



Industry Center

## **THE EGG INDUSTRY CENTER**

CONTRIBUTING TO A SUSTAINABLE EGG SUPPLY

2020

# IMPACT REPORT

# ADVISORY BOARD

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## PLEASE WELCOME NEW BOARD MEMBERS

**GREG HERBRUCK**  
President, Herbrucks Poultry Ranch, Inc

**MICKEY RUBIN**  
Executive Director of the Egg Nutrition Center

## THANK YOU



**Dr. Dennis Casey** was a founding member of the EIC Board and acted as chairman for five years. As a relentless promoter of EIC, his commitment and enthusiasm will be impossible to replace.



**Beth Schnell** was a founding member of the EIC Board. Her ideas, deep questions, insight and love for applicable industry research will be greatly missed.



**Dr. Susan Lamont** served on the EIC Board while Interim Director of the Egg Industry Center in 2019. Her commitment and leadership during this crucial time will never be forgotten.

EIC thanks each of you for your service, and wishes you the very best in your future endeavors.

# A YEAR OF CHALLENGING FIRSTS ONLY HEIGHTENS EIC'S IMPACT

All corners of the globe and all sectors of the food industry have felt the disruption and uncertainty of 2020. While the COVID-19 pandemic still smolders, the summer storm season packed a punch with an incredible straight-line windstorm that devastated millions of acres of crops, toppled structures, and wreaked havoc on communities throughout the Midwest while seasonal hurricanes brought the same destruction plus flooding to coastal regions and western wildfires have incinerated forests and communities with impunity.

Yet, as awful and heartbreaking as these events are, the resilience and strength of people and communities, and their commitment to building a better world, are astounding. "The human spirit is not measured by the size of the act, but by the size of the heart" (Smirnoff). The many heart-felt displays of compassionate action this year have been inspirational.

As EIC's new director, it is refreshing to see that the Center's board remains energetic, visionary and committed to our mission of research and outreach. Here at the Center we have adjusted to a number of firsts this year, perhaps most significant being the shift to a completely online Egg Industry Issues Forum, an assessment and educational campaign regarding the impact of COVID-19 on the egg industry, and a move to a mostly remote work environment.

In addition, we have seen successful completion of previously funded research projects, and with the generous support of donors, our endowment has funded another round of research work. Please enjoy a few of these many successes in the following pages and visit our website for others.

Big changes will continue in our industry, with greater pledges for cage-free eggs by retailers, but little direct investment in facility conversion and construction. Amid all the disruption, EIC remains laser focused on providing research and analysis that adds value to the industry and its stakeholders. While the Center does not develop policy, the research we help facilitate directly addresses the social, environmental, welfare, and food safety aspects needed to help guide that policy development in a sane and rational manner. If you have journeyed with us this year, thank you for your partnership; if you haven't, please join with us as we work to advance the U.S. egg industry into the future through impactful research and outreach.

**RICHARD GATES**  
Director, Egg Industry Center  
Iowa Egg Council Endowed Professor  
Iowa State University



RICHARD GATES

Amid all the disruption, EIC remains laser focused on providing research and analysis that adds value to the industry and its stakeholders.



Cover photo courtesy: Big Dutchman, Inc.

# ENHANCING CAGE-FREE AIR QUALITY

Cage-free egg commitments by major US food retailers and restaurants, plus state mandates being added to the law books, mean that more than 70% of the current US layer inventory will need to be raised in cage-free housing to meet the demand by 2026.

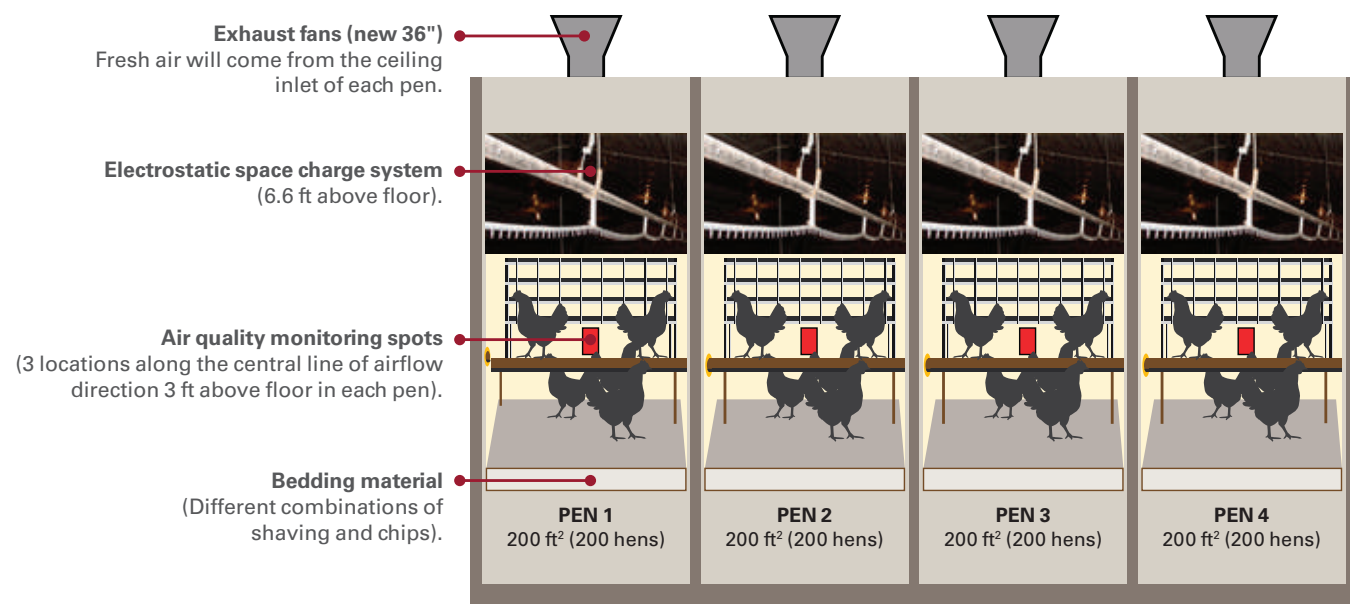
While cage-free housing allows birds to perform more of their natural behaviors (e.g., foraging, dustbathing, wing-flapping) than is possible in conventional cage housing systems, an inherent challenge with cage-free housing is less than optimal indoor air quality. Ammonia, particulate matter (dust), and airborne bacteria are common challenges, especially during cold weather when the house has limited ventilation.

The air quality challenges in cage-free units primarily arise from the accumulation of manure and wet litter on the floor which can result in increased ammonia production. Excessive particulate matter can arise from birds dustbathing, foraging on the litter, and their general activity. This particulate matter is the primary carrier of airborne bacteria (as well as endotoxins, viral particles, and fungi spores) in animal housing. A new study proposed by Dr. Lilong Chai at the University of Georgia (UGA) is employing an integrated system to simultaneously mitigate ammonia, particulate matter, and airborne bacteria generation in cage-free henhouses with the support of a “2019 challenge grant” from the Egg Industry Center.

Dr. Chai is a tenure-track assistant professor and engineering specialist in the Department of Poultry Science at UGA in Athens, Georgia where he’s worked since 2018. His research and extension interests include animal environmental engineering, precision poultry farming, and poultry health and welfare as affected by production management. Dr. Chai will collaborate with Drs. Casey Ritz and Woo Kim of the UGA Poultry Science and Dr. Deana Jones of USDA ARS-Athens in this project. The team has already done tremendous work related to poultry house air quality management, but in this case are combining their previous experiences to enhance air quality in cage-free henhouses by investigating the role of various management practices, including bedding material adjustment, electrostatic space charge systems, water sprinkling, and litter materials.

This study is expected to yield a practical means of, and best management practices for, suppressing ammonia, particulate matter, and airborne bacteria levels. These best management practices will in turn lead to a healthier year-round environment for the birds and their caretakers.

Chai’s team is well versed in this subject matter. For instance, Chai has tested various water sprays in the laboratory and commercial houses and found that higher water spray dosages did result in higher particulate matter reduction efficiency. However, ammonia generation also increased



The goal of this research is to improve cage-free house air quality to acceptable levels (e.g., 80-90% reduction in airborne dust/bacteria concentrations and 50% reduction in ammonia).

with liquid agents as did bacterial generation due to elevated litter moisture content.

The electrostatic space charge system (ESCS) is another intriguing potential strategy for reducing airborne pathogens. A study of ESCS for dust mitigation led by co-investigator Dr. Casey Ritz found that the ESCS significantly reduced airborne dust and ammonia in a broiler house. Currently, the concern in using an ESCS in a cage-free henhouse is the dust accumulation on grounded surfaces such as ceiling, walls, and equipment. Dr. Chai and his team will innovate the system design by developing an automated dust cleaning/removal operation.

In other past work, Chai observed that using a larger size of wood shavings/wood chips in bedding may reduce dust generation from a litter floor in poultry houses. A good quality bedding product should be super absorbent, compostable, and create minimal dust. There is currently no standard for litter in a commercial cage-free henhouse. Chai and his team of colleagues will try to determine how much substrate should be used and its quality (e.g., shaving/chips size, depth, and moisture) as each of these may affect animal welfare and indoor air quality.

The goal of this research is to improve cage-free house air quality to acceptable levels (e.g., 80-90% reduction in airborne dust/bacteria concentrations and 50% reduction in ammonia). The research team expects the study to yield practical best management practices for improved litter management (e.g., bedding material adjustment, water sprinkling, and litter additives, ratio of different size shavings, depth, moisture, and pH) and air treatment (electrostatic space charge system).

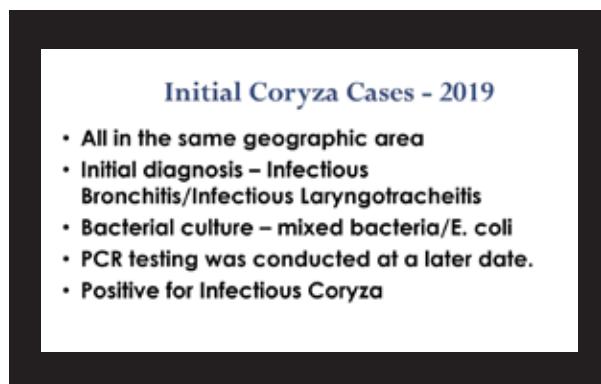
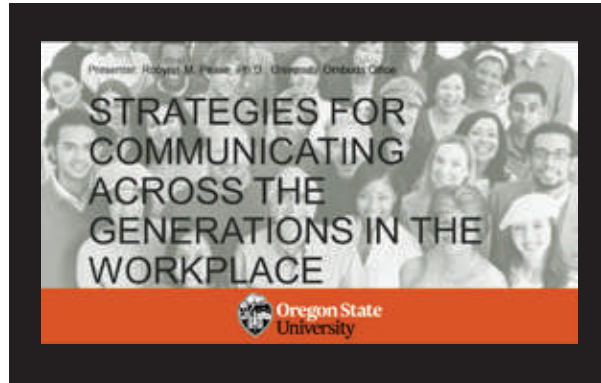
The first stage of the project will be the test of mitigation strategies on the UGA Poultry Research Farm and the second stage of the study will be verification tests on a commercial cage-free poultry farm. Ultimately, these mitigation strategies will lead to enhanced environmental stewardship of cage-free operations by lowering emissions and increasing the fertilizer value of the litter.



This photo: Dr. Lilong Chai, principle investigator for project

Left: Diagram for the project pens located at the UGA Poultry Research Farm

# 2020 EGG INDUSTRY ISSUES FORUM A VIRTUAL SUCCESS



The Egg Industry Center (EIC) adds value to the business of egg production through the identification, funding, and dissemination of relevant research designed to address current issues, as well as timely reviews of economic impact and outlook. EIC's flagship vehicle for distributing all of that information is the annual Egg Industry Issues Forum. However, like so many events of 2020, our face-to-face Egg Forum attendance was cancelled as COVID-19 concerns ramped up and was instead held in a virtual format.

“While cancellation of the April 15 in-person Forum venue was unfortunate, we felt it was in everyone’s best interest to try to minimize the spread of this virus,” said Dr. Richard S. Gates, director of EIC. “We are so fortunate that our sponsors, partners, speakers and registered participants graciously allowed us to move forward in this new way for 2020.”

Although it looked different, the annual education and outreach event organized and facilitated by EIC achieved its goal of updating and increasing egg farmer and allied-industry awareness of research developments and priority issues concerning the U.S. egg industry. This year, EIC transformed speaker presentations into webinar-style educational segments, creating a virtual Forum experience that was free of charge on the Egg Industry Center Egg Forum webpage. Presentations included a variety of topics including research on cage-free building ventilation strategies, communication in the workforce, hen health protection, and market trends.

The unique viewership of the virtual presentations was higher than the combination of past annual attendance and all post-Forum presentation downloads. “The increase in traffic could have resulted for a variety of reasons, but it definitely demonstrates success in reaching more people with the latest information, and that’s our mission,” said Lesa Vold, EIC’s communications specialist.

EIC thanks its generous sponsors, talented presenters, and virtual attendees for their patience and flexibility during this unprecedented time. It is because of each of them that the virtual Forum was a success.

“We are so fortunate that our sponsors, partners, speakers and registered participants graciously allowed us to move forward in this new way for 2020.”

DR. RICHARD S. GATES, EIC DIRECTOR



## EGG FARMERS OF CANADA PARTNERS FOR AN INNOVATIVE FUTURE

IOWA STATE UNIVERSITY  
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## STUDIES RECEIVING EGG FARMERS OF CANADA SUPPORT

2015

Identifying genetic basis for resistance to avian influenza in commercial egg layer chickens  
**Completed**

2015

Evaluation of alternative environmental sample matrices for avian influenza surveillance and stability in commercial poultry facilities  
**Completed**

2015

Evaluation of feedstuffs for the presence of avian influenza virus collected from feed mills and poultry farms and their role in spreading of avian influenza  
**Completed**

2016

Analysis of sequence data of survivors and controls from highly pathogenic avian influenza outbreaks  
**Completed**

2016

Feasible methods to extract immune-enhancing yolk IgY and produce differentiated and functional yolk products  
**In progress with report anticipated AUGUST 2021**

2017

Feathers as convenient samples for monitoring avian influenza virus in poultry houses  
**In final reporting stage**

2017

Characterizing intestinal health, bacterial communities and their interaction between caged and cage-free housing in commercial layer  
**In final reporting stage**

2018

Studies on infection parameters of the newly emerging avian reovirus variants on egg-laying hens and efficacy of non-metallic disinfectants on reovirus  
**In progress with report anticipated OCTOBER 2021**

2019

False layer syndrome in hens, prevention strategies and their long-term effects  
**In progress with report anticipated MARCH 2023**

Since 2015, Egg Farmers of Canada has helped fund key research that has provided important results for the North American egg industry. The following are highlights of the impact of a few projects. For more details regarding each project, please see the center website at [www.eggindustrycenter.org](http://www.eggindustrycenter.org).



### Studies on effects of the newly emerging avian reovirus variants on egg-laying hens and efficacy of non-metallic disinfectants on reovirus

Avian reovirus and *Gallibacterium anatis* are a health challenge in the laying hen industry. This project is twofold: It will study the infectivity, transmission, immune response, length of infection and effects on egg production for three index strains of the newly emerged layer avian reovirus variants in egg-laying hens. It will also test the efficacy of non-metallic or “soft” disinfectants for disinfection of the variants. Additionally, it will conduct a *Gallibacterium* survey for peritonitis problems on layer farms and include the study of genetic diversity of *G. anatis* field isolates. It will then develop a simple molecular typing technique to track *G. anatis* in poultry farms and study antimicrobial resistance patterns in *G. anatis*.

#### Anticipated deliverables

This project will define parameters of infectivity, transmission, immune response, length of infection and effects on egg production for newly emerged layer avian reovirus variants in laying hens. It will also determine the population dynamics of *Gallibacterium* related to the development of peritonitis within commercial layer flocks, as well as recommend the most effective “soft” disinfectants to be safely applied in egg laying hen flocks for the control and prevention of avian reovirus infections, *Gallibacterium* related disease and other avian viral and bacterial diseases.

(PI: Huaguang Lu, The Pennsylvania State University)

### Evaluation of alternative environmental samples matrices for avian influenza virus surveillance and stability in commercial poultry facilities

The main objective of this study was to validate the efficacy of collecting environmental samples using items such as Swiffer® sweeps and drag swabs, and from water, feather and feed as convenient surveillance sampling for accurate and timely detection of avian influenza in a flock. The study also intended to optimize processing of these sample matrices and test performance to reliably detect the virus.

#### Takeaway

This study showed that using environmental samples provides a convenient and continual method of animal and facility monitoring without invasive sampling of live hens. While further testing is needed to verify efficacy of the method for detecting the early stage of an outbreak of avian influenza, these results demonstrate its distinct possibility.

(PI: Phillip Gauger, Iowa State University)

### Identifying genetic basis for resistance to avian influenza in commercial egg layer chickens

The objectives of this study were to conduct a case-control genome-wide association study to identify genomic regions that differ between HPAI survivors vs. their age- and genetic-matched controls, and determine whether the same genetic regions affect survival to avian influenza in three genetic varieties of commercial layer chickens and whether the same genetic regions affect survival of H7N3 and H5N2 strains of the virus.

#### Takeaway

Analysis of the DNA from highly pathogenic avian influenza survivors showed a genetic influence on survival, with genetics appearing to account for 20 percent of the variation in survival rate. However, there is neither a single gene nor a small number of genes involved with the resistance, which complicates the process of selecting for improved resistance.

(PI: Anna Wolc, Iowa State University)

### False layer syndrome in hens, prevention strategies and their long-term effects

This research will study false layer syndrome, a condition in egg-laying flocks in which hens do not reach peak production. This disease is thought to be caused by early exposure to Infectious Bronchitis Virus (IBV).

#### Anticipated deliverables

This research will answer the following questions: What virus mutations enable the IBV subtypes that induce false layer syndrome lesions? What field strain of the disease can be replicated so that prevention strategies can be studied to determine the repercussions of the preventive strategies being used?

(PI: Rodrigo Gallardo, University of California - Davis)



I want to thank the Egg Farmers of Canada for their generous and sustained financial support of the EIC. Their funding allows us to broaden our research project portfolio and increase the number of relevant projects that are funded each year. EFC's participation in the EIC is critical to shaping a North American focus on emerging issues in the egg laying industry.

**RICHARD GATES, EGG INDUSTRY CENTER DIRECTOR**





Through their partnership with the Egg Industry Center, Egg Farmers of Canada has supported research that has provided practical solutions for egg farmers and helped ensure a safe and secure way forward from the threat of avian influenza – and other challenges – for the entire North American egg industry.

The Egg Industry Center looks forward to a continuing partnership that will advance the entire North American egg industry through research and innovation.

IOWA STATE UNIVERSITY  
FOUNDATION

A world where everyone – whether it be due to want or need – can enjoy the immeasurable benefits of the humble egg.

EGG FARMERS OF CANADA VISION STATEMENT

## ECONOMICS

# EIC HELPS INFORM COVID-19 RESPONSES

For U.S. egg farmers, the COVID-19 pandemic could not have come at a more economically vulnerable time. Low prices in 2019 led to economic losses leaving the industry operating on limited financial reserves as we entered the first quarter of 2020.

The immediate effect of COVID on the egg industry can perhaps best be described as a tale of two markets: a sharp but short-lived increase in shell egg demand, and a less sharp but more sustained decrease in demand for egg products.

Almost instantaneously, the Egg Industry Center (EIC) staff was inundated with urgent stakeholder calls and electronic inquiries for accurate and current data to inform their responses. EIC took decisive and direct action by generating special reports and fact sheets to help industry leaders understand what was going on with the markets and more importantly how to respond and relate meaningful market information to their customers, clients, and others.

Several local, state, and national organizations as well as officials at various levels of state and federal government turned to EIC to navigate their pandemic responses. Information EIC shared was used by entities ranging from the local food bank system all the way up to the United States Department of Agriculture (USDA) and its work with the federal Coronavirus Food Assistance Program (CFAP).

In addition, it was important for stakeholders to understand normal liquid and shell egg market fluctuations and Extension offices needed to know how best to inform farmers on the disposal of liquid egg deliveries refused by restaurants and hotels under the force majeure clause in their contracts. EIC worked to disseminate pertinent information to industry media as well.

The pandemic provided an opportunity to showcase the ongoing importance of EIC's mission. The COVID response required science-based facts and answers to questions for people in authority needing to determine next steps, for farmers, for the industry, and for the government.

Looking back at the first half of 2020, the industry experienced the second greatest drop in the national layer flock since the avian influenza outbreak in 2015. That market disruption was caused by a lack of supply, but the COVID-19 situation was created by shifts in consumer demand.

While EIC doesn't have a crystal ball, USDA is projecting a consumption drop from 293 eggs per person in 2019 to 284 eggs per person in 2020. EIC expects this potential drop in demand will further exacerbate egg farmers' inability to access the credit needed to convert (or expand) current facilities into cage-free henhouses.

It is no secret that our industry faces a challenging time ahead, but EIC remains committed to the hard work, research, analysis, and ingenuity that can help the industry come back strong!



U.S. RETAIL LARGE WHITE EGGS PRICE JANUARY 2010–JUNE 2020

# DATA-DRIVEN EDUCATIONAL MODULES FOR TRAINING EMPLOYEES

The overall goal for this project is to establish a video training tool template that could identify and then respond to gaps in caretaker knowledge and skills.

A hundred years ago, when nearly everyone kept chickens, people were somewhat versed in their care and handling. Knowing to keep an eye on the rooster or how to coax an egg away from a broody hen were early life lessons, like riding a bike. Today, the business of your breakfast eggs has evolved into a cutting-edge industry, featuring automation and sophisticated technology, requiring a new set of skills.

The availability of qualified personnel to execute continuous, quality animal care is critical to the success of an egg-farming operation. Ideally, automation and species-specific equipment enhances the birds' quality of life. However, egg farmers agree that even the latest technology does not eliminate the need for human caretakers making on-farm assessments and manually monitoring the flock.

Because many issues that arise in an egg production enterprise are management related, proper attention must be given to training new employees and developing a review process for existing employees to keep their husbandry skills sharp. Any personnel interacting with birds must be proficient, knowledgeable, and skilled to ensure compliance with animal care guidelines, such as those developed and promoted in the United Egg Producers (UEP) Certified program.

As in any business, employee orientation and training are key to setting the tone for the future employment relationship. Because the majority of the current workforce is of the Millennial generation (born 1981-1996), technology is a useful tool when training employees. While "microlearning" sessions (content delivered in brief, targeted formats) are easily accessible online for the commercial swine and broiler processing industries, these resources are not yet readily available to the commercial egg industry.

To address this training gap, principal investigator Dr. Yuko Sato assembled a dream team of investigators and industry collaborators to study "Data-driven Development of Task-specific

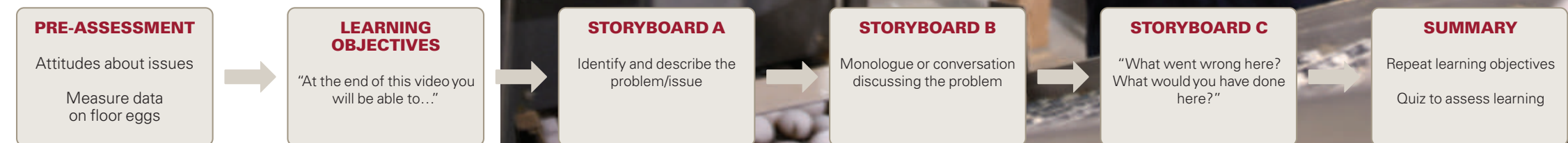
Educational Modules for Training Layer Employees in Animal Husbandry to Elevate Management Standards." Sato is a veterinarian and a Diplomate of the American College of Veterinary Pathologists and is an assistant professor in the Department of Veterinary Diagnostic and Production Animal Medicine (VDPAM) in the College of Veterinary Medicine at Iowa State University (ISU). Her ISU research team includes Mohamed El-Gazzar, assistant professor VDPAM; Suzanne Millman, professor VDPAM; Brett Ramirez, assistant professor, Department of Agricultural Engineering; and Jesse Robbins, postdoctoral researcher assistant VDPAM. The team will work with Dr. Craig Rowles, a veterinarian, and Director of Cage-Free Operations for Versova Management Company, LLC.

With a team ticking all the boxes in behavior (Millman), engineering (Ramirez), and health (Sato/El-Gazzar), the goal of Sato's research is to target knowledge gaps with informative and effective video learning modules that can be applied in different management settings. As a starting point, live-production supervisors at Versova Farms/Iowa Cage-Free LLC met and identified critical knowledge gaps for their incoming and current employees. The consensus was that a majority of new caretakers needed specific training to ensure they could complete their work properly. Sato agreed, saying "With the current move to cage-free management, an understanding of bird behavior and animal husbandry has never been more important."

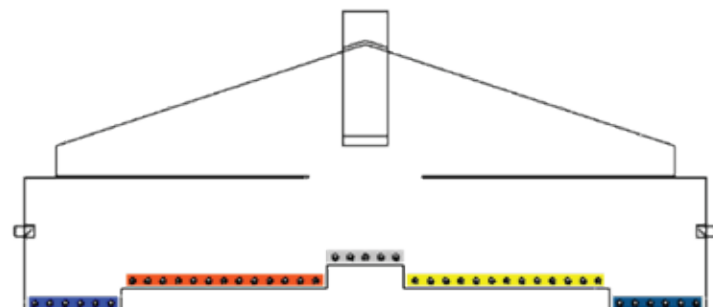
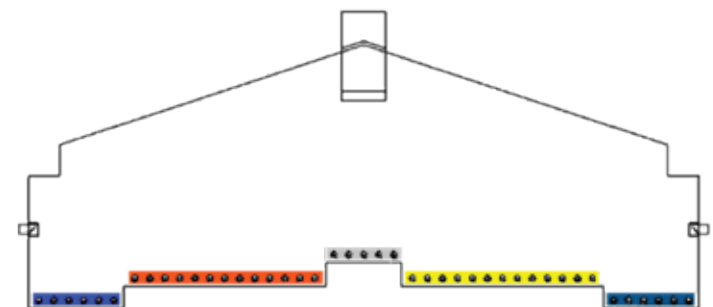
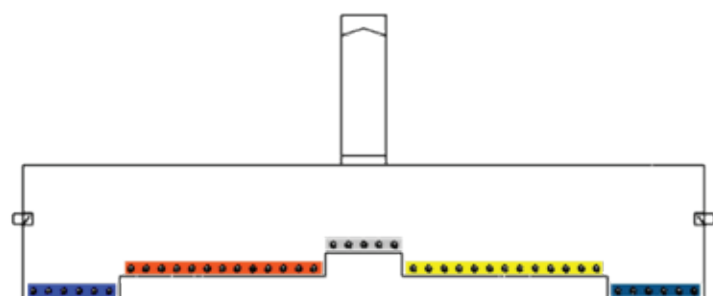
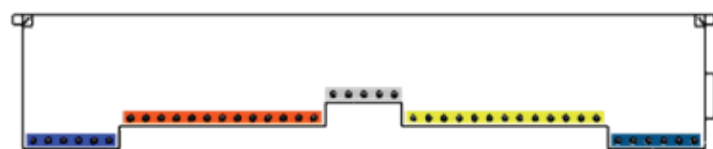
The overall goal for this project is to establish a video training tool template that could identify and then respond to gaps in caretaker knowledge and

skills. Ultimately the videos, through narration or follow-up conversations, will focus on practical research and its application, with short, task-based modules for training or retraining employees. The videos would then be a resource available to all farmers. The template for this training focuses on improving observation and husbandry skills by teaching an understanding of healthy bird behavior and well-being.

Large, individual egg industry stakeholders have long expressed strong interest in such accessible training resources for employees in egg production, especially in cage-free settings where available research and data are limited. Ultimately, the deliverables created from this study (videos and assessment quizzes) will be powerful tools that will prove useful for all segments of the commercial egg industry.



## A VENTILATION WIN-WIN: LESS DISEASE SPREAD AND MORE COMFORT



Cross sections of simulated structures with various colors indicating different regions measured for animal comfort.

For further details on this project, go to <https://www.eggindustrycenter.org/egg-forum/egg-forum-archives/forum2020>

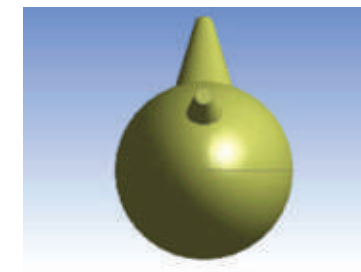
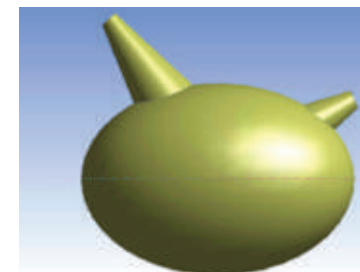
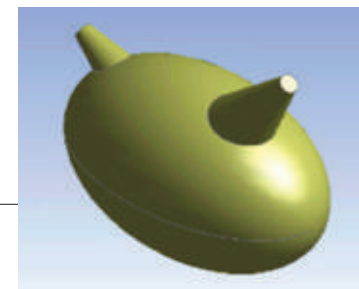
The shift to cage-free eggs has contributed to a reassessment of poultry facility design that the industry hasn't experienced in almost two decades. It was 15 to 20 years ago that commercial egg farmers transitioned from high-rise, A-configured cage systems to towers of cages and automated manure belts. At the time, old facilities were gutted, and the new cage and belt systems were installed. However, the old ventilation designs were not suited to the new stacked cage design, leading to a scramble to refit the ventilation of these buildings.

To avoid history repeating itself, about three years ago, Egg Industry Center funded a project to test practical upgrades to current henhouse ventilation systems. The ultimate goal of these upgrades was to ensure bird welfare through uniformly comfortable house temperature, better managed fresh air distribution and indoor air quality, and ideally improved containment of disease outbreaks within and between houses.

Building on prior accomplishments in agricultural structures and ventilation design, principal investigator Dr. Eileen Fabian, professor of agricultural engineering and environmental biophysics at Penn State University, and other Penn State colleagues Long Chen, doctoral student; Paul Patterson, professor of Poultry Science; Daniel Hofstetter, extension research assistant; and John Cimbala, professor of mechanical engineering, examined various existing and new cage-free building ventilation configurations.

Fabian's recognized expertise is in indoor air quality of agricultural buildings and design principles of heating and ventilation systems, which served her well in this endeavor. However, it was the use of computer modeling and the application of computational fluid dynamics (CFD) powered by the Penn State "supercomputers" that greatly expedited the answers, according to Fabian.

To assess the performance of each henhouse ventilation configuration, a series of CFD models were constructed to simulate interior air movement, temperature distribution, and the distribution of simulated disease contaminants. Three-dimen-



The birds were modeled individually using simplified three-dimensional "bird-like" shapes, (rather than solid cubes), evenly distributed at a real stocking density allowing for much more accurate analysis.

sional geometries for each model were developed based on a commercial floor-raised henhouse. This "standard" ventilation configuration featured air inlets at the top of the walls (near the eaves) and sidewall exhaust fans. Air flow in this standard design was generally lateral from the eave inlets, across the ceiling, and eventually downward and toward an exhaust fan mounted lower in the building sidewall.

Previous CFD modeling of belt cage henhouses by the Fabian-Cimbala team noted a distinct improvement in disease vector containment and uniformity of house temperatures with an upward ventilation flow. Therefore, the first alternative ventilation design of the cage-free house had mid-wall air inlets and ceiling exhaust to promote a more upward air flow. The second alternative ventilation design again had mid-wall inlets with a completely open house interior and exhaust fans located on the roof ridge. The third alternative design also had mid-wall inlets, but a partial ceiling with attic and ridge exhaust. This third design could provide an attic plenum for air treatment prior to exhaust. All the alternative fan installations had ducts from the fan to the exterior of the henhouse.

Dr. Fabian is particularly proud of the breakthrough in modeling animal geometry and heat production brought to the project by co-investigator Long Chen. The birds were modeled individually using simplified three-dimensional "bird-like" shapes (rather than solid cubes), evenly distributed at a real stocking density, allowing for much more accurate analysis.

The three alternative designs were analyzed against the performance of the standard ventilation model. Conditions at animal level were

judged most important for animal welfare, particularly in zones representing the nesting, perching, feed, water, and scratch areas. Indoor air speed, temperature, and presence of a simulated disease contaminant were compared. In all three alternative models the indoor conditions were found to be as comfortable (at or within 1°C of guidelines for temperature, 19–21°C; 66–70°F) and air movement in the bird-occupied zones as calm as in the standard ventilation scheme.

Introducing fresh air from inlets at the mid-wall and exhausting the indoor air through a fan located at the top of the building (ceiling, ridge, attic), is practical for cage-free henhouses. However, the biggest advantage noted in the alternative upward-flow designs was the potential for containing the spread of disease contaminants to one half of the henhouse and an exhaust air trajectory that would likely decrease the contamination impact on nearby downwind houses.

The usefulness of this study was enhanced by the practical field knowledge of industry partners, project advisors, building and facility managers, as well as the experience and expertise of Dr. Fabian and her team. Making full use of CFD models will help investigators in the future offer even more refined and practical solutions to problems related to cage-free hen housing and achieve better approaches for ventilation system design. Applying CFD to more geometrically complex aviary henhouses is an important next step in finding effective answers to bird comfort and disease mitigation through cage-free housing ventilation. Understanding this, the Egg Industry Center has already approved funding to help support this next phase of the project.

## LASER FOCUSED SUPPORT

The year 2020 was marked by uncertainty around the world. The unprecedented COVID-19 pandemic shook up our daily routines and egg markets.

**THANKS TO THE SUPPORT, GENEROSITY, AND FAITH IN OUR MISSION HELD BY LOYAL DONORS, PARTNERS, AND FRIENDS, EIC REMAINED ENGAGED, RESILIENT, AND CONCENTRATED ON SOLUTIONS FOR THE INDUSTRY.**

THANK YOU! It was an honor to walk alongside you during this unprecedented time.

**To learn how you can help advance the work of the Egg Industry Center, please contact EIC today at [eggindustrycenter.org](http://eggindustrycenter.org).**



## IOWA STATE UNIVERSITY

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