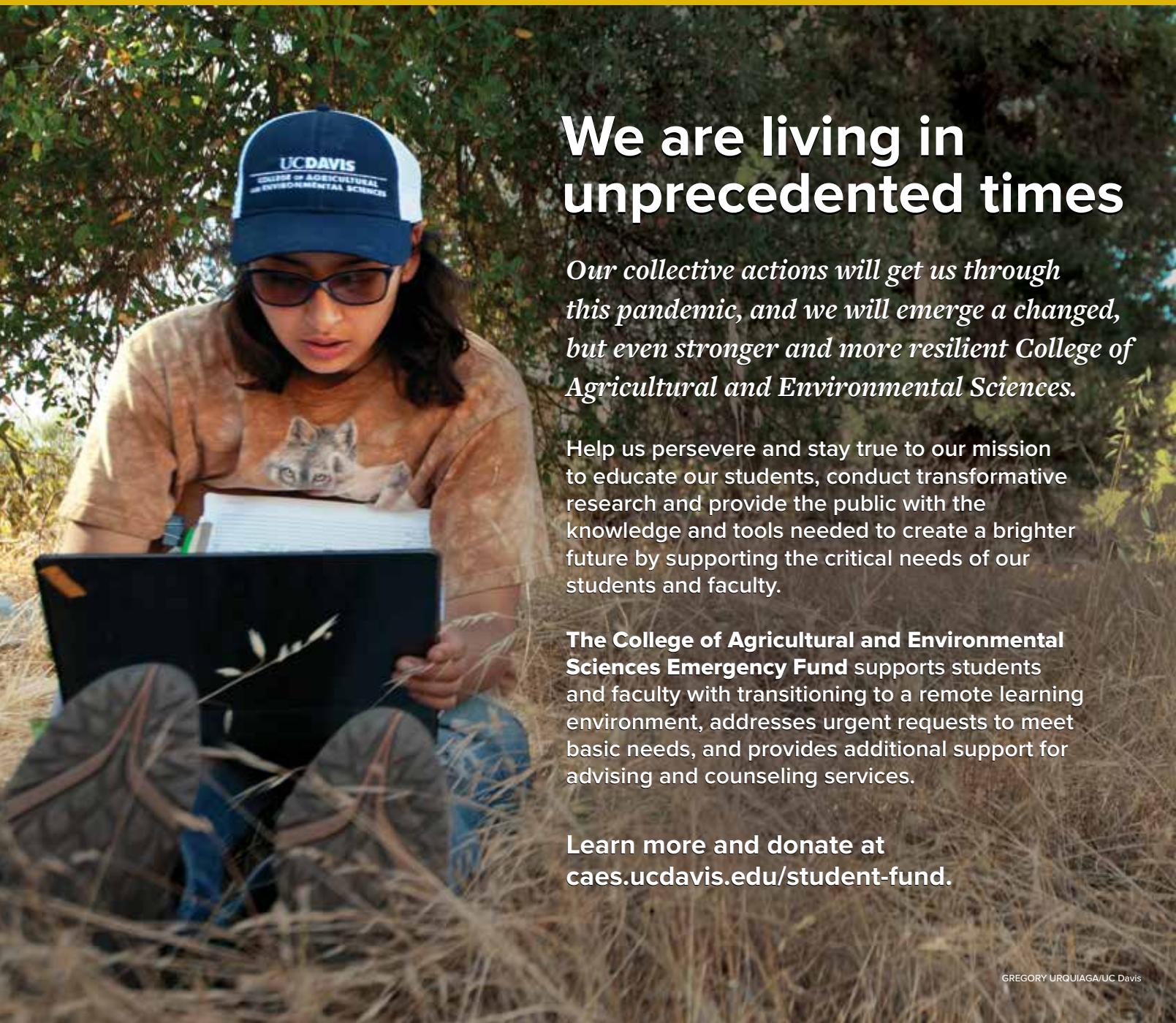


HECTOR AMEZCUA/UC Davis

Welcoming tomorrow's leaders

The future of agriculture is in good hands, judging from the pluck and preparedness of the nearly 4,000 FFA and 4-H students who gathered at UC Davis in March for the 44th annual College of Agricultural and Environmental Sciences Field Day. The two-day event happened prior to California's mandate to limit crowd size and stay home in order to reduce the spread of COVID-19. Field Day 2020 featured contests in 25 areas including floriculture, pictured here, along with livestock, milk quality, computer applications, public speaking and much more. Hundreds of CA&ES faculty, students, staff and local community members volunteered to make the event a success.

University of California, Davis
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#986H



We are living in unprecedented times

Our collective actions will get us through this pandemic, and we will emerge a changed, but even stronger and more resilient College of Agricultural and Environmental Sciences.

Help us persevere and stay true to our mission to educate our students, conduct transformative research and provide the public with the knowledge and tools needed to create a brighter future by supporting the critical needs of our students and faculty.

The College of Agricultural and Environmental Sciences Emergency Fund supports students and faculty with transitioning to a remote learning environment, addresses urgent requests to meet basic needs, and provides additional support for advising and counseling services.

Learn more and donate at
caes.ucdavis.edu/student-fund.