HIGHLIGHTS

Research and the Storrs Agricultural Experiment Station · 2019

College of Agriculture, Health and Natural Resources • University of Connecticut

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VISION

The College of Agriculture, Health and Natural Resources moves the state, country and world toward a sustainable future through scientific discovery, innovation, education, and community engagement. Our accomplishments lead to 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. We are dedicated to tackling big challenges and creating a viable future for our world.

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 in 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.

Indrajeet Chaubey
Dean and Director
College of Agriculture,
Health and Natural Resources

MESSAGE FROM THE DEAN

It is a pleasure to present 2019 highlights of our research conducted through the Storrs Agricultural Experiment Station. As Connecticut's land-grant institution, we have a federally charged responsibility to educate the next generation of students; conduct fundamental and translational research to address the needs of Connecticut's **$4 billion agricultural economy**; be stewards of the state's natural resources, and improve human health; and provide education and outreach to Connecticut's citizens through the Cooperative Extension System. Our research continues to be fully integrated with our academic programs, and our students are directly engaged with faculty in research as we train the next generation of scientists and leaders. Likewise, our research discoveries are delivered directly to those who can benefit from them through our Cooperative Extension System.

INTRODUCTION

The University of Connecticut's College of Agriculture, Health and Natural Resources (CAHNR) is committed to research that solves problems and investigates new areas relevant to agriculture, food, forestry, the environment, and human and animal health. 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 agriculture 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 value applied research approaches and the application of results from all research endeavors.

The College of Agriculture, Health and Natural Resources hosts nine departments that are home to 174 faculty members and 131 staff. These individuals 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 a framework for graduate student and postdoctoral scientist training, ensuring that the next generation of scientists is prepared for addressing the state, regional, national and global challenges.

The Storrs Agricultural Experiment Station and Research

The Storrs Agricultural Experiment Station (SAES) receives capacity funding from the USDA each year and a 1:1 state match is provided through the University's block grant from the state legislature. For FY2019, funding in the amount of $1.4 million was received to support independent investigator and multistate research in the broad fields of agricultural sciences, forestry, and human and animal health. The allocation of those funds is indicated in Figure 1. Ninety-four percent of the budget was used to fund personnel (i.e., graduate students and faculty/staff) that contributed to research associated with USDA-approved capacity projects.

In FY 2019, CAHNR faculty and staff members were engaged in over fifty research projects supported directly by USDA capacity funds. 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 pursuit of competitive extramural funding in the form of single- or multi-year grant awards.

Table 1. Proposals to Federal Agencies by Lead Agency

Agency	Request	%
Department of Commerce	$ 4,261,581	5.18
Department of Defense	$ 5,359,966	6.52
Department of Energy	$ 3,837,211	4.67
National Institutes of Health	$ 37,391,729	45.46
National Science Foundation	$ 12,686,883	15.43
US Department of Agriculture	$ 15,403,432	18.73
Other Federal Agencies	$ 3,302,590	4.01
Total	**$ 82,243,392**	

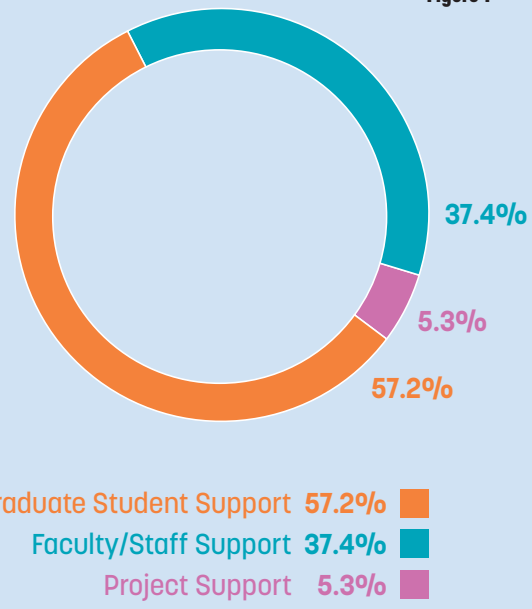
Table 2. Grant Awards by Federal Agency

Agency	Request	%
Department of Commerce	$159,108	0.95
Department of Defense	$663,395	3.95
National Institutes of Health	$2,508,207	14.99
National Science Foundation	$2,307,849	13.79
US Department of Agriculture	$9,345,499	55.85
Other Federal Agencies	$1,747,775	10.45
Total	**$16,731,833**	

Allocation of Storrs Agricultural Experiment Station Funds, FY 2019

Source: Office of Vice President for Research

Figure 1



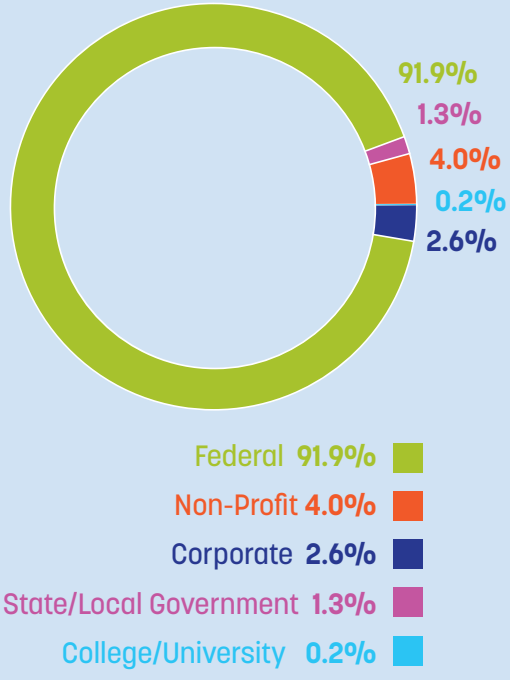
In FY 2019, CAHNR researchers applied for a total of approximately $89.5 million in extramural grant funding (Figure 2). Proposals were submitted to a variety of federal and non-federal sources. Based on quantity of requested funds, federal agencies were approximately 92 percent of the destinations for grant submissions. The majority of these were targeted to NIH, NSF, and USDA (Table 1).

In FY2019 more than $20 million in extramural grant funding was received by CAHNR researchers. The majority of funding awards were from federal agencies and amounted to approximately $16.7 million. Approximately 46 percent of all funding awards were received from USDA (Table 2).

Proportion of Funding Requests by Sponsor, FY 2019

Source: Office of Vice President for Research

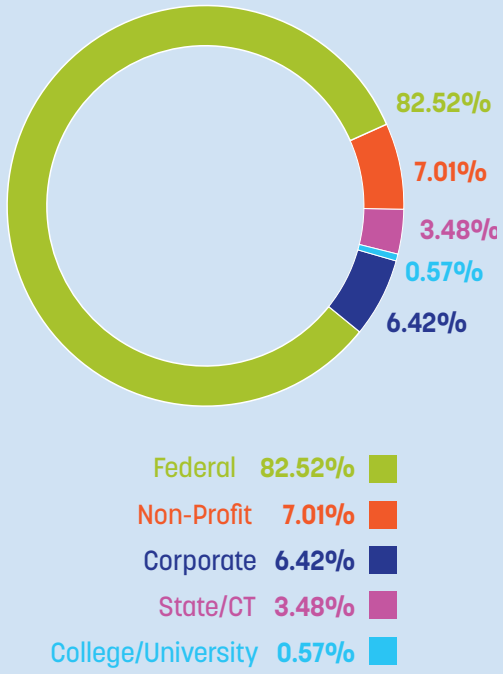
Figure 2



Proportion of Funding Awards by Sponsor, FY 2019

Source: Office of Vice President for Research

Figure 3



Scholarly Productivity

The application for and acquisition of funding is a common metric used to gauge research activity. While it communicates the value of a research idea/mission as judged by qualified peer scientists and agencies, it represents only the input side. The outputs that are realized from research funding are measured in terms of scholarship and the number of scientists (i.e., MS and Ph.D. students; postdoctoral fellows) trained.

Scholarly Product/Indicator	Number
Peer-reviewed journal articles	225
Books authored	4
Book chapters	2
Published conference proceedings	262
Technical reports and manuals	43
Patents	7
Editorships of major journals	20
Associate editorships/editorial board memberships	174
Member of federal peer review committees	37
Member of other national/international peer review committees	99
Member of state or regional peer review committees	23
Ad hoc reviews for granting agencies	664

Training the Next Generation of research scientists

Human Capacity Development in the Agricultural, Health, and Environmental Sciences

Human capacity development in the agricultural, health, and environmental sciences is necessary for our state and nation to remain competitive in the global marketplace. An essential element of the CAHNR research mission is the training of MS, Ph.D., and postdoctoral scientists for the purpose of meeting this need. The US Department of Labor Bureau of Labor Statistics recently noted that research scientists will continue to be in high demand with Ph.D.-trained individuals enjoying the greatest opportunities.

Fiscal Year 2019

49 **Ph.D.** degrees awarded

25 **MS** degrees awarded

27 **DPT** (Doctor of Physical Therapy) degrees awarded

Ph.D. Degrees Conferred FY 2019

Student	Advisor	Dept	Thesis Research Title
Janet Rice Barclay	Ashley Helton	NRE	Title Imprints of the Land: Spatial and Temporal Connections Between Land Use and Water Quality
Luke Norman Belval	Douglas Casa	KINES	Factors Contributing to Heat Tolerance and Recovery from Prolonged Exercise in the Heat
Julie Parkinson Burland	Lindsey Lepley	KINES	Disruptions in Physical and Neurocognitive Wellness After Anterior Cruciate Ligament Reconstruction
Juan Carlos Cabrera-Garcia	Rosa Raudales	PSLA	Identifying Clogging Factors and Thresholds of Greenhouse Irrigation Pipes
Anwesha Chakrabarti	Stephen Swallow	ARE	Economic Aspects of Selling, Acquiring and Managing Ecosystem Services
Jesse David Chiero	Amy Mobley	NUSC	Evaluating the Impact of Local Vegetable Messaging on Elementary School Students' Vegetable Choice and Nutrition Behaviors
Ryan Matthew Curtis	Douglas Casa	KINES	Establishing an Injury Determinant Framework in NCAA Division I Soccer
Laurie L. Devaney	Lindsay DiStefano	KINES	The Relationship Between Spinal Mobility Measures and Shoulder and Elbow Injury in College Baseball Pitchers
Quin Du	Huanzhong Wang	PSLA	Investigating the Functions of Two Transcription Factors in Vascular Development and Wall Biosynthesis in *Arabidopsis thaliana*
Jingyue Duan	Xiuchun Tian	ANSC	Genomic Imprinting and X Chromosome Dosage Compensation in Domestic Ruminants
Rania Ahmed El-Tanbouly	Li Yi	PSLA	The Role of Jasmonate in the Shade Response of Perennial Ryegrass
Rebecca Heller	Amy Mobley	NUSC	The Development of Evidence-Based Early Child Feeding and Obesity Prevention Messages for Parents of Children Birth to 2 Years Old
Lorenzo Katin-Grazzini	Yi Li	PSLA	Analyzing The Role of Gibberellin in Dwarfism and Shade Tolerance in Perennial Ryegrass (*Lolium perenne, L.*) as Exhibited by the Shadow-1 Mutant Lineage
Bruno Silva De Oliveirea Lemos	Maria-Luz Fernandez	NUSC	Effects of Egg Intake on Choline Metabolism and HDL Functionality in a Healthy Population
Marjorie Rose Liberati	Chadwick Rittenhouse	NRE	Constraints, Tradeoffs, and Opportunities for Conservation in Contemporary Landscapes
Timothy Murray	Richard Dunn	ARE	Housing Dynamics of Older Americans in the 21st Century
Muhammed Shafeekh Muyyarikkandy	Mary Anne Amalaradjou	ANSC	Functional Characterization of the Probiotic Attributes of *Lactobacillus delbreuckii* subsp. *bulgaricus* NRRL-B-548, *L. paracasei* DUP-13076, and *L. rhamnosus* NRRL-B-442 and Their Potential Application in Poultry Production
Lucas Randall Nathan	Jason Vokoun	NRE	Conservation Applications of Watershed-Level Brook Trout Riverscape Genetics
Gregory Harrison Norris	Christopher Blesso	NUSC	Dietary Sphingomyelin for the Prevention of Diet-Induced Metabolic Dysfunction in Mice
Abraham Joseph Pellisser	Kumar Venkitanarayanan	ANSC	Natural Strategies for Controlling Virulence and Antibiotic Resistance in *Clostridium difficile*
Sara Joana Pereira Pedor	Melissa McKinney	NRE	Influence of Northward Redistribution of Marine Prey and Predator Species on the Trophic Dynamics of Environmental Contaminants and Nutrients in Arctic Marine Food Webs

ARE: Agricultural and Resource Economics; ANSC: Animal Science; KINES: Kinesiology; NRE: Natural Resources and the Environment; NUSC: Nutritional Sciences; PSLA: Plant Sience and Landscape Architecture; PVS: Pathobiology and Veterinary Science

Ph.D. Degrees Conferred FY 2019, continued.

Student	Advisor	Dept	Thesis Research Title
Alicia Marie Pike	Stephanie Singe	KINES	Conflict and Pressures Faced by Secondary School Athletic Trainers: A Comparison Across Employment Models
Ling Wang	Young Tang	ANSC	Understanding the Mechanisms and Improving the Efficiency of Reprogramming
Yin Wu	Linda Pescatello	KINES	A Comparison of Two Tai Chi Interventions Tailored for Different Health Outcomes
Amanda Lee Zaleski	Linda Pescatello	KINES	Using the Immediate Blood Pressure Benefits of Exercise to Improve Exercise Adherence: A Pilot Study

Doctor of Physical Therapy Degrees Conferred in 2019
Department of Kinesiology

Zachary Ryan Breen	Steven Joseph Lagasse	Emily Paliulis	Kellie Smolenski
Michael Cascone	Matthew Anthony Larkin	Stephen Michael Peszynski	Marissa Elizabeth St Lois
Shelby D'Andrea	Chris Leroux	Michael Ranando	Deborah Rachel Taylor
Sarah Deacon	Stephanie Kalanta	Dylan Peter Roman	Alyssa Sue Vallee
Emily Giampaoli	Ryker Gregory Kallas	Matthew Scavo	Michael Christopher Velasquez
Marielle Jean Handley	Olivia Takako Kane	David Scott	Allison Wagner
Jennifer Lynne Mosher	Patrick Gregory Kinsella	Kyle Sirois	

Recent Ph.D. Collaborates with Advisor and USGS Scientists to Study Groundwater Nitrogen in Farmington River Watershed.

By Patsy Evans

Janet
BARCLAY

Graduate Student
Department of Natural Resources
and the Environment

In May 2019, Janet Barclay received her Ph.D. in hydrology and water resources science from the **Department of Natural Resources and the Environment**. She is **currently a hydrologist** with the **New England Water Science Center** of the United States Geological Survey (USGS) and continues to collaborate on an ongoing research project with the College.

Funded by a $696,000 grant from the National Science Foundation, Barclay and her Ph.D. advisor, Associate Professor **Ashley Helton**, are collaborating with Jeffrey Starn and Martin Briggs from the US Geological Survey to assess groundwater nitrogen within the Farmington River watershed.

The Farmington River watershed drains into the Connecticut River and then to the Long Island Sound, where excess nitrogen has been a pervasive problem, leading to massive algae blooms. Oxygen is depleted as the algae die and decompose, resulting in dead zones, or **hypoxia**.

Most nitrogen studies focus on runoff to surface water (streams, ponds, wetlands, etc.) from septic systems, fertilizers, and wastewater treatment facilities. Surface runoff is a fairly quick process, while nitrogen moving through groundwater may take years or possibly decades to reach the Sound. This means that management efforts to reduce nitrogen application may also take years or decades to show visible decreases in the Sound as the nitrogen that's already in the groundwater continues to make its way to the Sound.

"Understanding the dynamics of groundwater transport and nitrogen transformation will allow us to manage and set realistic nitrogen load and reduction goals," Barclay explains.

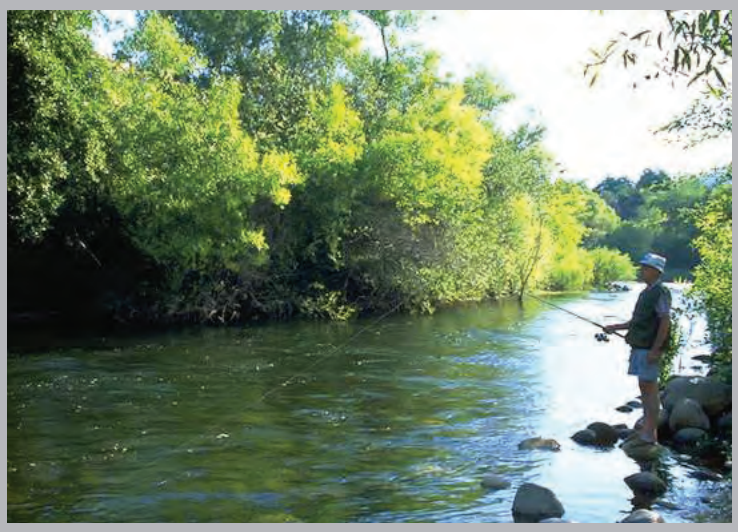
The study includes postdoctoral fellow Mark Harvey, Ph.D. student Eric Moore, and MS students Kevin Jackson and Adam Haynes. "It's exciting for me to continue my dissertation research and see this new group carry it forward," says Barclay.

The group is using a combination of standard and novel techniques to understand where groundwater and nitrogen are entering streams and rivers and how nitrogen is being removed in river sediments at the boundary between groundwater and rivers. Fieldwork includes water sampling and thermal infrared surveys using handheld and drone cameras along sixty miles of stream and river throughout the Farmington River watershed, identifying areas where groundwater enters the river, and how much nitrogen is being removed. The field work is integrated with three-dimensional groundwater flow modeling, enabling the researchers to understand patterns of groundwater discharge and nitrogen removal across the watershed.

"Our goals are to follow the nitrogen from the groundwater, through the river sediments and into the river. We want to understand how long the nitrogen spends in the groundwater, where it discharges to the river, and how much is removed as it discharges through river sediments, as well as to revise our current models for understanding nitrogen movement in rivers," Barclay explains. "I love being able to think about this and understand how water is moving, where it's going and what it is taking with it, and the effects on the surrounding environment. It's important because clean water is so essential for humans and nonhuman members of our community."

In her current work with USGS, Barclay is continuing this type of research in a collaborative project involving the Connecticut Department of Energy and Environmental Protection, the **Long Island Sound Study**, and the US Environmental Protection Agency. The group is developing a regional-scale model to simulate groundwater flow in watersheds along the Connecticut coast and will simulate nitrogen loading in one watershed. These watersheds input directly to the northern shore of Long Island Sound.

Barclay's other research interests also focus on water quality and include road salt leaching, pharmaceutical and personal care product compounds in streams and rivers, watershed land use, water body classification, and water resources management.



Research Features

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

Our focus has always been on hiring talented researchers to help advance the College's research mission and solve real-world problems. The following articles provide brief summaries of the research activities of selected faculty and staff.

Economists' Reports Show Impacts of Connecticut's Agricultural industries

By Kim Colavito Markesich

Rigoberto
LOPEZ

Richard DelFavero Professor
Department of Agricultural
and Resource Economics

In 2014, UConn's Office of the Associate Vice President for Budget, Management and Institutional Research hired outside consultants to conduct a study on the economic impact of UConn in the state of Connecticut. The **five-year update** was prepared in-house by a group of UConn experts in a collaboration between the **Department of Agricultural and Resource Economics** (ARE), the **Zwick Center for Food and Resource Policy**, and the **Department of Economics**. The team included ARE Professor **Rigoberto Lopez**, who is the team leader; ARE Ph.D. student Mahdi Fallahi; and **Steven Lanza**, assistant professor in residence in the Department of Economics.

"UConn has been a key economic driver of the state for nearly 140 years," says Lopez. "The purpose of this study is to ascertain and document the significance of the University of Connecticut to the state's economy as measured by the chain of spending linked to UConn's programs and activities. We know at this point in the study that the total impact is in the billions of dollars, and it is significantly higher than estimated in 2015."

The study examines the economic contribution of the main campus in Storrs, regional campuses, and UConn Health and includes impacts on statewide output, employment, payroll, and benefits, and their contribution to the state's gross domestic product.

"There is a cascading effect on many industries from retail businesses and health care, to real estate, trade industries, and state and local taxes," says Lopez. "It's important to document in numbers the impact of UConn on the state economy. It's not just about teaching; the mission of UConn is more complex and includes research and outreach programs and hospital services, all of which affect the economic and quality of life of residents throughout Connecticut."

In another project, Christopher Laughton, director of knowledge exchange at Farm Credit East and a master's student in ARE, researched the impact of the green industry in Connecticut as part of an independent study under the supervision of Rigoberto Lopez. In the latest census, the green industry accounts for 51 percent of all agricultural sales in Connecticut, making it the largest agricultural sector in the state.

"The Connecticut Nursery and Landscape Association (CNLA) hired us to do an economic impact of the industry," says Lopez. "Christopher is uniquely qualified to create this report, having earned his horticulture degree from Cornell and MBA from UMass Amherst, in addition to having horticultural experience working at a family nursery business."

"This **report** gives those in the industry a chance to show their economic significance and jobs impact in the state," says Laughton.

The study includes Lopez; **Victoria Wallace**, extension educator and CNLA president; and Dustyn Nelson, CNLA vice president and operations manager for Frank's Landscape Construction. Nelson is a 2014 CAHNR graduate.

"The Connecticut Nursery and Landscape Association has found that the service sector of the green industry is growing in Connecticut," Nelson points out. "The green industry economic impact study provides the data to back up these claims."

In addition to the data provided to the green industry, the report will provide information for UConn students.

"The green industry impact study can be used to highlight current trends in the Connecticut industry and to expose students to viable green industry employment opportunities," says Wallace.

Future studies for Lopez include an update on the economic impact of the emerging hemp industry.

"We have found that this type of information is necessary and helpful to stakeholders," he says. "As an example, the hemp market is new in Connecticut, but we have to be very careful with risks and investments as the state was a late entering this market. Everyone is looking at the revenues, but not many are looking at the long-term costs and risks. The industry needs information."

"Our goal is to provide quantitative information for private individuals as well as public officials with respect to agriculture, food, and natural resources in order to improve their decision making."

Animal Scientist Studies Effects of Maternal Nutrition on Offspring

By Kim Colavito Markesich

Kristen
GOVONI

Associate Professor
Department of Animal Science

Associate Professor Kristen Govoni has spent the majority of her career at UConn, having earned her BS, MS, and Ph.D. degrees in animal science in the College. Her research focuses on animal growth, development, and health.

For the past eight years, **Govoni** has been involved in a collaboration with two other faculty in the **Department of Animal Science**, Professor **Steven Zinn** and Associate Professor **Sarah Reed**. Using sheep as a model, the team has recently received their fifth USDA grant to examine the effects of maternal diet during gestation on offspring health and growth, with a goal of improving livestock health and production efficiency.

Their research has demonstrated that overfeeding and restricted feeding during gestation adversely affects offspring, resulting in decreased muscle growth and increased fat, as well as changes in metabolism. Specifically, a decrease in the ability to regulate and utilize glucose and changes in hormones such as leptin, which regulates satiety, lead to altered overall body composition and metabolism in offspring.

"We are looking at fetal and postnatal growth, and because of our interest in production animals, we are looking at muscle and fat development," Govoni says.

"We often see similar negative effects of both restricted and over feeding on growth and metabolism, and they both have similar phenotypes, but we're finding the mechanisms, whether it be specific proteins or metabolites, differ between the diets."

For sheep producers in western states where animals graze on the range, undernutrition is an issue. In the Northeast, where sheep are more intensively managed and where the animals spend more time in barns during the winter breeding and pregnancy season, overfeeding is more of a concern as grain is nutrient dense. Overfeeding not only results in negative health impacts for offspring, it is more costly for producers.

The fourth project has one year remaining. The group teamed up with faculty at North Dakota State University, where the North Dakota team had received a USDA seed grant to examine maternal nutrient restriction and realimentation and its effects on uterine development, nutrient transfer, and blood flow between mother and fetus. The UConn team added a half-million-dollar USDA grant to the project, studying the effects of maternal nutrient restriction and realimentation on offspring metabolism in the liver, muscle, and blood.

"I've truly enjoyed the collaborative effort both with our team at UConn and collaborators at other institutions," Govoni remarks. "We've had a lot of opportunities to meet with other scientists in the field, and I find that everybody in the fetal programming area is eager to work with each other and share their information. That has been exciting."

With the newest USDA grant, also totaling a half-million dollars, the team is examining the multi-generational effects of maternal diet on offspring. They plan to investigate these findings to determine whether the offspring use nutrients differently or if they are biologically programmed to consume more food. They will also determine the impact of maternal diet on inflammation and **oxidative stress** in the offspring.

"We see those effects in offspring when they are born or during early growth, but a lot of these effects are persistent into adulthood and there is evidence they are multigenerational," Govoni says. "This next five years will really give us a better idea of the long-term impact of inadequate feeding during gestation. If these changes are permanent, we need to identify new ways to manage offspring for the healthiest animals and most efficient production."

When asked if this type of research could relate to obesity in human health, Govoni responds, "Our work has focused on improving livestock production, as well as improving animal welfare and reducing the environmental impact. However, sheep are an accepted biomedical model, so our findings can be translated to similar growth and metabolic challenges in humans."

The team recently attended the **Aspen/Snowmass Perinatal Biology Symposium** in Colorado, where both animal and medical scientists met to report and exchange research findings. Collaborator Sarah Reed presented recent findings on the negative effects of maternal diet on offspring metabolism and inflammation. Ph.D. student Brandon Smith presented a

poster on the changes in metabolites in liver, muscle, and blood in response to maternal nutrient restriction and realimentation.

"This meeting is an excellent opportunity for scientists in the field of fetal programming to share current, unpublished research and develop new and continue existing collaborations," Govoni says. "It is small, intensive meetings such as this one that allow the field to advance more quickly in a collaborative manner."

While Govoni is focused on her research, she is just as passionate about mentoring the next generation of scientists. She says, "We want to give undergraduates the hands-on experience with animals and research, but also give them an appreciation of animal agriculture and research that goes into production. We do all the care and feeding of these animals ourselves, and it provides an excellent opportunity for students to learn all the components of research, from designing the experiments to animal and laboratory work."

"These projects cannot be completed without our army of undergraduate and graduate students, as well as the animal science farm managers and staff who have supported us through all these studies. Our work is truly a team effort."

Govoni also enjoys being a mentor to women in science, currently in her fifth year serving as faculty director of the UConn Women in Math, Science and Engineering (WiMSE) learning community.

This research was funded by USDA-AFRI-NIFA Projects 2013-01919, 2014-01982, 2015-06329, 2016-08401, 2019-05861; UConn Research Foundation Large Grant 2010; and the Storrs Agriculture Experiment Station.

Researcher Finds Harvesting Invasive Species Promotes Biodiversity but Increases Methane Release

By Kim Colavito Markesich

Beth
LAWRENCE

Assistant Professor
Department of Natural
Resources and the Environment

As an assistant professor in the **Department of Natural Resources and the Environment** (NRE), **Beth Lawrence** focuses much of her research on the consequences of managing invasive plants. One such project is a three-year $650,000 EPA-funded collaboration in Northern Michigan with Oregon State University, Loyola University, Michigan Technological University, Dartmouth College, and the Sault Ste. Marie Tribe of Chippewa Indians, seeking alternative ways to combat a vigorous invasive hybrid cattail species.

The project focuses on the St. Marys River and Les Cheneaux Island region of the Great Lakes, where invasive cattails have encroached and diminished native-dominated wetlands, reducing the biodiversity of plants, fish, and wildlife. To study how to promote biodiversity in marshes where the cattail dominates, the group uses an amphibious harvester, cutting and shredding large swarths of cattails at the base and collecting the cut biomass that may prove useful for other applications.

"We've been doing this at a variety of sites, scales, and durations over the last couple years to investigate how cattail harvest affects plant, fish, bird, and animal diversity, as well as nutrient and carbon cycling in these wetlands," explains Lawrence, who has a joint appointment in UConn's **Center for Environmental Science and Engineering**. "We have found that harvesting cattails increases light penetration to the surface, and over time, we see that the cattails are not able to grow back, which provides an opportunity for native species to return. That's pretty exciting."

But there is a caveat: Wetlands are the world's largest natural source of methane, a potent greenhouse gas, and disturbing invasive cattails may increase methane release to the atmosphere.

"What's interesting in this project is how the carbon cycle is affected by harvesting this invasive species," Lawrence says. "While harvesting increases biodiversity, it also increases methane emissions as the stored carbon is released after harvest. It's complicated but it's important to understand the tradeoffs, whether we want to manage a wetland for biodiversity or carbon sequestration."

In a new project, funded with $298,000, from the Illinois Tollway, Lawrence is working with some of the same collaborators to assess the retention of road salt in wetland detention basins in the Chicago area.

Road salt contributes to the salination of freshwater areas throughout North America, reducing drinking water quality and affecting freshwater environments. The salt compounds leach into groundwater and subsequently infiltrate lakes and streams.

Cattails and common reed are two large invasive species that thrive in salty roadside ditches and detention basins and are capable of taking up and storing chlorides and heavy metals found in these roadside environments. The group is harvesting these basins and examining the chemistry and retention properties of these invasive plants. They are working with the Metropolitan Water Reclamation District of Greater Chicago with the idea of combining the invasive plant biomass with the water district's biosolids to create compost available for use by local municipalities.

"However," says Lawrence, "While we're interested in turning invasive species into something useful for society, such as soil amendments or biomass fuels, we need to know the chemical composition of its biomass," Lawrence says.

In a project focusing on Long Island Sound, Lawrence is working with Associate Professor **Ashley Helton** (NRE) and Associate Professor **Chris Elphick** (**UConn's Department of Ecology and Evolutionary Biology**) on a three-year $317,000 EPA-funded project. The group is examining how shifts in wetland vegetation associated with sea level rise and tidal restoration may affect carbon and nitrogen cycling.

Coastal wetlands on the Eastern Seaboard have salinity zones, becoming less salty and drier further inland, and plants sort themselves out along those gradients. Native *Spartina* marsh grasses live nearer the ocean, while the invasive grass *Phragmites* is not particularly flood or salt tolerant, so it grows at higher and drier elevations. This tall invasive plant outcompetes native grasses, reducing biodiversity, but, as with other invasive species, it is capable of sequestering carbon and removing nitrogen at higher rates than native grasses.

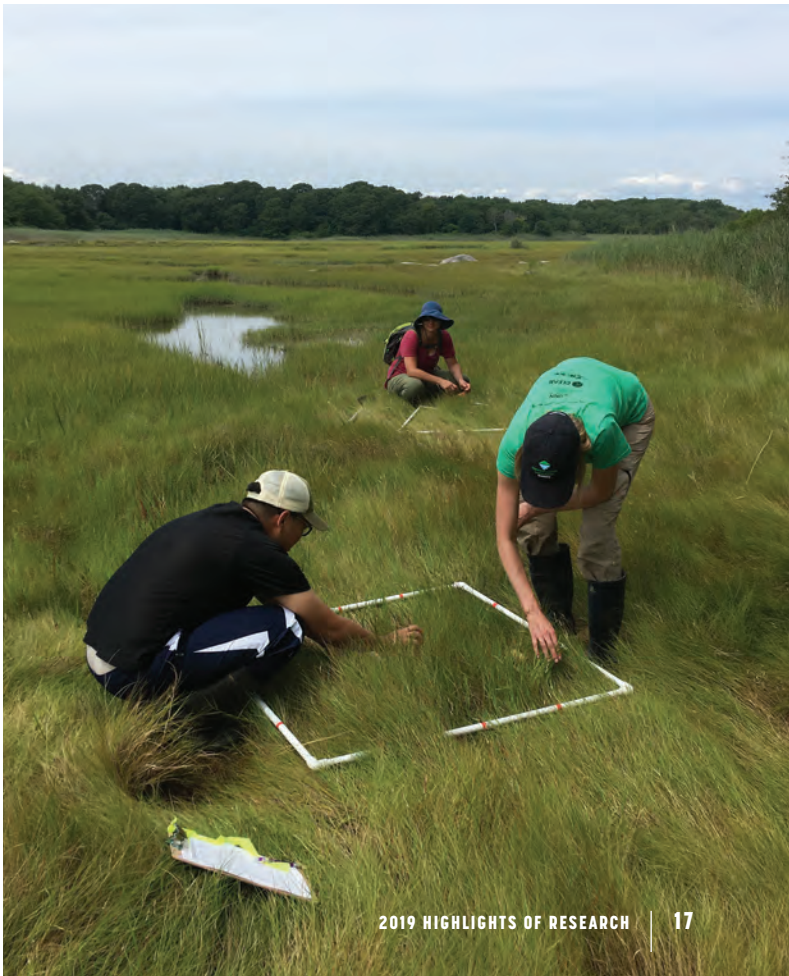
"While invasive *Phragmites* has negative consequences for biodiversity, there are some benefits," Lawrence says. "Our work suggests that soils dominated by *Phragmites* have greater nitrogen removal rates and hold on to carbon more effectively. It's critical to investigate and quantify these tradeoffs in ecosystem services so we can make more informed decisions on how we manage our remaining natural areas."

Lawrence is also involved in several other projects, including:

- A study of the effects of road salt on forested wetland plant communities and biogeochemistry in eastern Connecticut.
- A collaborative project involving cranberry bog restoration in Massachusetts. The state is restoring these agricultural wetlands to native-dominated wetlands that remove nitrogen and provide habitat for wildlife.
- A project with educators in the Long Island Sound region to create an interactive climate change module for high school teachers highlighting local examples of how climate change affects us in our backyard.

"These issues are important because in an era of global human domination, we need to wisely allocate limited conservation funding," Lawrence notes. "Do we spend our limited restoration dollars on combating invasive wetland plants that provide important carbon sequestration and nitrogen removal services? Or should we focus our conservation efforts on areas that harbor unique assemblages of species? These are questions that keep me up at night."

The research related to Long Island Sound is funded by EPA Award LI 96172701. The Illinois Tollway work is funded by AG190307 from the Illinois Tollway. The research related to the effects of road salt in eastern Connecticut is funded by USDA NIFA McIntire-Stennis Project CONS00968. The Massachusetts cranberry bog project is funded by USDA NIFA Hatch Project 1020626.



Nutritional Sciences Researcher Studies Sugar Kelp to Prevent and Treat Obesity

By Jason M. Sheldon

Young-Ki PARK

Assistant Research Professor
Department of Nutritional Sciences

Nutritional Sciences Assistant Research Professor Young-Ki Park says his recent research shows that fucoxanthin, a carotenoid from sugar kelp, may have benefits for human health. Carotenoids are pigments produced by plants and algae, and they can have powerful antioxidant properties.

Park studies bioactive compounds in foods as part of his research in molecular nutrition. Bioactive compounds are chemicals that promote health beyond supplying basic nutrients to the body. Despite their small quantity in foods, these extra-nutritional constituents can have profound effects on cellular and molecular metabolism.

"I study how nutrients enter the body and affect cellular responses and gene expression," says Park. "I want to understand which nutrients create a beneficial response and learn how to enhance it."

There have been many claims made about the benefits in taking supplements of various bioactive compounds, including carotenoids from sea vegetables, and their ability to promote good health and reduce or inhibit all kinds of diseases, but research to back these statements is limited. Park is addressing this knowledge gap. He recently completed a preliminary study using sugar kelp as a dietary supplement to treat and prevent diseases associated with obesity.

According to a 2016 study by the World Health Organization, an estimated 1.9 billion adults and 41 million children are overweight or obese. As body fat accumulates it can lead to numerous health risks, including conditions such as chronic inflammation, which is linked to many cancers and insulin resistance and the development of type 2 diabetes. Park conducted a study in mice to determine the effects of consuming sugar kelp (*Saccharina latissima*).

Sugar kelp is a type of seaweed, native to and cultivated in the waters of Long Island Sound and along the New England coastline. It is an edible and nutritious sea vegetable, high in micronutrients, including iron, fiber, calcium, and vitamins B and K, and is a natural source of fucoxanthin.

"Seaweed is an emerging industry in New England and more farmers are starting to grow kelp, but there have not been many studies on the health benefits for the species grown here," says Park.

Park says he wanted to give farmers a reason to grow sugar kelp by exploring one of the health advantages it could provide to customers. He also wanted to source fucoxanthin from seaweed because of his background in horticulture and plant pathology. He earned master's degrees in both fields before earning his doctorate in nutritional sciences.

"I had studied nutrient pathways in plants, and I was interested in plant-based bioactive supplements. I became interested in sea vegetable as it is known as a strong antioxidant. There are advantages in understanding the plant, animal, and human sides of things." says Park.

In the study, Park investigated sugar kelp's effect on adipose tissue, commonly known as fat. While it does store excess nutrients and energy, this tissue is also involved in numerous biological processes, playing a crucial role in immune function, energy metabolism, and endocrine function, synthesizing and secreting hormones throughout the body. When fibrosis occurs in adipose tissue, there is an excessive growth of connective tissues similar to scarring, which affects these metabolic activities. The body responds to this as a pathological condition and inflammation and insulin resistance may begin to develop.

Mice were put on high- and low-fat diets as controls, with a group on a high-fat diet that included the consumption of sugar kelp powder. While the results of his study have yet to be published, Park indicated that the mice on the high-fat diet with the sugar kelp supplement showed lower body weight, improved adipose tissue, and healthier liver tissue. Many of the markers measured indicated the high-fat and kelp powder diet were comparable or even better than the low-fat regime.

After these promising initial results, Park hopes to continue his research with a human trial using the kelp dietary supplement. The results could help formulate dietary recommendations of sugar kelp to prevent inflammation and insulin resistance caused by obesity.

"It's just been a cell and animal study so far," says Park. "We need to do a human study to learn more and especially to determine how much sugar kelp is beneficial for human consumption."

This research has been supported by USDA Hatch project CONS00978.

Social Media Becomes Healthy

By Patsy Evans

Sherry PAGOTO

Associate Professor
Department of Allied Health Sciences

Technology, if not used wisely, can have problematic effects. However, one group in the College of Agriculture, Health and Natural Resources is collaborating with researchers in other disciplines to find ways that mobile communication devices can help people improve their health, such as in losing weight and reducing the risk of cancer.

A general term for the use of mobile phones and other wireless technology in health care is mobile health, or mHealth. UConn's efforts are conducted in the **Center for mHealth and Social Media**.

The center's director, Professor **Sherry Pagoto**, says that the center has core missions of interdisciplinary research methodology, technology, and training. A range of experts from UConn and off campus, such as engineers, behavioral scientists, physicians, and computer scientists, "collaborate to tackle health problems from different angles," Pagoto said. The center also provides expertise in grant writing and creating collaborations.

Pagoto is the principal investigator or co-investigator for numerous ongoing grants and is on the faculty of the **Department of Allied Health Sciences** (AHS). As part of an mHealth research group, she works on understanding how to use technology tools in weight loss and cancer prevention, specifically.

"Dr. Pagoto is a trailblazer. She is leading efforts nationally to use technology, and in particular social media and mobile devices, to help prevent and better manage costly chronic disease. She is also building important bridges between academics and industry, getting them to partner together to increase the relevance and innovation in graduate training in behavioral and social sciences," says Justin Nash, department head and professor in AHS.

The availability of online health advice is growing daily, but researchers know that not all of it is from expert sources. Center staff want to deliver the health messages in the most effective way. UConn researchers are asking, "Is technology successful in impacting clinical and health-related outputs?" So far, the results seem promising.

For example, the center recently completed a study that used social media platforms to interface with those who wanted to lose weight. In this research, 25 to 50 people received health messaging and interaction with a weight loss counselor via a private Facebook group for three months, according to Pagoto. The participants were sent two Facebook feed posts a day that discussed making time for exercise, stress management strategies, and other weight loss topics. There were weekly goal setting and weigh-in days.

In addition, individuals were able to interact online with a professional weight loss counselor. Pagoto sees this as a bonus for busy people who may not have time or money to spend for regular appointments. She describes this social media method as "more access for less effort."

A positive result was that the members of the social media group supported one another and worked together to manage their weight. Many of them reported weight loss.

Pagoto's group is currently using Facebook in another research project focused on cancer prevention. She hopes to reduce the prevalence of indoor tanning by teenage girls by reaching their mothers through social media.

Pagoto says that one risk factor for skin cancer is the use of tanning beds, and that 15- to 25-year-olds are the most frequent visitors to indoor tanning facilities. Some states ban minors from using them while others allow visits with parental permission.

Therefore, it is important to reach moms, as role models and gatekeepers, with cancer prevention education. Pagoto says she hopes to discourage permissiveness for tanning among mothers and to encourage the establishment of lifelong healthy habits in the daughters.

Hundreds of moms nationwide are involved in the study. They receive information about the risk of tanning as well as other health topics, such as the HPV vaccine, good nutrition, and the dangers of smoking. Participants also learn to confidently address issues with their daughters when conversation becomes difficult. Pagoto said, "We give moms a tool for discussions, and we want both moms and daughters to make health decisions based on the best available evidence."

Results are measured by comparing answers on end-of-program surveys with answers to questions in the beginning surveys, which both mothers and daughters fill out.

In the future, the center will continue to study the best ways to leverage social media to deliver health promotion programs. Some questions being asked are "Where can we use social media in different ways to promote health?" and "What changes people's behavior?" Pagoto sums it up this way, "How can we communicate health messages that people understand and that move them to do something different?"

The UConn Center for mHealth and Social Media is housed within the Institute for Collaboration on Health, Intervention, and Policy (**InCHIP**), which has a multi-disciplinary focus on health behavior and policy.

Feasibility trial of a problem-solving weight loss mobile application was supported by NIDDK grant R21DK098556.

Likes, Pins and Views: Engaging Moms on Teen Indoor Tanning Thru Social Media is supported by NIH/NCI grant 1R01CA192652-01.

Kinesiologist Studies Blood Clots in Athletes and Side Effects of Statins

By Anna Zarra Aldrich

This article first appeared in UConn Today, June 10, 2019.

Beth
TAYLOR

Associate Professor
Department of Kinesiology

Beth Taylor is a lifelong runner and she is someone who has been lucky enough to turn her passion for exercise and health into a career in kinesiology.

Taylor is an associate professor in the **Department of Kinesiology** and director of exercise physiology research in cardiology at Hartford Hospital.

After graduating from Pennsylvania State University with a Ph.D. in kinesiology, Taylor was hired as a research scientist at Hartford Hospital, where she worked with Dr. Paul Thompson, chief of cardiology and the Athletes' Heart Program. Through her work with Thompson, Taylor was introduced to the world of sports cardiology.

"I loved the world of sports cardiology and I've continued to work with Dr. Thompson," Taylor says.

In working at both Hartford Hospital and UConn, Taylor has the unique opportunity to gain first-hand medical insights from the doctors like Thompson who see patients directly and then apply them to her research at UConn.

"The benefit with collaborating is it's very easy to get clinical populations and medical insights at Hartford Hospital," Taylor says. "And we can do things through UConn that we could never do at Hartford Hospital because it's not a research facility. It's a perfect combination."

One of the most interesting projects Taylor has worked on started with an incident that hit close to home. Taylor's sister flew from Seattle to run a half-marathon with her, but when Taylor's sister returned home, she got a blood clot–something very unusual for a young person in good shape.

"At the time no one really understood why this happened because she was a relatively healthy person and you don't usually see blood clots in athletic people," Taylor says.

This question inspired Taylor to conduct field studies at the Boston and Hartford marathons, drawing and analyzing blood samples from athletes who flew to compete in the races to assess their risk for blood clots.

Over the last five years there have been more studies about this issue, but when Taylor began her research, she was breaking new ground.

"When we did our studies, no one had ever really assessed this risk directly in a study," Taylor says.

A follow-up study showed that wearing compression socks at some point in the travel or event probably helps reduce the risk of blood clots.

"Compression socks probably do help reduce the risk of blood clots, but it's not as clear-cut and easy to explain," Taylor says.

One of the most challenging aspects of doing this unique field study was the amount and range of unknown and uncontrollable variables.

"You spend all this time on logistics, but after all of it's done, the data can look really messy because there could have been ten things that happen to a runner that day that affect your results that you can't account for," Taylor says.

Taylor's lab is always on the hunt for additional athletes to enroll in studies. They've launched **a new website** devoted to exercise and blood clots to bring more attention to the issue.

Another focus for Taylor is statins, cholesterol-lowering drugs. Statins are one of the most commonly prescribed drugs in the world, but they can cause a host of serious side effects, including the breakdown of skeletal muscle cells and muscle pain and weakness.

Currently there are no diagnostic test criteria to determine the effects of statins and how they should be treated. Taylor hopes to someday change that through her research.

Another project Taylor is working on is a collaboration with Robert Astur, an associate professor of psychology at UConn, studying the impact of regular exercise on a person's risk for Alzheimer's disease.

"We've started doing new research on the connection between the hippocampus and exercise," Taylor says.

The hippocampus is the part of the brain responsible for memory function and one of the first areas to be affected by the onset of Alzheimer's. In their study, Taylor and Astur will have participants take part in a virtual reality maze that focuses specifically on utilizing the hippocampus.

Taylor emphasizes that for her research to be possible, she values the support and resources of those around her.

"The longer you're in research, the more you realize it's not a single person game," Taylor says. "You need students, graduate assistants, faculty, and colleagues. And I've had some spectacular ones."

One person who stands out to Taylor is Linda Pescatello, a fellow UConn professor of kinesiology with whom Taylor has collaborated on many projects.

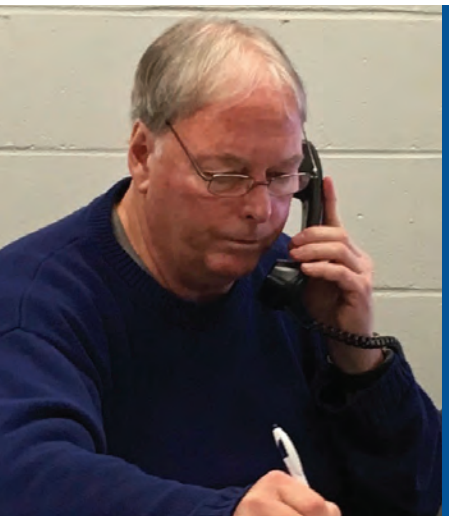
"She's been a real mentor to me," Taylor says. "She runs a really well-managed lab and that taught me a lot. It's important for a newer researcher like I was to have someone like that."

Taylor says she is grateful that she has had the opportunity to do research that impacts so many people.

"I study very common things. And the more I talk to people about the work I'm doing, the more inspired I am because everyone is affected by these things or has a connection to someone who is," Taylor says. "It's really great that I'm inspired by the research I do. I'm grateful and humbled."

National Animal Vaccine Research Coordination Network Connects with Partners, Sets Priorities

By Jason M. Sheldon



Steaven GEARY

Professor and Head
Department of Pathobiology
and Veterinary Science

Vaccination is one of the safest and most effective ways to protect individuals from disease. According to the World Health Organization, **two to three million deaths are prevented every year** because of immunizations. In addition to the crucial role they play in human health, vaccines are also an important tool to prevent illness in hundreds of millions of companion animals and livestock.

The creation of new and improved vaccines to respond to current and emerging infectious disease threats to animal health has long been a priority for the **Center for Excellence in Vaccine Research** (CEVR) in the **Department of Pathobiology and Veterinary Sciences** (PVS). Established in 1998, CEVR is the oldest university-based animal vaccine center in the country. Under the leadership of Steven Geary, professor, department head, and director of the center since its inception, CEVR has taken a multidisciplinary and collaborative approach to animal vaccinology.

The demonstrated success of CEVR in leading cooperative initiatives in animal disease research is one reason it was recently designated the center of operations for the new US Animal Vaccinology Research Coordination Network by the USDA's National Institute for Food and Agriculture. Geary was named network chair with additional leadership provided by network coordinator Edan Tulman, a research associate in PVS, and a board of directors.

The vaccine network brings together academic, government, and corporate vaccine researchers to identify current and future agricultural and aquacultural vaccine needs and opportunities to safeguard the country's food supply. The network capitalizes on ongoing multidisciplinary research at partner institutions, working to coordinate technologies and program components to ensure efficient use of resources, preventing duplication of effort to achieve a common purpose. Geary says quickly distributing information gained at one unit to others is essential to develop integrated strategies based on collective data.

In agriculture, vaccines safeguard productivity by improving animal and herd health. Vaccines can be an alternative to antibiotics, combating antibiotic resistance in livestock and reducing concern over traces of medications in farmed animals. Vaccinating livestock also curtails potential zoonotic diseases, pathogens that can pass from animals to humans.

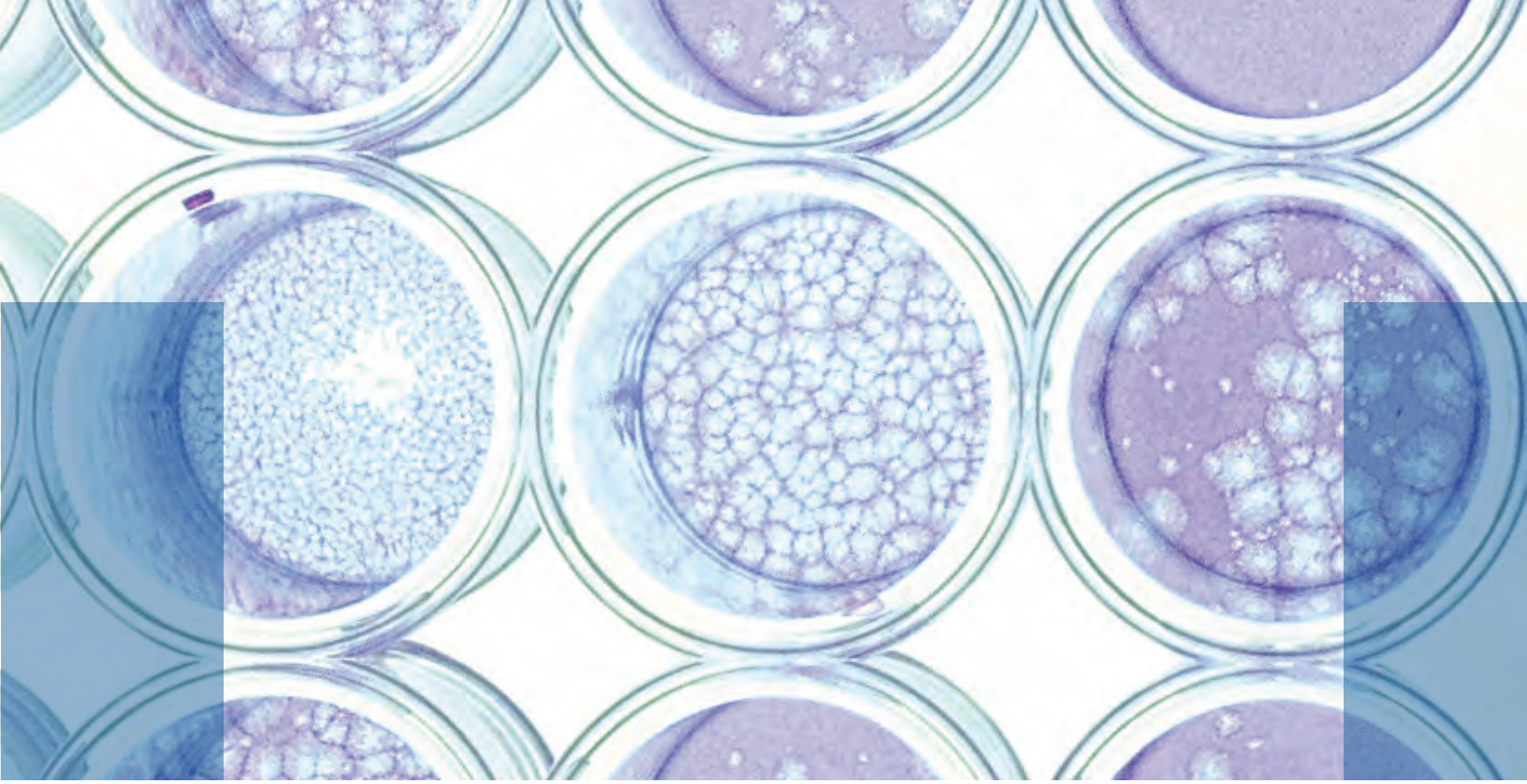
"We will be including some researchers who are working on human vaccines also. That's not the focus of the network, but I think discussion and sharing of knowledge and technologies is very valuable," says Geary.

The development of vaccines for food animals is a long and expensive process with many obstacles. Livestock vaccines must be safe and efficacious, but factors that affect the work of vaccinologists include demands by the agricultural industry; funding for research and production; product cost and availability; and regulatory approval processes. To start addressing these hurdles, the vaccine network held their inaugural meeting in November 2019 in Chicago at the Conference of Research Workers in Animal Diseases (CRWAD). The goal was to introduce the network and discuss partnerships with CRWAD members to identify research priorities.

Says Geary, "We had a hundred people join us and we were pleased with the level of enthusiasm and engagement for the initiative."

Geary says discussion topics included issues that slow the development of vaccines; calls to study new adjuvants, ingredients that can strengthen the immune response; targeting vaccines to specific tissues and cells; and improving vaccine delivery systems. As with those for humans, many agricultural vaccines are administered by needles and some vaccines require multiple shots, making inoculation challenging and expensive.

"It's labor intensive to vaccinate food animals," says Geary. "If you have to do it two or three times it drives the costs up, not only for the vaccine, but in manpower as well. Even in human health, it can be difficult to get people back for that booster shot. It also might be impractical if you're talking about areas where people or animals have to make quite a trek to



get even an initial vaccination. We're looking at the ability to stimulate long-lasting and protective immunity with a single administration of a vaccine."

The vaccine network is currently organized into six investigative teams. Five are focused on particular animal species, including ruminant, poultry, swine, equine, and fish, while another group focuses on new research technologies. The team leaders are responsible for gathering and organizing information to identify gaps and needs of the teams and the members of the network as a whole. Geary says the network will communicate findings to the USDA, sharing information that will help drive research initiatives and program funding at a national level.

"While there are high-profile diseases, we didn't want to focus on any one in particular. This is about the needs of the research community and getting something from the lab to finished product. These teams will get us going, but there may be more in the future. In this way, it's similar to another highly successful network with which we've recently established a formal linkage," says Geary.

Geary is referring to the **International Veterinary Vaccinology Network**, a research collaborative with more than a thousand members from countries around the world working to develop improved vaccines for livestock and zoonotic diseases.

"They see great potential in our vaccine network," says Geary. "They're eager to access our US membership and we're anxious to partner with them. Initially, the USDA wanted this to be a national entity, but they clearly see the benefits of global collaborations and expansions."

The network is thinking about the next generation of researchers as well. Another objective is to create a vaccinologist training program. Geary says the program will mentor researchers early in their careers, within five years of receiving their doctoral degrees. Geary envisions enrolling five vaccine researchers chosen through a competitive process that considers experience, accomplishments, vision, and commitment to the field of vaccinology. The program will provide guidance in grantsmanship and in the requirements for developing and licensing vaccines, to ensure students understand regulatory conditions, manufacturing costs, and the mechanics of distribution. Network members will collaborate to create a curriculum tailored for each student that seeks to expand their capabilities and introduce them to new thought processes.

Says Geary, "When Edan and I first worked on the proposal to develop a network that coordinates all the research activities for animal health around the country, it might have seemed that the big Midwest universities, where more agriculture takes place, would make more sense as a center of operations. But it's not about the animals in your backyard, it's about the research that goes into this: the concept, the designs, and the ability to get things funded."

The vaccine network is funded by USDA NIFA Project CONS2018-06661.

Molecular Geneticist Advances Cannabis Science with Research Partnerships and Course Offering

By Jason M. Sheldon

Gerald
BERKOWITZ

Professor
Department of Plant Science
and Landscape Architecture

In spring 2019, UConn offered an undergraduate course unlike any other in the country. The new class introduced students to the science behind cultivating a healthy crop of cannabis. Offered through the **Department of Plant Science and Landscape Architecture** (PSLA), the course grew from research started by **Gerald Berkowitz**.

Berkowitz, a horticulture professor, began studying cannabis at UConn after the passage of the 2014 US Farm Bill. The bill included a provision that allowed institutions of higher education to grow and cultivate industrial hemp, a non-psychoactive strain of cannabis, for research purposes. That same year, Connecticut began to issue growing licenses for medical marijuana businesses. Berkowitz visited one of these local growing facilities and learned the company was interested in building a research partnership with a university. After receiving a grant from the company, Berkowitz brought cannabis research to UConn.

Berkowitz soon developed a second research project with another company to study additional aspects of commercial growing, leading to the planting of two acres of hemp at the department's research farm. This **initial research** centered on cannabis genetics and the production and extraction of cannabidiol (CBD), a highly valued chemical extracted from the plant's flowers. CBD is purported to have therapeutic effects and is used in a variety of products. Only hemp plants are used for research in Storrs, and they are legally required to contain less than 0.3 percent of tetrahydrocannabinol (THC), the principal psychoactive component in cannabis.

These projects created opportunities for students to become involved with Berkowitz's research. He began advising several undergraduates in hemp-related independent studies. Research partnerships with additional growing facilities and companies followed for Berkowitz and other faculty members, with the department increasingly seen as a leader in **cannabis research**.

Berkowitz says that PSLA graduate student Peter Apicella is leading the bulk of the research on cannabis in the Berkowitz lab. Yi Ma, a research assistant professor in PSLA, directs the molecular genetic aspects of the research. Both supervise undergraduate students doing research projects. In addition, Berkowitz collaborates with **Yi Li**, PSLA professor and director of the department's Transgenic Plant Facility, on his research.

The creation of independent studies and expanding research partnerships in the department allowed Berkowitz to help coordinate undergraduate student internships with medical marijuana growing facilities, flower testing labs, and cannabinoid extraction factories. Considering students' active involvement in research and professional work opportunities, creating a course open to all UConn students seemed a logical next step to Berkowitz. He also saw the class as a platform to share the accumulating knowledge from these ongoing research projects.

"For too long, there has been a paucity of bona fide scholarship in the area of cannabis horticulture and molecular genetics," says Berkowitz. "We are a university in the business of generating and using knowledge. As far as courses related to cannabis, what better place to 'turn on the light' and generate knowledge in this area?"

With PSLA alumnus Matthew DeBacco, Berkowitz developed the three-credit course Horticulture of Cannabis: From Seed to Harvest. In addition to sharing science on cannabis, the course provides students with agricultural training to meet industry needs.

As of early 2019, **Leafly and Whitney Economics estimated** there were 211,000 full-time workers in the US cannabis industry, representing a gain of 44 percent from the previous year. As cannabis businesses continue to thrive, companies are looking for trained scientists and students are seeing potential career paths.

The horticulture class covers the life cycle of cannabis and addresses issues related to indoor and outdoor growing. Production techniques specific to the cannabis plant are discussed, including seed production, propagation of clones from cuttings, pruning and plant training, soil and tissue testing, and crop management techniques. Course topics also include plant hormones and genetics. To provide students with hands-on examples, new hemp plants are seeded and tended throughout the class.

Hundreds of students from different majors across UConn signed up for the course. An **online version** of the class was available last summer and the on-campus offering returned for spring 2020.

"Our cannabis course last year included invited lectures from a number of professionals in various aspects of the cannabis business," says Berkowitz. "In some cases, students enrolled in the course were lined up after class to speak with the lecturers about jobs in the industry. It seems there is a great need in the industry for our graduates; it's an expanding business and the job prospects seem excellent."

While the class received considerable media attention, behind the scenes Berkowitz continued to establish local and national partnerships with businesses and other universities to advance cannabis research.

Berkowitz is currently engaged in molecular genetic studies with companies in Connecticut and California. He continues to focus his work on the production of CBD, as well as other cannabinoids, by studying biological pathways and the expression of enzymes in cannabis. This research seeks to understand ways to control the production of these chemical compounds through the plant's hormones or through genetic engineering techniques.

Berkowitz is also aiding commercial growers with disease management by evaluating non-pesticide control strategies. This research examines the activation of defensive genes in cannabis to common pathogens, such as powdery and downy mildew.

In addition to these projects, Berkowitz is contributing his expertise in the areas of disease resistance and assessment of crop quality to a multi-state USDA study of hemp. The project coordinates and pools resources to evaluate hemp production, processing, and marketing across the US in an effort to ramp up basic research on the plant to help a rapidly growing number of stakeholders.

"As laws have changed and acceptance for medical marijuana has grown, we've seen more and more interest and more and more opportunities for students and faculty alike to delve into the science of cannabis," says Berkowitz. "UConn is making inroads on both the educational and research fronts to support our students, our science, and our state's economy."

National Seaweed Hub is Extension Educator's Latest Project to Spur Industry

By Jason M. Sheldon

Anoushka
CONCEPCION

Assistant Extension Educator
UConn Extension

Aquaculture, the farming of fish, shellfish, and aquatic plants, is the fastest growing sector of food production, currently providing more than half of the seafood consumed globally. But with overall consumption of both wild-caught and farmed seafood more than doubling in the last fifty years, according to a 2018 report published by the Food and Agriculture Organization (FAO) of the United Nations, questions have arisen about whether demand can be met sustainably in the future. Responding to those concerns in the United States, where the majority of seafood is imported, coastal states, including Connecticut, have been increasing their commitment over the last two decades to expand domestic marine aquaculture production.

Connecticut Sea Grant, a partnership between **UConn** and the **National Oceanic and Atmospheric Administration**, works to support Connecticut's aquaculture industry, including a shellfish industry that generates more than $30 million annually. Clam and oysters beds in Long Island Sound are providing residents with fresh seafood options. **Anoushka Concepcion**, an assistant extension educator with **UConn Extension** and an aquaculture specialist in Connecticut Sea Grant at UConn's Avery Point campus, is working to put another sustainable item on local plates: seaweed.

"Most of the work I do with seaweed is applied research and outreach," says Concepcion. "I respond to stakeholder requests and help them overcome challenges that they face."

For the last several years, Concepcion has been engaging with Connecticut farmers, processors, chefs, and regulatory agencies to advance the creation of a local market for seaweed. Seaweed is already a popular crop around the world, particularly in Asia, and interest in the United States is building. The 2018 FAO report found the global commercial seaweed market is currently a $6 billion industry and projected to continue growing. About 85 percent of the seaweed harvested is used for human consumption, as an additive in processed foods, and as an ingredient in sushi, soups, salads, and other freshly prepared dishes. Most seaweed available in the state is imported and found only at specialty markets.

"Asia has been cultivating seaweed for decades," says Concepcion. "The biggest challenge here is that there's no established market, but there is a lot of potential."

Concepcion has been assisting stakeholders, including industry and regulators, by offering guidance on the cultivation of sugar kelp (*Saccharina latissima*). An edible seaweed native to Long Island Sound, kelp is a nutritious sea vegetable, high in vitamins B and K, fiber, calcium, iron, and other minerals. It also has uses in many commercial products, such as pharmaceuticals, cosmetics, fertilizers, animal feed, and as a biofuel.

Along with other species, kelp also boasts numerous environmental benefits. It helps remediate pollution from wastewater treatment plants, stormwater, and agricultural runoff by absorbing excess nutrients, such as nitrogen and phosphorus. It can also reduce ocean acidification and produce oxygen, improving water quality and ensuring a healthy coastal ecosystem for shellfish and other marine life.

"Connecticut has long been a leader in seaweed research," says Concepcion. "UConn's Dr. **Charles Yarish** first received development funds from Connecticut Sea Grant to study our native seaweeds with the purpose of one day cultivating them. One of the first seaweed farms in the United States was established in Connecticut."

The trailblazing role that Connecticut has played in the study and growth of seaweed is set to continue with the establishment of a National Seaweed Hub in Groton, a project headed by Concepcion. She received a $1.1 million grant from the National Sea Grant Program to nurture the growth of a domestic seaweed industry in the United States by helping states reveal and remove barriers and identify opportunities. The project will create a repository of science-based information and descriptions about outreach efforts related to seaweed aquaculture.

By collecting and centralizing these resources, the Seaweed Hub will foster the exchange of practical resources to help stakeholders make more informed decisions. It will also enable Sea Grant programs around the country, along with local, state, and federal agencies, to guide planning and outreach efforts. The project brings together nearly two dozen partners, including other Sea Grant Programs, the National Sea Grant Law Center, and the Connecticut Department of Agriculture's Bureau of Aquaculture.

"The Seaweed Hub will provide a mechanism where Connecticut stakeholders can learn from other states how to address challenges and find opportunities in the areas of product development, processing, and market outlets for seaweed," says Concepcion. "We are also leading the way in food safety of domestically produced seaweeds."

There is no existing framework of regulations at the federal level regarding the handling, processing, and storage of seaweed or food safety guidelines. Concepcion says overcoming this hurdle would allow for expanded cultivation and investment in the seaweed industry. She has been developing protocols compliant with the Food and Drug Administration's (FDA) Hazard Analysis and Critical Control Point management system and the Food Safety Modernization Act Preventative Control for Human Food rule. Concepcion and the Bureau of Aquaculture are partnering with the National Sea Grant Law Center in a new initiative to craft a model law, regulation, or guidance document for the sale of seaweed in its whole form as food.

"The FDA hasn't made a decision on seaweed safety protocol and it depends if they choose to consider it as a produce product rather than a seafood product," says Concepcion. "We want to be proactive and develop practices that adhere to both standards. It's responding to a concern from the Connecticut Department of Agriculture to ensure the food safety of seaweed and from producers, who need authorization from the department to sell their products."

While addressing product safety is critical, another important challenge is getting seaweed into more kitchens, particularly of those who cook professionally and can help create popular demand. Concepcion has been working closely with the **Connecticut Chef's Association** about opportunities to incorporate sugar kelp into meals at restaurants and in catering fare. They have found numerous ways to include seaweed in dishes such as baked fish, rice pilaf, and manicotti as well as a variety of soups, stews, and salads.

Connecticut food processors are also exploring creating edible products for consumers. Concepcion says there has been interest in producing chips and pasta noodles using kelp. Her efforts to organize workshops and events that bring stakeholders together has proven to be a useful step in identifying and overcoming the difficulties facing the fledgling seaweed aquaculture industry.

"Chefs wanted to gain a better understanding of what seaweed is like to work with," says Concepcion. "By having the farmers and regulators explain what the production cycle is to chefs, the volume they're producing, the time of year it's available, and how the permitting process works, everyone can talk about challenges and opportunities. This creates a network."

She continues,"I like working at Sea Grant. I know what I'm doing with seaweed is contributing to something positive and addressing long-term needs."

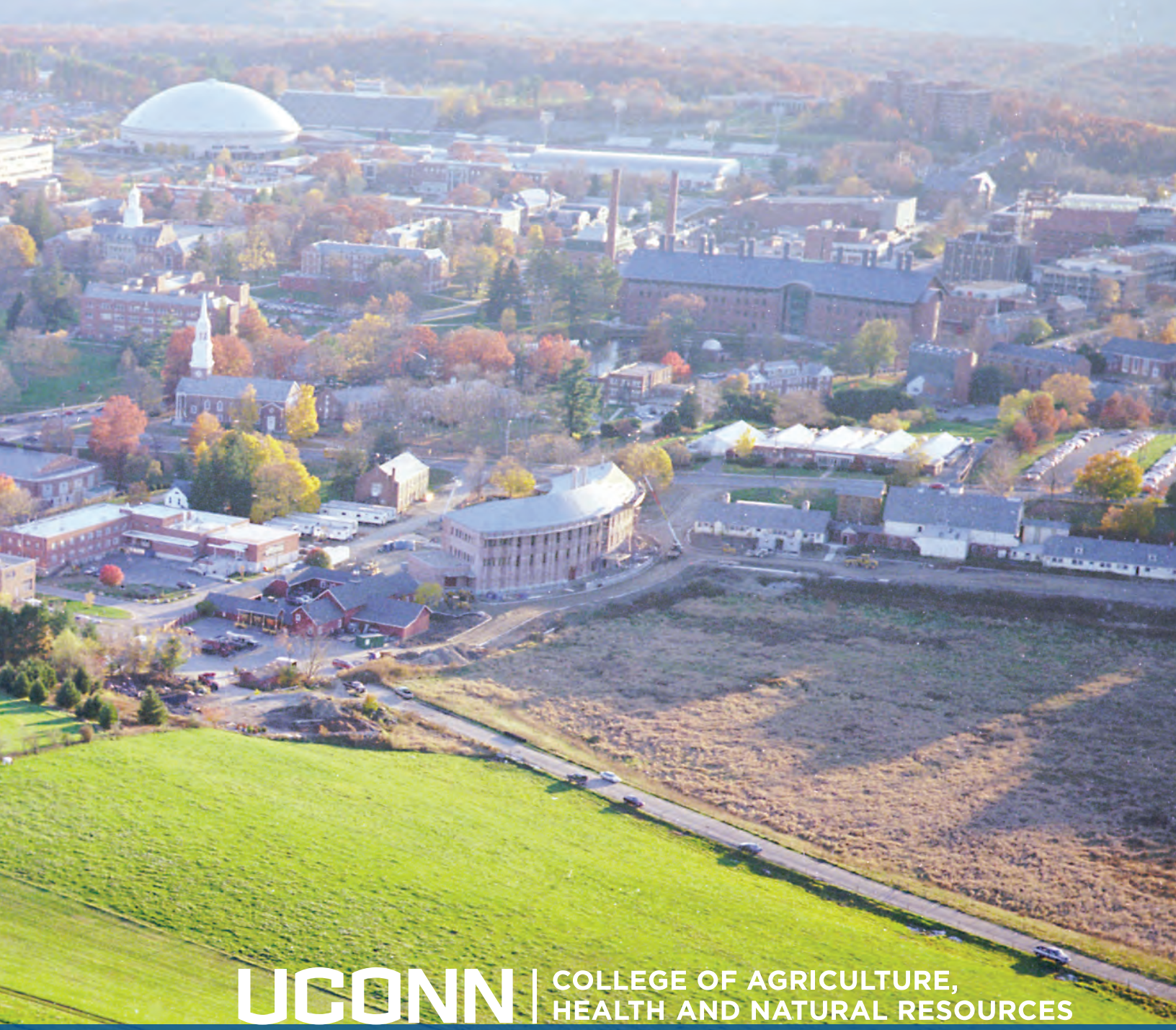
Administration

Indrajeet Chaubey
Dean and Director
(860) 486-2917

Kumar Venkitanarayanan
Associate Dean for Research and Graduate Education,
Associate Director, Storrs Agricultural Experiment Station
(860) 486-1957

Sandra Bushmich
Associate Dean for Academic Programs
(860) 486-2919

Michael O'Neill
Associate Dean for UConn Extension,
Associate Director, Cooperative Extension System
(860) 486-6270



Contributors

Anna Zarra Aldrich
Judy Benson
Patsy Evans
Dmitry G
Tessa Getchis
Kim Colavito Markesich
Sara Putnam
Jason Sheldon

Graphic Design by

Dean Batteson, Kevin Noonan

cahnr.uconn.edu

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1376 Storrs Road, Unit 4066 Storrs, CT 06269