RESEARCH

Highlights from the Storrs Agricultural Experiment Station

2021

UCONN | COLLEGE OF AGRICULTURE, HEALTH AND NATURAL RESOURCES

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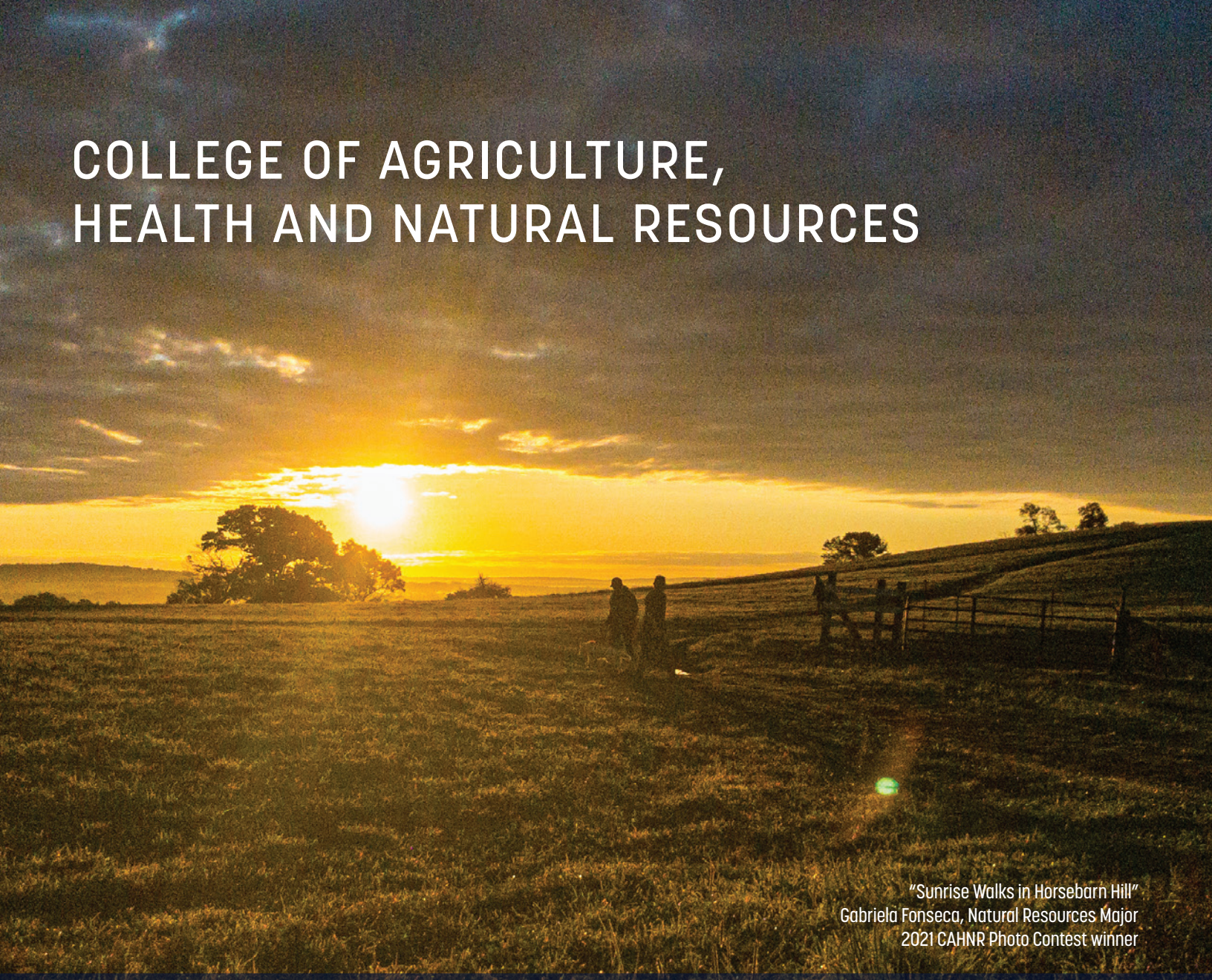


"Sunrise Walks in Horsebarn Hill"
Gabriela Fonseca, Natural Resources Major
2021 CAHNR Photo Contest winner

VISION

The College of Agriculture, Health and Natural Resources will provide for a global sustainable future through scientific discovery, innovation, and community engagement. Our accomplishments will result in safe, sustainable, and secure plant and animal production systems; healthier individuals and communities; greater protection and conservation of our environment and natural resources; balanced growth of the economy; and resilient local and global communities.

MISSION

Our research mission is to develop knowledge and disseminate it through the three academic functions of teaching, research, and outreach education. This mission is based on historic federal legislation that led to the modern day land-grant university, including the Morrill, Hatch, Smith-Lever, McIntire-Stennis, and Animal Health acts, and enabling state statutes.

MESSAGE FROM THE DEAN

Over the last two years, communities across our state have faced challenges of all kinds. Economic strife, physical illness, constant disruptions, and agonizing uncertainty of when life would return to normal. While the COVID-19 pandemic still affects how, when, and with whom we interact, the research enterprise at the College of Agriculture, Health and Natural Resources (CAHNR) never stopped innovating.

Indrajeet Chaubey, PhD

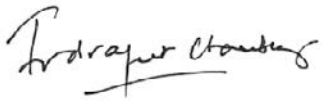
Dean and Director

College of Agriculture, Health and Natural Resources

Crossing boundaries between research, transformational education, and extension outreach, CAHNR faculty continue to push the limits of scientific discovery for the benefit of our state, nation, and global communities. As a land grant institution, generating knowledge that positively impacts the world is in our roots, it is what drives all that we do. While our dedication to supporting the residents of Connecticut hasn't changed since our founding in 1881 as the Storrs Agricultural College, our diverse community never stops evolving to tackle challenges faced by modern society. CAHNR faculty have built on that original foundation of discovery to improve quality of life today for a sustainable global future tomorrow.

With this report, we highlight some of the ways that CAHNR research has helped members of our state, industry, and governments to address unprecedented challenges in health and the natural world.

Thank you for taking the time to learn how we've served our state. We are honored and ready to do it again and again, for many years to come.



CAHNR RESEARCH

Improving Quality of Life For a Sustainable Future

The Office of Research and Graduate Education is responsible for facilitating CAHNR's research environment, which is supported by capacity and competitive funds. Capacity research funding is provided through the federal-state partnership managed by the Storrs Agricultural Experiment Station (SAES). Competitive funds are obtained from a variety of federal and non-federal sources through the independent initiative of CAHNR's faculty and staff. We encourage fundamental research to gain knowledge in relevant fields, and multidisciplinary collaborations between institutions, agencies, and fields of study to advance national goals established by the United States Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA).

We also invest in innovative applied research that leads to workforce development, technology commercialization, and economic growth. The faculty and staff who conduct cutting-edge research and actively seek external funding all contribute to the discovery of new knowledge and its communication to the broader population of the state, region, and nation. An essential component of the CAHNR research mission is to provide opportunities for graduate student and postdoctoral training, ensuring that the next generation of scientists, entrepreneurs, and leaders is prepared to address emerging challenges, no matter how complex they may be.

THE STORRS AGRICULTURAL EXPERIMENT STATION (SAES)

The Storrs Agricultural Experiment Station (SAES) receives capacity funding from the U.S. Department of Agriculture (USDA) each year and a 1:1 state match is provided through the University's block grant from the state legislature. For FY 2021, total funding in the amount of $4.2 million was received to support independent investigator and multi-state research in the broad fields of agricultural science, environmental science, forestry, and human and animal health. The block grant state match supports faculty, and staff who were engaged in over 74 USDA-approved competitively funded research projects.

The investment provided by the federal-state SAES partnership is leveraged considerably by the creative and scholarly efforts of CAHNR's faculty and staff. This is done primarily through the pursuit of competitive extramural funding in the form of single- or multi-year grant awards.

In FY 2021, CAHNR researchers applied for a total of approximately $118 million in extramural grant funding. Proposals were submitted to a variety of federal and non-federal sources. Federal agencies accounted for approximately 95% of grant submissions. The majority of these were targeted to National Institutes of Health (NIH), National Science Foundation (NSF), and USDA (Table 1). In FY 2021, $31.7 million in extramural grant funding was secured by CAHNR researchers. Federal agencies accounted for the majority of this funding, with a total of $26 million (Table 2).

Non federal funds for were also received for research, (Figure 1). The Korey Stringer Institute in the Department of Kinesiology was awarded 3 million from the NFL Foundation to increase athletic training services in secondary schools. Eversource awarded $597,000 to Professors in the Department of Natural Resources and the Environment to study activities to mitigate storm damage.

261 new extramural grants

31.7 million in extramural funding

4.2 million in USDA capacity funding

74 USDA capacity research projects

2021 By the Numbers

Federal Proposals & Funding by Agencies

Table 1. Proposals to Federal Agencies (includes capacity funding)

Agency	Request	%
Department of Commerce (DOC)	2,997,758.00	2.65
Department of Defense (DOD)	4,698,844.00	4.16
Department of Energy (DOE)	2,112,049.00	1.87
National Aeronautics and Space Agency (NASA)	319,552.00	0.28
National Institutes of Health (NIH)	53,678,346.00	47.50
National Science Foundation (NSF)	12,261,334.00	10.85
U.S. Department of Agriculture (USDA)	23,893,223.00	21.15
Other federal agencies	13,034,184.00	11.54
Total	**$112,995,290.00**	**100%**

Table 2. Grants Awarded by Federal Agencies (includes capacity funding)

Agency	Award	%
Department of Commerce (DOC)	1,305,273.00	5.02
Department of Defense (DOD)	398,859.00	1.53
National Institutes of Health (NIH)	8,840,698.00	33.99
US Department of Agriculture (USDA)	11,255,180.00	43.27
Other federal agencies	4,211,366.00	16.19
Total	**$26,011,376.00**	**100%**

95
faculty and staff supported on the state Block Grant

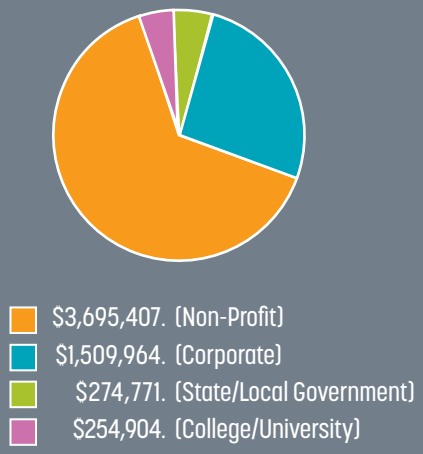
65
graduate students supported on USDA capacity funds

1,580
publications and scholarly activity by CAHNR faculty including, but not limited to, peer-reviewed journal articles, books, patents, technical reports and manuals

Non-Federal Funding by Organization

Source: Office of Vice President for Research

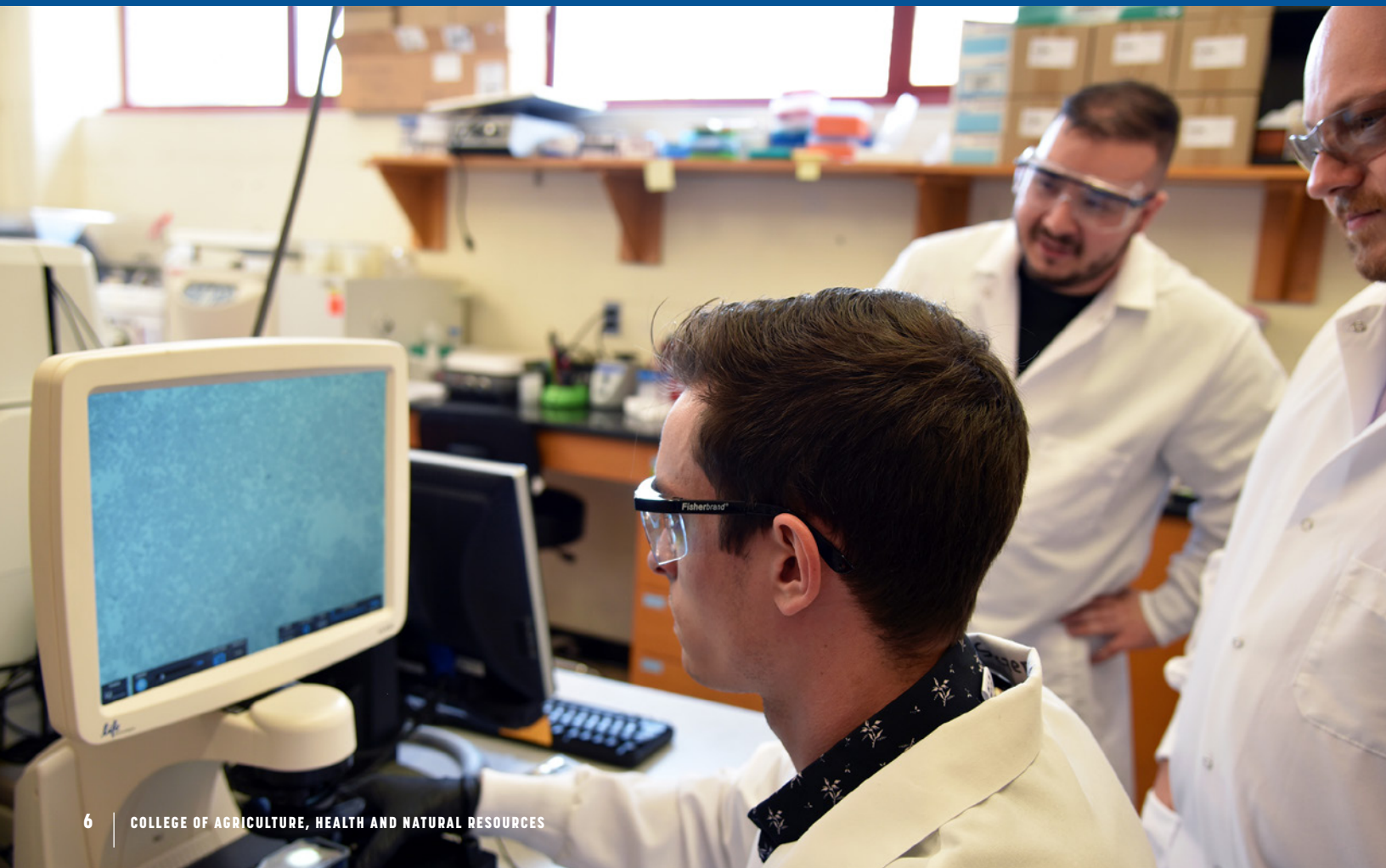
Figure 1



SCHOLARLY PRODUCTIVITY

Successfully applying for external funding is just one step in a long process towards creating new knowledge, scientific discoveries, and new technologies. Research activity is also gauged by the products of scientists' work—peer-reviewed articles published, patents filed and secured, and undergraduate, graduate, and postdoctoral scientists trained. Scholarly activity from CAHNR faculty in FY 2021 underscores the impact our research has in all of these metrics and more.

Scholarly Product/Indicator	Total
Peer-reviewed journal articles	321
Books authored	3
Book chapters	12
Published conference proceedings	226
Technical reports and manuals	43
Patents	7
Editorships of major journals	21
Associate editorships/editorial board memberships	179
Member of federal peer review committees	30
Member of other national/international peer review committees	82
Member of state or regional peer review committees	32
Ad hoc reviews for granting agencies	624



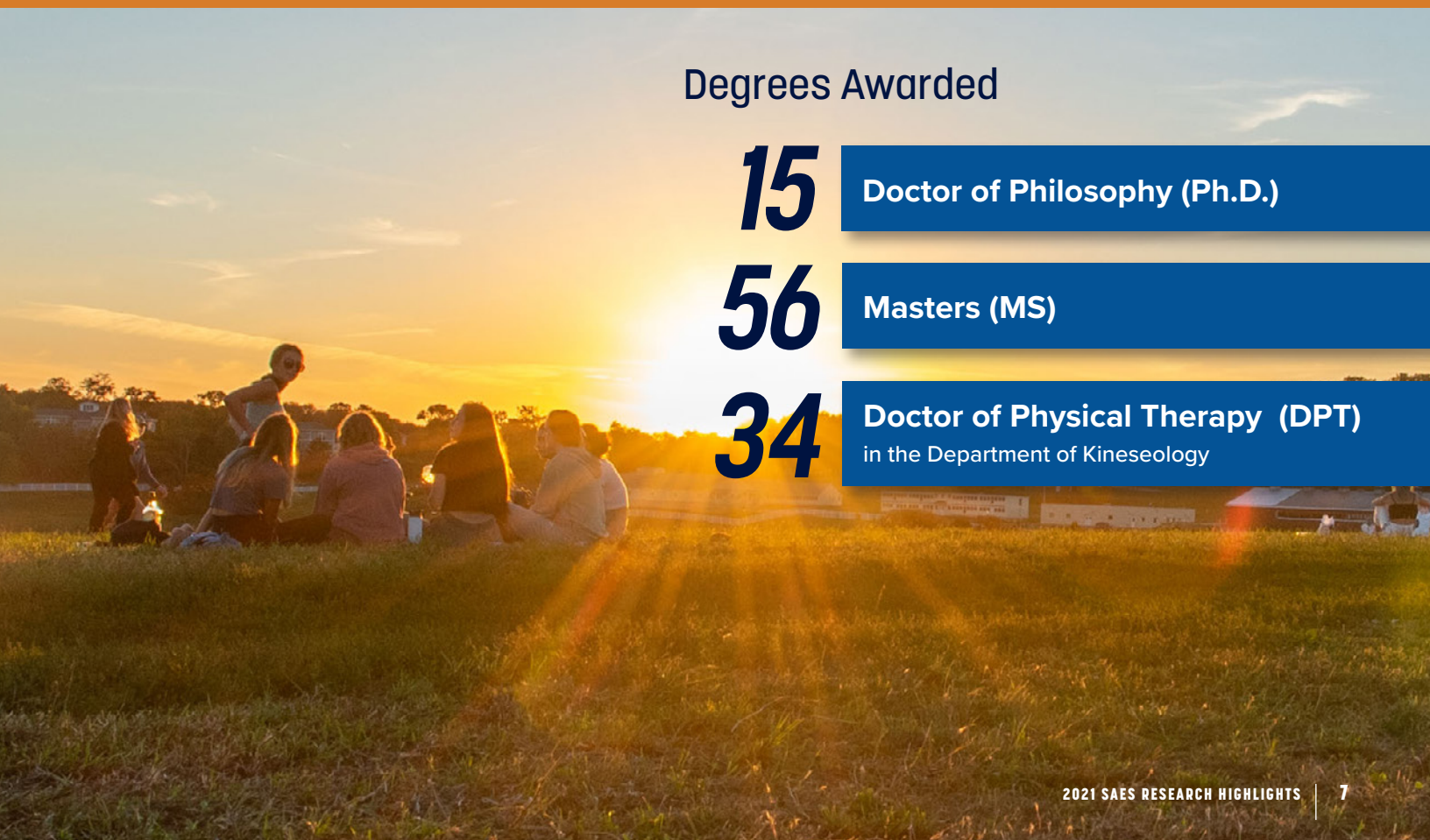
PREPARING FUTURE LEADERS

in Agriculture, Health and Environmental Sciences with Life-Transforming Education

For our state and nation to remain competitive in the global marketplace, we must prepare future leaders to rise to the challenge. An essential element of the CAHNR research mission is providing life-transforming education to aspiring scientists in diverse fields to tackle the challenges we face now and the ones that have yet to emerge.

"CAHNR helped me launch my research career. Through several university programs, I fell in love with nutritional science because it showed me what research was all about."

Chelsea Garcia, Graduate Research Assistant, UConn Department of Nutritional Sciences



Degrees Awarded

15 Doctor of Philosophy (Ph.D.)

56 Masters (MS)

34 Doctor of Physical Therapy (DPT) in the Department of Kineseology

"I stepped onto a launchpad when I began my graduate research in CAHNR. I attribute my current career success to my graduate education in plant sciences at the University of Connecticut." Peter Apicella (CAHNR) '18, '22

Graduate Students Enrolled **460**

GRADUATE STUDENT EXPERIENCE

CAHNR is not only the foundation of the University of Connecticut, we are a driving force in UConn's future. With our diversity of disciplines and areas of expertise, we serve as a hub of innovation that will support the economic development and innovation for the state of Connecticut. In 2020, we set out to develop a strategic vision that would enable us to launch new careers, discover new technologies, and improve quality of life for all residents in our state. We identified five areas of need in which CAHNR faculty and graduate students have particular strength:

> *Ensuring a vibrant and sustainable agricultural industry and food supply*
>
> *Enhancing health and well-being locally, national, and globally*
>
> *Promoting diversity, equity, and inclusion through anti-racist approaches*
>
> *Advancing adaptation and resilience in a changing climate*
>
> *Fostering sustainable landscapes across urban-rural interfaces*

Our 2021 PhD graduates contributed to these efforts, with dissertation topics aligned with four of the five strategic vision areas.

Ph.D. Degrees Conferred in 2021

Ensuring a Vibrant and Sustainable Agricultural Industry and Food Supply

Student	Department
Joanna Noelia Kamiche Zegarra	ARE
Chang Huang	ANSC

Enhancing Health and Well-Being Locally, Nationally, and Globally

Student	Department
Alicia Veronica Barriga	ARE
Mahdi Fallahi	ARE
Siqi Hu	NUSC
Shane J. Sacco	AHS
Hyunju Kang	NUSC
Poonam Gopika Vinayamohan	ANSC
Yoojin Lee	NUSC

Advancing Adaptation and Resilience in a Changing Climate

Student	Department
Tao Wu	PSLA
Mouhamadou Fallilou Ndiaye	ARE

Fostering Sustainable Landscapes Across Urban-Rural Interfaces

Student	Department
Qian Lei	NRE
Yayu Li	PSLA
Yin Ma	ARE
Kersey Lawrence	NRE

** ANSC (Animal Science), ARE (Agriculture and Resource Economics), AHS (Allied Health Sciences), NRE (Natural Resources and the Environment), NUSC (Nutritional Sciences), PSLA (Plant Science and Landscape Architecture)*

RESEARCH FEATURES

The research enterprise of any entity is only as good as its scientists.

At CAHNR, we recognize that our most valuable asset can't be measured with numbers and graphs. We are enriched through the strength of our community of scientists and the populations we serve. The following stories highlight the people, discoveries, and innovations that help the College of Agriculture, Health and Natural Resources improve quality of life for a sustainable future.

CONTENTS

Increasing Knowledge to Inform Dietary Strategies for Diseases

Ji-Young **Lee**

Department Head and Professor, Nutritional Sciences

Ji-Young Lee is the head of the Department of Nutritional Sciences. Her research program focuses on identifying molecular mediators involved in lipid metabolism and inflammatory signaling pathways. She also works on questions related to how molecular mechanisms that control how dietary factors, such as incorporating foods and nutrients such as blue-green algae, berries, phospholipids, and astaxanthin, regulate the integration of energy metabolism, inflammation, and fibrosis by modulating histone deacetylase 4 (HDAC4) and HDAC9. Lee received her Ph.D. in nutrition from the University of Nebraska. She is a fellow of the American Heart Association and the American College of Nutrition.

Lee also leads the Metabolic Phenotyping Facility which combines state-of-the-art technology with the expertise of faculty in the UConn Department of Nutritional Sciences to provide researchers across the University with valuable information about the metabolic implications of their work.

Lee and her colleague, assistant research professor Young-Ki Park, published a study in the *Journal of Nutritional Biochemistry* reporting significant findings supporting the nutritional benefits of Connecticut-grown sugar kelp. They found brown sugar kelp (*Saccharina latissima*) inhibits hepatic inflammation and fibrosis in a mouse model of diet-induced non-alcoholic steatohepatitis, a fatty liver disease.

They studied the differences between three groups of mouse models. They placed two on high-fat diets but incorporated sugar kelp, a kind of seaweed, into the diet of one. The third group was on a low-fat diet as a healthy control. The group that ate sugar kelp had lower body weight and less adipose tissue inflammation—a key factor in a host of obesity-related diseases—than the other high-fat group.

Consuming sugar kelp also helped prevent the development of steatosis, the accumulation of fat in the liver. Nonalcoholic steatohepatitis (NASH) is a condition often associated with obesity that can cause inflammation and reduced functionality in the liver.

The mice on the sugar kelp diet also had healthier gut microbiomes. The microbiome is a collection of bacteria and other microorganisms in and on our bodies. The diversity and composition of the microbiome are key to maintaining a host of health functions.

"I wasn't surprised to see the data, as we know seaweeds are healthy," Lee says. "But it's still pretty amazing data as this is the first scientific evidence for health benefits of the Connecticut-grown sugar kelp."

This study is the first time researchers have looked at the link between the U.S.-grown sugar kelp and obesity.

Park and Lee saw an opportunity to conduct research on the nutritional science of seaweed, a growing agricultural industry in the United States. They hoped that, by gathering concrete data on the health benefits of sugar kelp, it could encourage people to consume seaweed.

"Consumers these days are getting smarter and smarter," Lee says. "The nutritional aspect is really important for the growth of the seaweed industry in Connecticut."

The researchers specifically used Connecticut-grown sugar kelp, as Connecticut regulates the safety of

Findings from Ji-Young Lee (standing) and her team will help highlight health benefits of Connecticut-grown sea kelp, strengthening the growing seaweed industry in the state.

seaweeds. This is important for monitoring heavy metals that seaweed may absorb from the water.

Most of the seaweed consumed in the U.S. is imported. Lee and Park hope more research on the benefits of locally grown seaweed will prompt consumers to support the industry stateside.

After completing this pre-clinical study, the researchers now hope to move into clinical studies to investigate the benefits sugar kelp may have for other health concerns. They also want to work on reaching out to people to teach them how to incorporate sugar kelp into their diets.

This work represents a fruitful collaboration between researchers, farmers, and the state. In collaboration with Anoushka Concepcion, an extension educator with the Connecticut Sea Grant and UConn Extension Program, Lee and Park hope to build stronger partnerships with seaweed growers in Connecticut.

This work was supported by funding from the USDA Hatch Program and Park received another USDA grant to further assess how sugar kelp grown in Connecticut promotes health.

Assistant Research Professor, Young-Ki Park displays sugar kelp.

Lee is currently working on other projects funded by USDA. One project is focused on how the chemical compound astaxanthin, often found in foods like salmon, may be able to effectively prevent and treat alcoholic liver disease.

She is also working on a project assessing how blackcurrant berries interact with our cells to produce health benefits. Blackcurrant is a berry with one of the highest polyphenol contents which has been linked to a variety of health benefits. In a previous study, Lee found that, in mice, blackcurrant can help prevent adipose inflammation and hyperglycemia, and decreases inflammation in diet-induced obesity.

Lee is now working to determine if blackcurrant enhances mitochondrial biogenesis, or when cells increase their number of mitochondria, and energy utilization in skeletal muscle. These processes launch a cascade of responses that can prevent obesity-induced inflammation and insulin resistance. ●

Reducing Health Inequity Through Sustainable Food Policy

Kristen **Cooksey Stowers**

Assistant Professor, Allied Health Sciences

Kristen Cooksey Stowers is an assistant professor in the Department of Allied Health Sciences. She works in the Rudd Center for Food Policy and Obesity. Cooksey Stowers' interdisciplinary research program focuses on reducing inequities in diet-related health outcomes by improving food environments through sustainable policy solutions. Cooksey Stowers' research looks at how factors like food swamps, zoning policies, and food pantries impact diet-related health outcomes across racial, geographic, and socioeconomic groups.

Cooksey Stowers published her findings related to how unhealthy food donations and social stigma contribute to food insecurity and obesity for food pantry clients.

According to the United States Department of Agriculture, 11% of American households experience food insecurity, a proportion that increased to 44% due to the COVID-19 pandemic. Those who are food insecure are also at an increased risk of being overweight or obese due to a lack of affordable, healthy food options.

Research has shown that long-term food pantry users and Latinx and Black clients have a significantly greater risk of being burdened by both food insecurity and obesity compared to short-term users and white users. These disparities also mean these populations are at a greater risk of diet-related health outcomes like type 2 diabetes or heart disease.

Cooksey Stowers conducted in-depth interviews with 10 key stakeholders who are familiar with the food banking system in a professional capacity, including food bank directors, food bank board members, advocates, and elected officials.

Cooksey Stowers' findings, published in *PLOS One*, reveal a strong consensus among those interviewed that structural and social characteristics of the food banking system play a role in health inequities.

"This is a health equity issue that needs to be not only understood, but also addressed," Cooksey Stowers says. "The COVID-19 crisis' role in increased levels of food insecurity and additional health risks for individuals with obesity and other preexisting conditions warrants this issue being addressed with urgency and intentionality."

Structural barriers, or organizational factors, include things like food banks' fear of losing corporate donors. These donors contribute large quantities of food and beverages, but these products are often unhealthy. There is often a gap between the nutritional profile of the foods available and clients' needs. This is an especially significant issue for

clients with obesity, diabetes, and other diet-related health challenges.

Food banks in urban areas also often lack access to farmers and fresh produce.

Social barriers identified by Cooksey Stowers include negative stereotypes about hunger and food insecurity in the media. These stereotypes misrepresent the preferences and needs of food pantry clients.

There is often a disconnect between food donors and recipients. This can cause fears of racism and discrimination, particularly among immigrant communities.

Food pantry clients also often have limited access to information about healthy eating and how to navigate the food banking system.

Given this information, Cooksey Stowers recommended several policy initiatives to address these issues. Initiatives such as prohibiting donations of unhealthy foods and instituting equitable hiring processes and trainings will help ensure the food bank system provides healthy and demographically responsive food options for clients.

The study was funded by a grant from the Robert Wood Johnson Foundation.

Predicting and Improving Animal Health and Performance

Breno **Fragomeni**

Assistant Professor, Animal Science

Breno Fragomeni joined UConn as an assistant professor in 2018 after earning his Ph.D. and completing postdoctoral training at the University of Georgia. Fragomeni uses modern genetic techniques to predict and improve animal health and performance by looking at areas including disease resistance, heat stress robustness, and resilience.

"My current research is focused on animal genomics to improve selection and breeding decisions," Fragomeni says. "Our goal is to find the right animals to improve the herd and be able to predict performance while the animals are very young."

Fragomeni is currently working on a three-year, multi-state project funded by the USDA designed to identify dairy bull performance by region. He is comparing bulls in New England and California, two areas with dramatically different weather patterns.

"We calculate breeding values based on particular traits of the bull by examining genotype by environmental interaction," he explains. "The best bull for New England dairy cows may not be the same as for California cows."

The study will examine milk production, fat and protein content, as well as lactation curves and weather. Weather can affect milk production as dairy cows are stressed by high temperatures. Looking at these measures in dairy cows will tell Fragomeni important information about the bull that sired the cow by using tens of thousands of genetic markers.

"We use information on females to learn about the bull and examine bull phenotypes, pedigree, and genomic markers," Fragomeni says. "We are interested in the sire of the cow. We have breeding values for evaluated traits to compare each bull to the national average."

With the knowledge gained through this study, Fragomeni and his team hope to someday be able to assemble an online database that allows farmers to identify the best bulls for herds in their region.

This project will benefit farmers and breeders by allowing them to select bulls that are better suited for their region's specific environmental conditions. This work will also increase understanding of the genetic underpinnings of environmental adaptation and help stakeholders prepare for shifts caused by climate change.

"I think it is important to note that we can actually breed animals for selected purposes without any pharmaceutical intervention, using naturally existing genetic variation within a population."

"I work with all livestock species. We can use the genetics to shape the animals for food, service, and health. In production animals, if we can increase

Breno Fragomeni's work on animal genetics has the potential to improve health and performance in livestock species as well as service animals.

the quality and quantity of food while using fewer resources, that can create a lasting impact on the environment."

In another project, currently in the initial stages, Fragomeni is collaborating with the International Working Dog Registry (IWDR) to examine genetic information for Labrador retrievers being raised to become service dogs for the organization Guiding Eyes for the Blind.

The IWDR trains people to collect phenotype information, or observable characteristics, and has collected data on 20,000 Labradors from several different countries.

"The IWDR tests and ranks animals in very specific scenarios where a dog might be affected by external stimulation," Fragomeni explains. "They have more than fifty phenotype characteristics for behavior."

Fragomeni is currently examining data to determine genotypes. He searches for animals that do not have any of the most common health issues, such as hip and elbow dysplasia and skin problems. But the most important part of this project is finding behavioral traits that are essential for working dogs.

"Behavior is very important for becoming a good working dog, and a group often spends quite a lot of time and resources training a dog that never graduates," Fragomeni says. "Our idea is to not only improve the herd overall but identify puppies that have a higher chance of becoming a guide dog in the end." •

Helping Coastal Connecticut Communities Develop Resilience

Juliana **Barrett** *Coastal Habitats Extension Educator*

Juliana Barrett is an extension educator and coastal ecologist whose work focuses on conserving, restoring, and enhancing coastal habitats in Connecticut. She also works with communities throughout the state to help them develop and implement climate adaptation strategies. She works with the towns and groups working on the conservation, restoration and enhancement of coastal areas. Barrett is developing programs to assist coastal community leaders with technical matters related to the impact of land use on coastal habitats, riparian buffers, habitat management, and restoration of coastal habitats. Barrett holds a Ph.D. from the UConn Department of Ecology and Evolutionary Biology, an M.A. from the Department of Earth and Planetary Science at Johns Hopkins University, and a bachelor's degree in biology from Smith College.

In a recent project, Barrett led a group of researchers to develop an innovative a strategy for coastal forest management at the Hoffman Evergreen Preserve in Stonington, Connecticut, which falls within the coastal boundary of Long Island Sound.

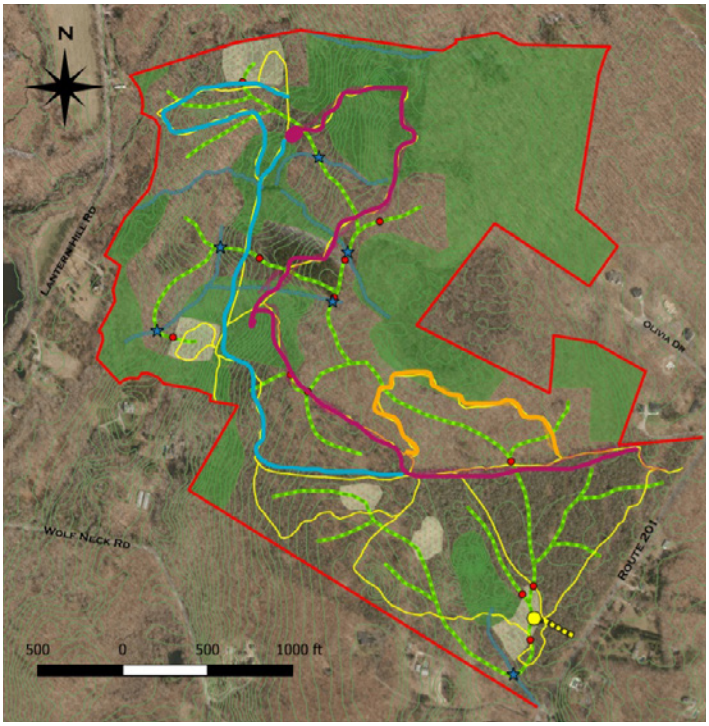
"Climate change is challenging so many aspects of our lives," Barrett says. "Working with Avalonia Land Conservancy on the Hoffman Evergreen Preserve is an opportunity to look forward and plan for healthy coastal forests for generations to come."

Coastal forests are unique ecological communities. They provide habitat to wildlife, reduce flooding, and trap carbon, preventing it from entering the atmosphere. Unfortunately, as the planet warms, sea levels are rising, periods of drought may increase, and coastal storms may become more frequent and intense. This is making these forests more susceptible to storm damage, seriously endangering them.

Robert (Bob) Ricard, a senior extension educator with the Department of Extension and Department of Natural Resources and the Environment, is also working on this grant. The researchers are collaborating with Beth Sullivan and Sharon Lynch from Avalonia Land Conservancy. Two UConn students, Griffin Licari and Chris Arrotti, did background research related to this work as part of independent projects for the Climate Corps course.

The 198-acre preserve in Stonington is in danger of facing more severe impacts of storms and other climate changes such as warmer air temperatures and altered precipitation patterns, soil conditions, and growing seasons. All of these factors could seriously upset the important balance at work in these forests.

This project will develop a multifaceted program to make forests in southeastern Connecticut more resilient to the looming threats of climate change



(Image, left) Hoffman harvest map and skid trails and walls. (Images, right) Juliana Barrett is working with towns, conservation organizations, and volunteers to support coastal forest management in the southern part of the state.

guided by the U.S. Forest Service Forest Ecosystem Vulnerability Assessment and Synthesis for the Mid-Atlantic and New England.

The researchers will identify native plant species capable of surviving and reproducing in shifting environmental conditions. This will then guide forest management and planting efforts.

The project will then put this plan into practice. The team will work to control invasive plant species, and volunteers will restore a portion of the forest by planting native trees and shrubs along with supplemental seeding. The researchers will continually monitor the success of this work.

The group will hold a lecture series and workshop based on this work for municipal officials, land trusts, natural resource managers, and members of the public to provide guiding principles for forest resilience management. Barrett's team will collaborate with Maria Janowiak, deputy director of the Northern Institute of Applied Climate Science, U.S. Forest Service, to develop this workshop.

Finally, the group will develop a "lessons learned" report for resource managers synthesizing the successes and key takeaways.

While this project focuses specifically on Avalonia's Hoffman Evergreen Preserve, the tactics employed will serve as a model for developing coastal forest resiliency in other areas around the Long Island Sound watershed.

This work was funded through a grant from the Long Island Sound Futures Fund (LISFF) and matching funds are provided by volunteers.

Exploring Local Food, Supports New Program for Native Students

Cristina **Connolly**

Assistant Professor, Agricultural & Resource Economics

Cristina Connolly is an assistant professor in the Department of Agricultural and Resource Economics. Her research focuses on local food, consumer behavior, and spatial econometrics. She holds a Ph.D. in agricultural, environmental, and development economics from the Ohio State University. She also earned an M.A. in economics and an M.S. in agricultural, environmental, and development economics from the Ohio State University and a B.A. in economics with a Spanish minor from Middlebury College. Connolly joined UConn faculty in August 2020. Since then, she has been working with local stakeholders and food producers in the Connecticut area. Connolly's research is interested in addressing questions related to farm location, consumer choice, and food access.

"My research focuses on local foods and direct marketing, which fits in really well with the agricultural landscape of Connecticut and New England in general," Connolly says. "These types of questions are being addressed by others using different frameworks, methods, and perspectives, allowing for interdisciplinary collaboration that leads to better research. One of the most rewarding aspects of working in an academic environment is being surrounded by so many smart and inquisitive people."

Connolly is dedicated to providing her students with hands-on research opportunities that allow them to work in the community.

"My favorite work involves stakeholders," Connolly says. "I love when I get to go out and speak with farmers and local community members. Another aspect that I really enjoy is having an opportunity to interact with so many smart and motivated colleagues and students. Every day I learn something new, and the work is never stagnant or boring."

Connolly is now leading an initiative to support the agricultural education of Native students through integrated financial, cultural, and academic programs.

Through a grant from the United States Department of Agriculture, the program, titled "New Beginning for Students of the Tribes of Southern New England: Enhancing the 1862 Land Grant Opportunities in the New England Region," will provide full scholarships for an initial cohort of three students starting in Fall 2022 and a four-person cohort starting in Fall 2023. Students will be recruited from Tribes across Southern New England.

The students will enter a two-year program in the Ratcliffe Hicks School of Agriculture. Ratcliffe Hicks offers associates degrees as well as other certifications in agricultural fields. Students in the program will gain the technical skills necessary to work in careers in agriculture and/or continue their education to earn a four-year degree.

Historically, Native Tribes serve as stewards of the land on which they resided. This relationship has been disrupted by centuries of detrimental U.S. policies that have displaced Native and Indigenous peoples from their lands, including those that helped found land grant universities like the University of Connecticut.

Native and Indigenous students make up the lowest proportion of any racial/ethnic group at UConn, with only 0.1% of students identifying as Native or Indigenous.

While Tribal Colleges in other parts of the country provide Native and Indigenous students with educational and community-building opportunities, no such colleges exist in the northeast.

The impetus for this program was an observed and stated need from Tribal communities in Connecticut. Members of Tribal communities have expressed interest in industries such as fishing and wildlife

UConn Extension educators make the Three Sisters recipe with members of the Mashantucket Pequot Tribal Nation. The recipe includes locally farmed corn, beans and squash.

management, food sovereignty, clean water initiatives, reclamation of forest land, and climate sustainability. However, Native and Indigenous people often lack access to the education and training necessary to enter these fields.

Agricultural industries, generally, lack trained experts. Current estimates find that there will only be enough graduates with agricultural degrees to fill 60% of open positions in these fields. Furthermore, those identifying as Native American operate just 5.6% of American farmland, highlighting the lack of diversity in the industry.

The curriculum developed through this program will teach students the skills necessary for these jobs through an Indigenous framework. This approach to food and sustainability education emphasizes the connections between people, plants, animals, and the land on which they reside.

CAHNR researchers, including Joseph Bonelli and Shuresh Ghimire, who are both investigators on the grant, have worked with Connecticut's Native Tribes as part of their research and extension outreach. They are leveraging these relationships to help establish a network for recruiting students and gaining valuable input from Tribal leaders. The UConn team also includes animal science lecturer Amy Safran.

The program will also work closely with the NACP, an organization supporting Native students at UConn, to provide students with the cultural and community support systems they need to succeed. This collaboration includes a First-Year Experience course for students in this program and other Native and Indigenous scholars starting at the University.

The program will provide students with weekly mentoring meetings with advisors and other students in their cohort. The faculty in Ratcliffe Hicks will help connect students to summer internships and other opportunities to help them explore their interests. The program will also help students learn time management, leadership, and communication skills necessary for success beyond their time at UConn. The program will also include a monthly seminar series by Native and Indigenous scholars.

"We want to show that a Native framework should be built into how we as practitioners approach problems. We want to change the culture at UConn to be more inclusive."

The UConn team is working closely with Tribal leaders in Connecticut including those from the Mohegan and Mashantucket Pequot, Nipmuc, and Golden Hill Paugussett Tribes. ●

Investigating Turmeric Component's Ability to Lesson Cholesterol Medication Side Effects

Oh Sung **Kwon**

Assistant Professor, Kinesiology

Oh Sung Kwon is an assistant professor in the Department of Kinesiology. In his research, Kwon utilizes a wide array of techniques to identify the role of oxidative stress and mitochondrial dysfunction on skeletal muscle and the vascular system with aging and age-related diseases. Kwon is currently working on a three-year project funded by a Hatch Grant from the National Institute of Food and Agriculture to determine if a component of the spice turmeric could reduce debilitating side effects of common cholesterol medicine.

Kwon is studying if a component in turmeric, a bright yellow spice widely used in dishes throughout Asia and the Middle East, can improve cholesterol levels for people taking statins and alleviate painful side effects.

Statins are a class of drugs that can help lower one's cholesterol and risk for cardiovascular disease morbidity and mortality. Statins effectively block the production of cholesterol by inhibiting the activity of the enzyme Hydroxy-methyl-glutaryl Coenzyme A reductase (HMG-CoA reductase). HMG-CoA reductase controls the metabolic pathway that produces all kinds of cholesterol found in the bloodstream.

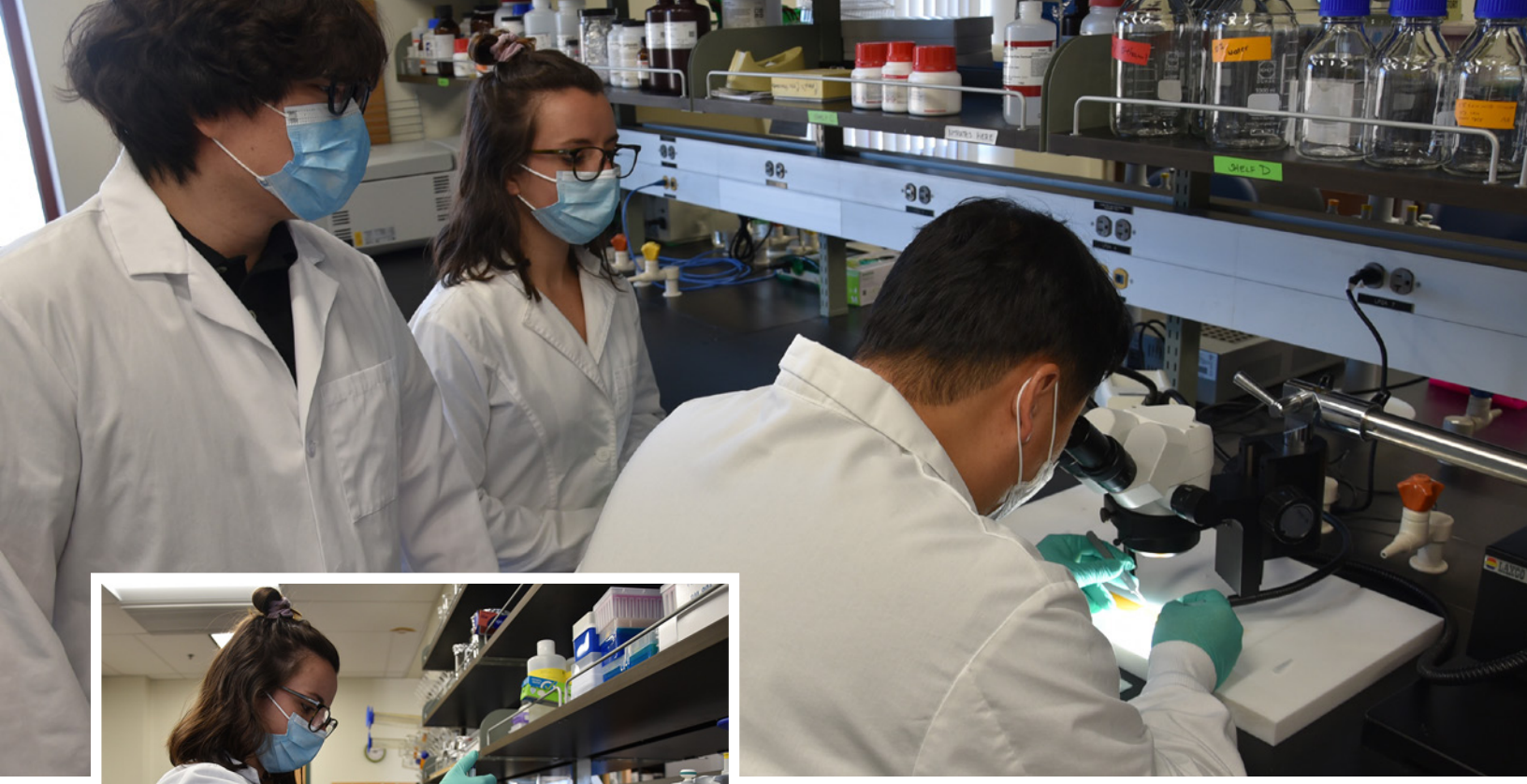
Despite their proven effectiveness, 50% of high-risk patients eligible for statins are untreated. Among those taking statins, the adherence rates are only between 30% to 40% after the first year.

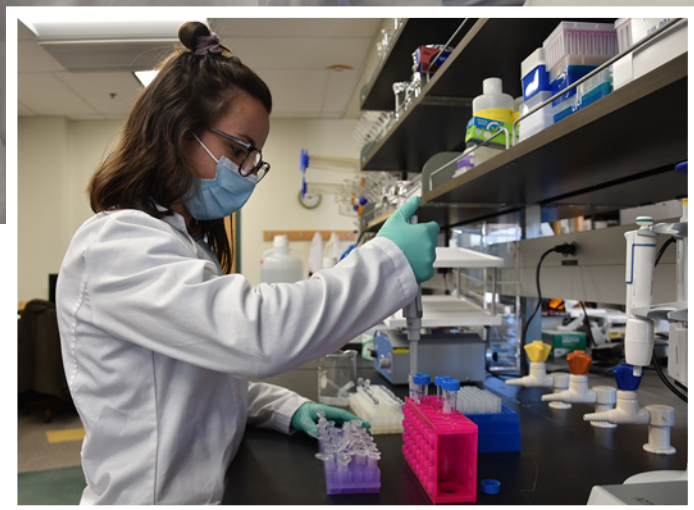
The most common reason people reportedly stop taking statins are statin-associated muscle symptoms (SAMS), which include muscle aches, pain, and stiffness. There are currently very few treatments for SAMS and there is no conclusive clinical data supporting the effectiveness of any of those treatments.

To address this significant lack, Kwon is investigating the possibility of using curcumin, the main active ingredient in turmeric, to treat SAMS. Curcumin has antioxidant, anti-inflammatory, and pain-relieving properties. Curcumin supplements have already been used effectively to treat muscle symptoms associated with osteoarthritis, rheumatoid arthritis, acute injury, and fibromyalgia.

Curcumin is a particularly attractive candidate for treating SAMS because it is low-cost and can be purchased over the counter, without a prescription. Curcumin is a safe and efficacious nutraceutical that would be more affordable as well as agriculturally and environmentally sustainable than traditional pharmaceutical treatments for SAMS.

"Currently, the only effective treatment of statin-induced myopathy is the discontinuation of statin use in patients affected by muscle aches, pains and elevated CK levels," Kwon says. "Our preliminary data revealed reduced mitochondria function and increased oxidative stress from mitochondria during exercise in patients with SAMS. So hopefully, the antioxidant properties in curcumin will attenuate statin-induced myopathy."





There are several advantages to the fact that curcumin comes from Turmeric, which grows well in a variety of indoor and outdoor settings. Turmeric has a long growing season, lasting from 120 to 360 days a year and there are no known diseases or pests that attack the crop. Turmeric can easily be grown in Connecticut, and so widespread adoption of curcumin as a SAMS treatment could help support agriculture in the state.

In addition to mitigating SAMS, curcumin can also improve cholesterol levels in the blood by lowering LDL-C, the kind of cholesterol associated with higher cardiovascular health risk, and raising HDL-C, which is associated with lower risk of heart disease.

Kwon will recruit 40 patients with SAMS and randomize treatment with either curcumin or a placebo in combination with regular statins. He will evaluate reductions in symptom presence and severity in patients. Kwon hypothesizes that combined curcumin and statin treatment will be more effective at lowering LDL-C than those taking only statins.

Kwon will also assess muscle oxygenation, tested through handgrip exercises. These exercises demonstrate how well the mitochondria, which provide energy to cells, are functioning. Muscle oxygenation refers to the rate of oxygen usage needed to support working muscle tissue, such as when a person is moving or exercising.

Patients with SAMS experience a greater level of oxidative stress, a sign that their mitochondria are not working as well as they should be and is providing muscles with more oxygen than they need. Increased oxidative stress can cause muscle damage and contributes to the pain SAMS patients experience.

By reducing the impact of SAMS, Kwon hopes this approach can help improve statin adherence and thus improve the overall health of patients with high cholesterol.

The research described in this article is supported by NIFA project # CONS01037.

Addressing Health Challenges from COVID-19 to Avian Respiratory Viruses

Steven **Szczepanek**

Associate Professor, Pathobiology & Veterinary Science

Steve Szczepanek is an associate professor in the Department of Pathobiology and Veterinary Science. His ongoing vaccine research spans from novel COVID-19 technologies to new vaccines for troublesome bacterial pathogens.

Szczepanek collaborated with Thanh Duc Nguyen, assistant professor in the Departments of Mechanical Engineering and Biomedical Engineering, to develop a single-use, self-administered microneedle vaccine technology for infectious diseases such as COVID-19, which can be quickly distributed at home in an epidemic or pandemic to provide effective, long-term protection. This work was funded by a grant from the Biomedical Advanced Research and Development Authority (BARDA).

The microneedle could replace traditional shots which can be painful, expensive, and inconvenient. Additionally, these shots also require several doses. The self-administered microneedle system only requires a single-time administration into skin to perform a release profile of vaccines, simulating the effect of multiple injections.

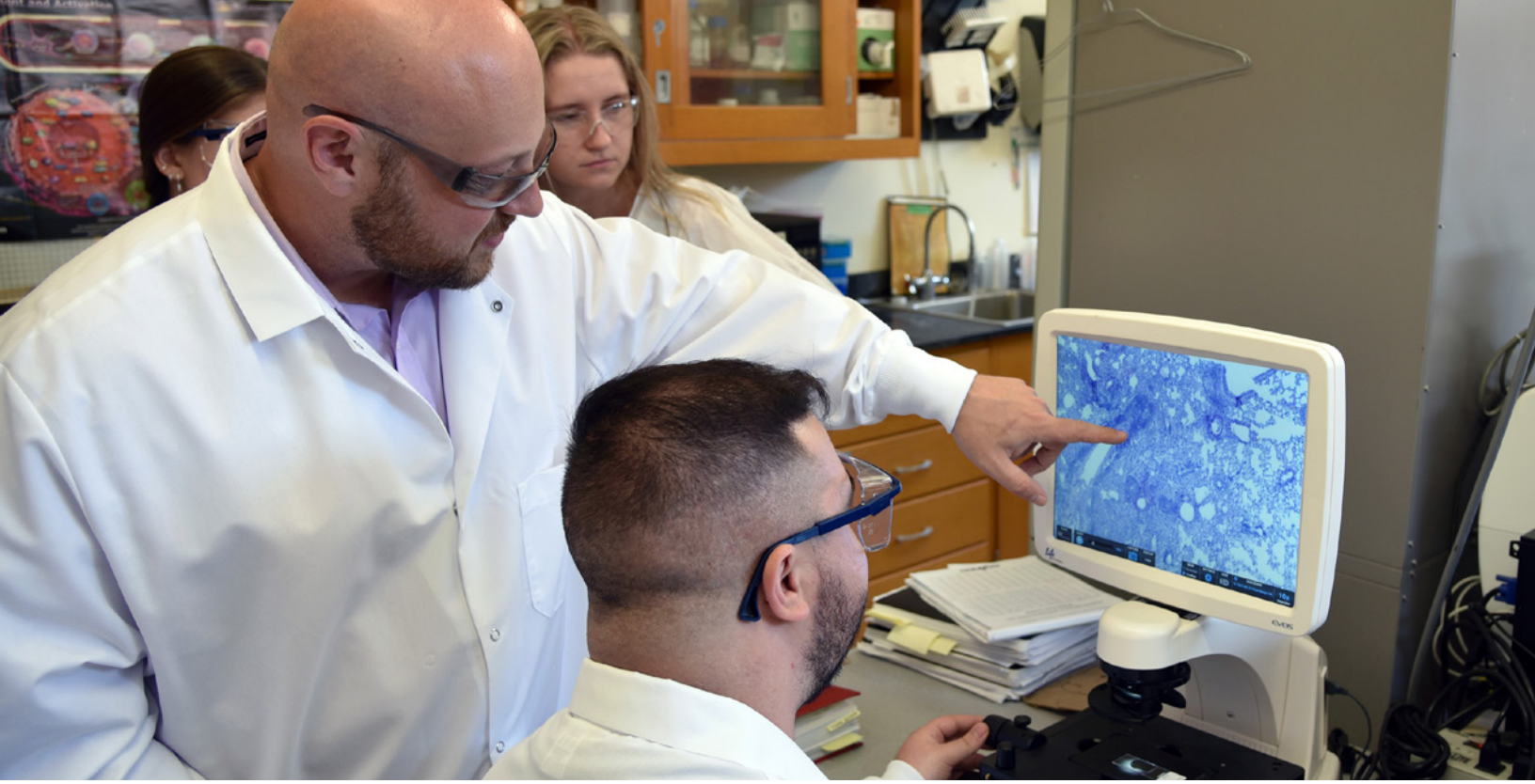
The microneedle patch will contain the spike protein, or S-protein on the shell of the COVID-19 virus, and will be programmed to automatically deliver the S-protein as a vaccine antigen against COVID-19 into the skin in time-release fashion—similar to the use of multiple vaccine injections—to trigger long-term immune protection against the virus.

The patch has different needles that dissolve at different times. This provides additional injections of the vaccine at specific times in a way that effectively mimics receiving multiple shots over a period of months. This approach avoids not only the hassle of multiple vaccination appointments, but also limits the risk of exposure to other people who may be infected.

"Periodic exposure tends to drive the immune system to attack foreign objects, which is why many vaccines against infectious diseases are given as multiple shots over a period of months or years," says Szczepanek.

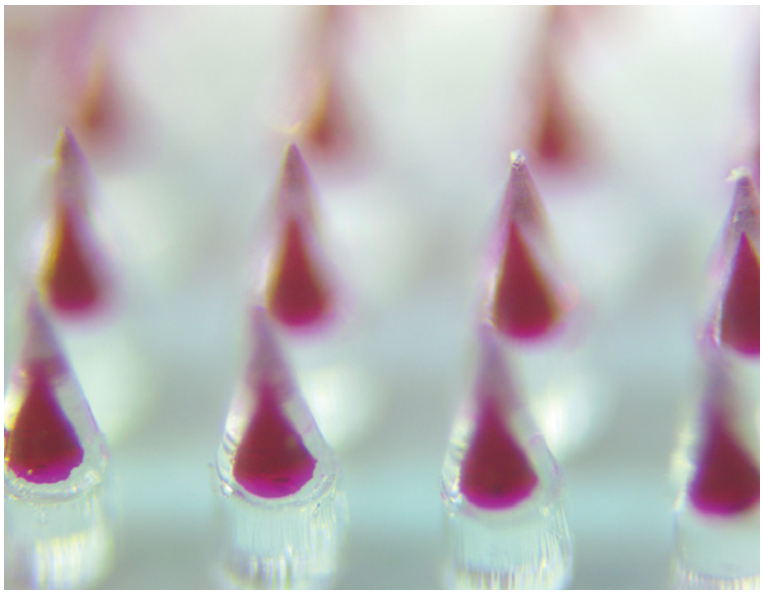
> "One of the holy grails in the field of vaccinology is to develop a platform that can deliver the vaccine with one administration, even if multiple injections are needed to achieve full immunity. This technology is truly ground-breaking."

Szczepanek is developing a recombinant subunit vaccine that circumvents a persistent problem with *Mycoplasma pneumoniae*. This respiratory pathogen can cause bronchitis and community-acquired pneumonia. This infection is especially problematic because it is often a co-infection with other respiratory infections like the flu or COVID-19.



“Those combinations of pathogens when people get sick with them tend to have very unfavorable outcomes,” Szczepanek says.

The most significant challenge to developing a vaccine for this pathogen is that previous attempts using live attenuated versions of the bacterial pathogen created a vaccine-enhanced disease with even worse outcomes.



Microneedle technology offers several advantages over traditional vaccines, including ease of application and the reduction of hazardous medical waste (photo by Thanh Nguyen).

Szczepanek made a breakthrough discovery in identifying the specific lipids on the surface of the bacteria responsible for this outcome. Szczepanek is now developing a vaccine that can provide immunity without these lipids through a recombinant subunit approach rather than using live attenuated or killed versions of the complete bacteria, as previous vaccination attempts had.

He has received funding from UConn’s Office of the Vice President for Research to optimize the vaccine formula. Szczepanek has a patent pending for this vaccine.

Szczepanek is using a similar approach to develop a vaccine for the *Mycoplasma gallisepticum*, a pathogen that causes respiratory infection in chickens and is a serious concern for the poultry industry. Szczepanek is working with UConn colleague Steve Geary on a USDA-funded project to address this need.

Traditional approaches with live attenuated strains of the bacterium, which tend to either under-stimulate the immune system and not provide effective immunity, or over-stimulate the system and cause infection. Killed bacterium strains tend to produce weak, short-lived immunity. Szczepanek and Geary are instead creating a recombinant subunit vaccine. •

Helping Connecticut Urban Communities Plan for Heat

Mariana **Fragomeni**

Assistant Professor, Landscape Architecture

Mariana Fragomeni is an assistant professor of plant science and landscape architecture. Before coming to UConn, Fragomeni earned her Ph.D. in geography and integrative conservation at the University of Georgia. Her research focuses on climate adaptation and decision-making. Fragomeni is particularly interested in heat vulnerability. Fragomeni works with urban communities throughout Connecticut to understand how to improve these cities to reduce heat vulnerability, particularly for at-risk populations. Fragomeni's research helps enable cities to implement adaptive design and land-use planning to improve how people perceive heat, which can improve the overall quality of life of people living in cities.

Fragomeni recently completed a project for Resilient Connecticut Project: Developed with the Connecticut Institute for Resilience & Climate Adaptation (CIRCA), as part of the Resilient Connecticut project. The project identifies areas in cities that are more vulnerable to extreme heat or cold. The project specifically focused on extreme heat, as it has a higher morbidity and mortality rate.

This addresses a critical and timely need. Climate change is increasing the incidence of extreme heat everywhere. In places like Connecticut where residents are less acclimated to this kind of heat, it is an even more significant public health risk.

As part of the Resilient Connecticut project, Fragomeni and her team, which included Tracey Miller and undergraduate student Katherine Day, gathered surface temperature data in New Haven and Fairfield counties using Landsat satellite imagery and land cover data from the National Land Cover Database (NLCD) to observe how land cover and surface temperature have changed in these areas over time.

Fragomeni's team combined this information with heat and humidity sensor data and examined the sensation of heat using the heat index.

The first part of the study looked at the past five years to understand what the land in these counties looks like right now. Fragomeni characterized areas based on local climate zone (LCZ) profiles. These classifications provide much more detail than simply identifying if an area is rural or urban. They take characteristics such as building height, materials, compactness, and vegetation into account.

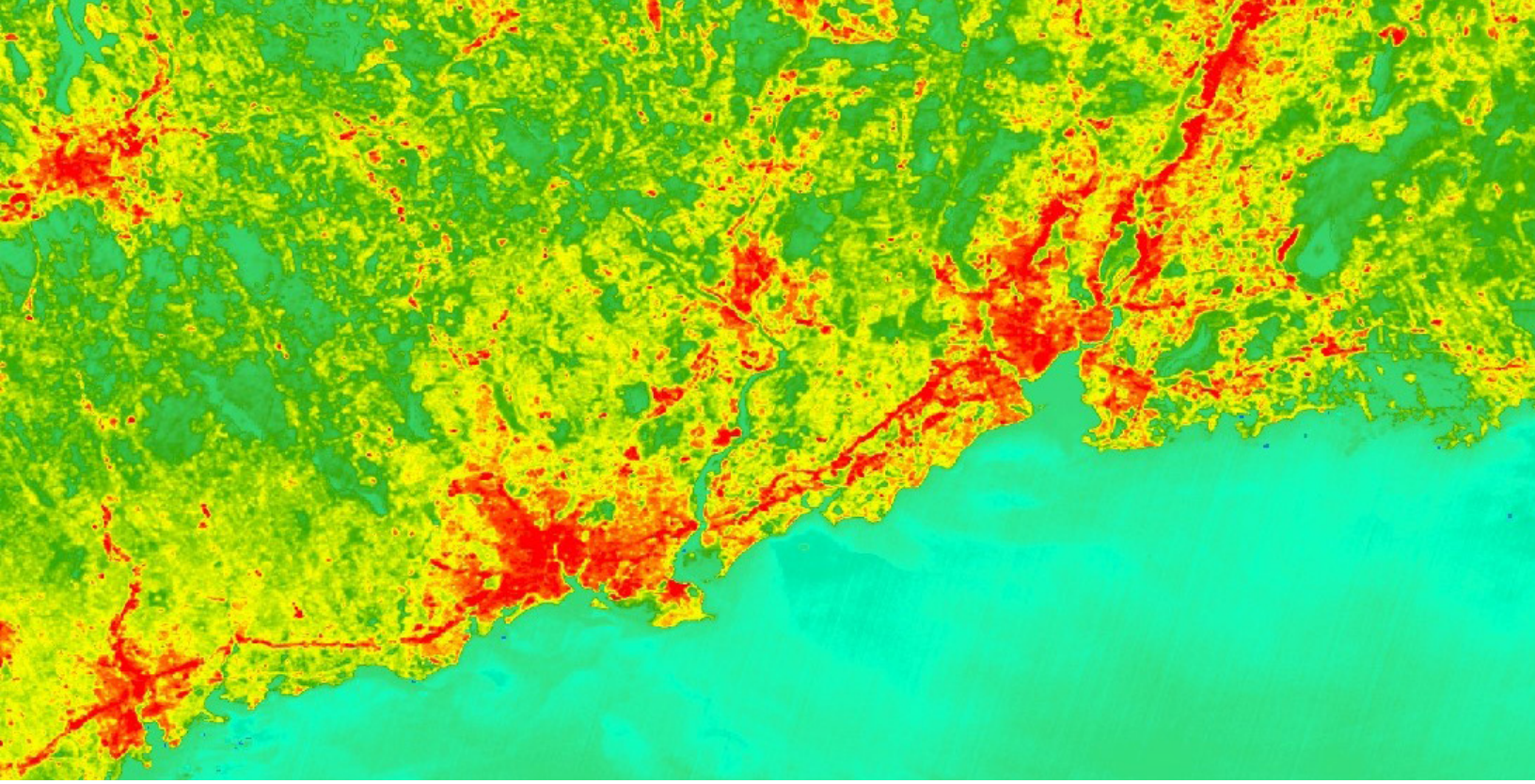
Fragomeni found an increase in urbanization, specifically mid and low-rise buildings, in some areas such as around Waterbury, Torrington, and Bridgeport.

Fragomeni then looked at longer-term changes using data about land surface temperature and land coverage going back to 1999.

The major changes have been a loss of pasture and forest land and an increase in urban development.

"Not all urbanization is alike," Fragomeni says. "But the one we've gained the most is the high-intense one, meaning the denser type of development."

Fragomeni found that some hot spots or "heat islands" in urban areas increased in surface temperature between five and 10 degrees over the past 20 years.



Fragomeni used temperature and humidity measurements to assess the heat index, a measure of how people feel in hot weather, using sensors placed in different types of landscapes across the city of New Haven.

Fragomeni found that areas with dense forests are cooler, while tightly packed urban areas were significantly hotter. The two key factors influencing this difference were ventilation and shade. Air flows more freely through trees than buildings, and the trees provide shade. The ground surface temperature is also generally cooler in areas with a lot of vegetation.

"This is an important factor we need to think through as we think about our environment," Fragomeni says. "It's not about any vegetation. Even if we're increasing grass or shrubs, they're not adding the shade we need to reduce that temperature."

Fragomeni's study used readily available data and machine learning methods, making it easy to apply this work to other contexts.

"This is a replicable methodology for our communities in the future to help us understand what's going on and keep going in the future and analyzing other areas," Fragomeni says.

The findings from this study can help communities plan more intelligently to make themselves more adaptable and resilient in the face of increasing temperatures. CIRCA's sensors are still collecting temperature and humidity data which she hopes to use to continue this research.

"We need to do more, we need to measure more, but there's definitely a lot already here for us to help our communities plan for heat," Fragomeni says. ●

Uncovering Racial Ties to Flood Risk Behaviors

James **Knighton**

Assistant Professor, Natural Resources & the Environment

James Knighton is an assistant professor in the Department of Natural Resources and the Environment. He holds a Ph.D. in Environmental Engineering from Cornell University. Knighton uses large datasets and emerging data analytic techniques alongside physically based hydrologic models to study plant-soil-water interactions. This research looks at how plant species compete for resources, the complex paths water takes between rainfall and reaching streams, and how these processes can impact communities in diverse landscapes. Knighton's work aims to minimize flooding risks for downstream communities, the economic risk of drought for the agricultural industry, and the environmental impact of human-water systems.

Knighton recently published a paper in *Proceedings of the National Academy of Sciences* suggesting that in the United States, the social reality of race inequity is an important factor influencing flood risk behavior, along with hydrological factors like stream flow.

Knighton and collaborators tailored the models to 50 metropolitan areas across the U.S. at risk for river flooding events. By feeding the model a time series of annual flooding hazards, it can use streamflow information to predict how much damage will occur in a flood, how much a given flood changes a community's behavior, and how long those behavioral changes will last. They further calibrated the models to include trends in behaviors related to flood insurance policies and claims.

"After running the model, we were totally shocked because it worked fairly well," Knighton says. "We shifted our focus to see what this model is saying about these communities."

The models show two diverging patterns among U.S. metro areas: one the researchers deemed "risk enduring," with lower flood defenses and a longer local memory of past flood events; and also "risk averse," with higher flood defenses and a shorter memory regarding previous floods. Risk averse patterns tend to be found in areas with larger dams and a higher proportion of white residents, while the reverse is true in risk-enduring metropolitan areas.

In risk-enduring cities, the aftermath of flooding brings a sharp rise in the purchase of flood insurance policies, which then declines quickly. In risk-averse cities, the number of flood insurance policies tends to be more stable; major floods bring a slight increase in insurance policies, which also don't drop off as sharply as in the first pattern group.

To learn more about these communities, the researchers, including Rebecca Elliot at the London School of Economics, analyzed census data for the cities to see if measurements of social vulnerability could describe the divergent patterns, which Knighton says was immediately apparent. Socioeconomic demographics were the main split between the patterns, with the proportion of white residents higher in risk averse communities, where there are fewer fluctuations in flood insurance policy numbers.

Knighton says the research team predicted poverty and race may be tied to socioeconomic barriers to

participating in existing federal programs such as the National Flood Insurance Program (NFIP). The program is a federal initiative that provides flood insurance policies to homeowners, businesses, and renters in roughly 23,000 communities at high-risk of flooding.

"There is probably also some aspect of this where people are rational actors in the economic systems where, if they perceive a big risk, they will take some sort of action to mitigate the risk, and if they don't perceive a risk, they won't," Knighton says. "The National Flood Insurance Program is built around this belief."

The researchers started from the opposite end of the spectrum, assuming there are no social barriers to people acting as rational actors and instead focused on the predictability of stream flow. This predictability can be measured with a variable called "flashiness." A stream that is likely to stay at roughly the same level day-to-day is less flashy, whereas flashy streams have drastic and less predictable level fluctuations.

Flashier streams corresponded to risk-averse metropolitan areas with higher proportions of white residents. Risk averse communities also tend to have more local investment in their flood control infrastructure, such as more and bigger dams with more federal attention directed at larger, richer, and whiter cities.

Barriers such as affordability and bureaucratic red tape may make access to insurance difficult and inequitable. Accounting for all these factors led to this research being the most comprehensive model-based investigation of flood risk behaviors in the U.S. to date. There are programs in place designed to make federal flood programs more accessible; however, inequities remain, and the researchers hope this research will raise awareness.

"Part of our hope is that there is strong support for a comprehensive affordability framework," says Knighton. "Some cities just live with risk. Flooding will likely get worse in the near future. Maybe people are able to live with the flooding we have now, but we can't know for certain if everyone can live with the flooding that is coming."

This work was supported by the National Socio-Environmental Synthesis Center (SESYNC) under funding received from the National Science Foundation DBI-1639145.

Investigating Impact of Diet on Health Conditions

Chelsea **Garcia**

Graduate Research Assistant, Nutritional Sciences

Chelsea Garcia is a Ph.D. candidate in the Department of Nutritional Science. Garcia works in the lab of associate professor Christopher Blesso studying the science behind the nutrition in food including those high in antioxidants which can have manifold health benefits including benefits for those suffering from atherosclerosis. This condition occurs when fats and cholesterol build up along the artery walls. This can restrict blood flow and cause blood clots.

"I've always been interested in health and food," Garcia says. "I always incorporated what I learned into cooking. I wanted to learn the science behind the food and its effect on the body."

As an undergraduate researcher, Garcia started working with Blesso the summer after her first year through the Bridging the Gap program, which assists students from community colleges and underrepresented groups in launching research careers.

"Bridging the Gap was the start of my future plans to conduct research," Garcia says. "That program was how I fell in love with nutrition research because it showed me what research was actually about."

She worked to determine the health effects of consuming freeze-dried grape powder after high-saturated fats in adults with metabolic syndrome. Garcia also co-wrote a book chapter with Blesso identifying the relationship between dried fruit and lipids in the blood.

Garcia was the first author, alongside Blesso, on an article in *Free Radical Biology and Medicine* outlining the research to date on a type of anti-oxidant called anthocyanins and its impact on atherosclerosis.

Atherosclerosis is associated with oxidative stress, a process our bodies undergo throughout our lifetime as they encounter free radicals. These oxygen-containing molecules are highly reactive and unstable. They occur when a molecule gains or loses an electron. The unpaired electron on the free radical can react with other molecules and cause age-related harms in the body.

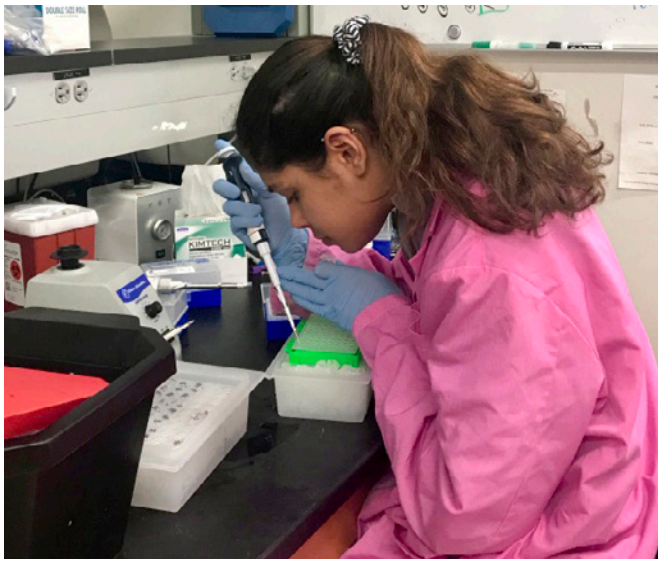
Antioxidants can intervene in this reaction by giving up an electron to stabilize the free radical. Decades of research support the benefits of antioxidant-rich diets to offset health problems such as cardiovas-cular disease, cancer, and diabetes. But not all anti-oxidants work in the same way. Anthocyanins had largely been neglected by researchers because they were thought to have lower bioavailability and not be as well-absorbed as other antioxidants.

However, more recent studies have shown that anthocyanins are absorbed and metabolized into many different forms that stay in circulation. Anthocyanin metabolites can significantly boost the activity of the body's naturally occurring antioxidant enzymes. Anthocyanins also increase the anti-oxidant properties of HDL, or "good" cholesterol. Blesso and Garcia's work consolidates the major

scientific findings on anthocyanins and atherosclerosis into a comprehensive reference for future studies.

“It’s a great way to see what research has been done and also see what other areas can be investigated,” Garcia says.

One of the major gaps Garcia identified is the need for more studies in humans. Many of the studies conducted in preclinical animal models used concentrations of antioxidants that would be much too high for human consumption.



Many foods, including berries, which Blesso studies in his lab, are high in antioxidants. Incorporating these foods into a healthy diet can help reduce the risk of atherosclerosis.

Research on how exactly high-antioxidant foods influence our health is critical. Understanding the mechanisms individual antioxidants use allows scientists to understand how they can complement or interfere with other nutrients or medications.

This level of information is important for supporting the increasing trend toward individualized nutrition.

“Knowing the mechanism is also useful when identifying a bioactive compound as a potential treatment for other diseases with similar pathology or intervention targets,” Garcia says.

Garcia was also a McNair Scholar, a University Scholar, and the inaugural recipient of the CAHNR Diversity Enhancing Graduate Assistantship, which seeks to make graduate studies more accessible to members of underrepresented communities.

INNOVATION FOR OUR COMMUNITIES

Innovation for our communities. This has been the guiding force behind the research enterprise at UConn's College of Agriculture, Health and Natural Resources (CAHNR). In 2022, CAHNR's preeminent faculty and talented students will continue to create new possibilities that can change our world. From the lab to the farm, or from the clinic to the forests, CAHNR researchers are translating discoveries into knowledge, services, and products that improve quality of life for a sustainable future.

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