Discoveries in research are thrilling for researchers, but they become truly meaningful when shared with the people who can benefit from them. That sharing is the mission of land-grant universities, established across the United States by President Abraham Lincoln through the Morrill Act of 1862.

As a part of the University of Illinois, the College of Agricultural, Consumer and Environmental Sciences takes the land-grant mission to heart in communicating our research findings with the public: through press releases sent to media; in field days, workshops, and other outreach programs; and using websites, fact sheets, and publications like this one.

We hope you enjoy reading the results of a sampling of studies conducted in the College of ACES in the last several years and learn how you can benefit from these Advancing in research.
Although the apple genome has already been sequenced, it can still take years for an apple breeder to see the first actual piece of fruit on a tree. That’s why University of Illinois plant molecular geneticist Schuyler Korban jumped at the chance to help sequence the genome of the woodland strawberry—a close relative of the apple that blooms in a mere 15 weeks, making his work much more efficient.

“I wanted a fruit model system so that I can evaluate in a short period of time the function of apple genes that control various fruit traits, such as those for flavor, texture, aroma, and other characteristics,” Korban said. “The woodland strawberry is a good surrogate system for genetic studies of other fruits in the same Rosaceae family. With its complete genome sequence in hand, we can use the strategy of comparative genomics to investigate similarities and/or differences between strawberry and apple or strawberry and peach, among others, to learn more about genes involved in various traits, such as fruiting and fruit quality. We can also use the strawberry to do functional genomic studies. It also provides us with a larger toolbox to pursue more targeted breeding.”

The cultivated variety of the strawberry has not yet been sequenced. And although it may seem like an obvious choice, Korban explained the difficulties. “The reason we chose the woodland strawberry is because it is a diploid—that is, it has two sets of chromosomes, whereas the garden or cultivated strawberry is an octoploid, with eight sets of chromosomes, so it’s much more difficult to sequence.

“This was a large project,” Korban said. “We wound up with 75 investigators at 38 institutions, each contributing different skills and expertise.”

Another aspect that made this project interesting, according to Korban, is that the sequencing was done using what is called “short-reads,” or short fragments of the sequencing. The reason, he explained, was due to the large number of chromosomes. “If one fruit has a higher sugar-to-acid ratio, for example, we can focus on the genes that produce this variation,” he said. “And if the fruit has a higher sugar-to-acid ratio, for example, we can focus on the genes that produce this variation.”

Korban said that by knowing genes, a plant’s structure and function, researchers can control and regulate these genes by expressing them in a plant. “If a plant is a diploid, and the gene or genes that produce this variation are expressed in a plant, it will be difficult to sequence,” he said. “And if the plant is a diploid, the gene or genes that produce this variation are expressed in a plant, it will be difficult to sequence.”

A recent report in the journal Nature noted that the sequencing was done using what is called “short-reads,” or short fragments of the sequencing. “If the sequencing was done using what is called “short-reads,” or short fragments of the sequencing, it will be difficult to assemble the genome,” Korban said. “When parents punish their toddlers for becoming angry or scared, children learn to hide their emotions instead of showing them. These children may become increasingly anxious when they have these feelings, because they know they’ll face negative consequences.

In our culture, boys are discouraged from expressing their emotions. If you add parental punishment to these cultural expectations, the outcome for boys who often experience negative emotions may be especially detrimental,” Engle said.

According to the researchers, parents play an important role in helping children learn how to regulate and express their emotions. “When parents punish their toddlers for becoming angry or scared, children learn to hide their emotions instead of showing them,” Engle said. “When parents punish their toddlers for becoming angry or scared, children learn to hide their emotions instead of showing them.”

The way you react to your two-year-old’s temper tantrums or clinging may lead to anxiety, withdrawal, and behavior problems down the road, and the effect is more pronounced if the child is a boy who often displays such negative emotions as anger and social fearfulness. “Young children, especially boys, may need their parents’ help working through angry or fearful emotions. If you punish toddlers for their anger or frustration or act as if their fears are silly or shameful, they may internalize these negative emotions, and that may lead to behavior problems as they get older,” said Nancy McElwein, a U of I associate professor of human development.

McElwein and lead author Jennifer Engle examined data gleaned from observations of 107 children who were part of a larger study of children’s social and emotional development and parent-child relationships.

When the children were 33 months old, mothers and fathers were asked how often their child had displayed anger or social fearfulness in the last month. The parents were also asked how they would respond to the child’s negative emotions in several hypothetical situations. “We investigated two types of parental reactions to children’s negative emotions. One type of reaction was to minimize their child’s emotions; for example, a parent might say, ‘Stop behaving like a baby.’ Another type of reaction was punishing the child for these emotions. A parent might send the child to his room for crying or being upset, or take away a toy or a privilege,” Engle said.

When children reached 39 months, parents answered questionnaires about their child’s current behavior problems. Moms and dads who were apt to punish their kids for their fears and frustrations were more likely to have children who were anxious and withdrawn at the time of the second assessment. And the effect was especially pronounced for boys who had been identified as having a high incidence of negative emotions at 33 months, Engle said.

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The researchers are intrigued with the finding that little boys were especially affected when their emotions were not supported during times of fear or frustration.

“More boys than girls are prone to display negative behaviors when their emotions are not supported during times of fear or frustration,” Engle said.

The researchers found that boys who were punished for their negative emotions were more likely to develop anxiety and social fearfulness as they got older. “This was especially pronounced for boys who had been identified as having a high incidence of negative emotions at 33 months,” Engle said.

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Facility to demonstrate new waste-to-energy process for converting wastewater biosolids and algae to crude oil

Yuanhui Zhang, also a professor in ABE, has spent almost 15 years researching the conversion of swine manure into crude oil. Now they have combined their efforts to develop an integrated system that will use biowastes, such as swine manure or municipal wastewater, to grow algal biomass, purify wastewater, recycle nutrients, capture carbon dioxide, and phosphorus, that can be used to produce biofuels.

“There are many advantages to this system,” Zhang said. “This process also creates a synergistic process is extremely advantageous,” said Schideman. “This process is used to ferment the sugars, which overexpression increased galactose fermentation by 250 percent when compared to a control strain. Overexpression of one gene in particular, a truncated form of the TUP1 gene, sent galactose fermentation numbers soaring. The new strain consumed both sugars (glucose and galactose) almost three times faster than the control strain—8 versus 24 hours, Jin said.

When we targeted this protein, the metabolic enzymes in galactose became very active. We can see that this gene is part of a regulating or controlling system,” he said. According to Jin, galactose is one of the most abundant sugars in marine biomass, so its enhanced fermentation will be industrially useful for seaweed biofuel producers.

Marine biomass is an attractive renewable source for the production of biofuels for three reasons:
• production yields per unit area are much higher for marine plant biomass than for terrestrial biomass
• marine biomass can be depolymerized relatively easily compared to other biomass crops because it does not contain recalcitrant lignin and cellulose crystalline structures
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Seaweed as biofuel?
Metabolic engineering makes it a viable option

When Americans think about biofuel crops, they think of corn, miscanthus, and switchgrass. In small island or peninsular nations, though, the natural, obvious choice is marine biomass,” said Yong-Su Jin, assistant professor of microbial genomics and a faculty member in the Institute for Genomic Biology.

Producers of biofuels made from terrestrial biomass crops have had difficulty breaking down recalcitrant fibers and extracting fermentable sugars. The harsh pretreatment processes used to release the sugars also resulted in toxic byproducts, inhibiting subsequent microbial fermentation, he said. But marine biomass can be easily degraded to fermentable sugars, and production rates and range of distribution are higher than terrestrial biomass.

“However, making biofuels from red seaweed has been problematic, because the process yields both glucose and galactose, and until now galactose fermentation has been very inefficient,” Jin said.

But Jin and his colleagues have recently identified three genes in Saccharomyces cerevisiae, the microbe most often used to ferment the sugars, whose overexpression increased galactose fermentation by 250 percent when compared to a control strain.

“This discovery greatly improves the economic viability of marine biofuels,” he said. Overexpression of one gene in particular, a truncated form of the TUP1 gene, sent galactose fermentation numbers soaring. The new strain consumed both sugars (glucose and galactose) almost three times faster than the control strain—8 versus 24 hours, Jin said.

“With this system, we will first convert swine manure into crude oil using hydrothermal liquefaction [HTL],” Schideman said. “The liquid portion of the manure lagoon is currently discharged to the local sanitary sewer at significant expense,” he said. “One immediate benefit of this kind of system would be a reduction in the sewer bill, but hopefully, the longer-term benefit would be value-added co-products from the center’s residuals management system.”

Zhang said the research theme is called Environment-Enhancing Energy, or E² Energy, because it is an effort to meet the challenge of energy production in a way that is both economically viable and environmentally sustainable.

“This synergistic process is extremely advantageous,” Zhang said, “because it brings together two rivals, energy production and environmental protection, to complement rather than compete with one another.”

Ultimately, Schideman said, they hope the laboratory at the SRC will become a cutting-edge facility for applied research and education on novel processes that convert agricultural residuals into valuable bioenergy and biochemical resources while also providing significant environmental benefits. “Right now we are developing strategic partnerships with stakeholders, including producers, equipment manufacturers, academicians, extension specialists, and co-product end users, to maximize the impact of this new research and extension facility,” said Schideman.
Efforts to control the Mississippi result in flooded farmland

When the water in the Mississippi River rose in May 2011 to 58 feet, with a forecast of 60.5 feet or higher, the emergency plan established over 80 years prior—to naturally or intentionally breach the levees—was put in motion. The flood of 1937 did top the frontline levee, and water passed into and through the New Madrid Floodway, built from 1928 to 1932, but the floodway had remained unused and flood-free since 1937.

Area landowners thus came to assume the floodway would never flood again. Some established the village of Pinhook in the 1940s with 50 residents; others rebuilt or expanded their farmsteads. All were now in the path of the Mississippi River.

U of I researcher Kenneth Olson followed the drama closely. He noted that the initial additional force and depth of floodwater may have caused more damage to buildings and more deep land scouring than was predicted. The strong current and sweep of water through the Birds Point, Missouri, breach created deep gullies in 200 acres of Missouri farmland within the 133,000 acre floodway, displaced tons of soil, and damaged irrigation equipment, farms, and homes.

Olson believes the deliberate flooding will create long-lasting, and perhaps permanent, damage to hundreds of acres of agricultural gully lands. The rushing water gouged large deep gullies into parcels of land adjacent to the blown levees and on some distant fields. The land was also covered with a thick sand deposit.

“Reclamation efforts by the Corps of Engineers included patching the frontline and fuse plugs levees with the sand, and topsoil was trucked in,” Olson said. “The former 60.5-feet fuse plug and the 62.5-feet frontline levees were rebuilt, initially to 51 feet and then, after input from local farmers, to 55 feet. Proper drainage in the area has been restored, but the unanticipated fields with large and deep gullies located five miles from the levee breaches will not be repaired very easily.”

Olson believes that even if the fields of gullies are reclaimed, the soils are likely to have lower productivity.

“The resulting land surface will have less soil aggregation and less organic carbon and will be more sloping, making it difficult to farm the land,” he said. “Some of this lost cropland could be restored as wetlands and wildlife habitat adjacent to the patched levees.

“Over the last 30 years, many soil and water conservation practices and structures were no longer used, and soil erosion standards were met using conservation tillage and no-till systems,” Olson said. “Most remaining terraces, contour farming, strip cropping, and waterways were effective. But many waterways were filled above capacity and were eroded by fast-moving water or had significant sediment deposits.”

During that period, Olson said, fewer soil conservation structures and retention ponds were being built and maintained than in the past, although in Missouri significant acreage of unprotected agricultural lands was converted to fish and wildlife use.

Olson recommended potential solutions to reduce the flooding impact on agricultural lands in flat watersheds with poorly drained soils. Remedies could include creating temporary water storage structures, changing the crop rotation in the upland to include more forages rather than row crops, converting more of the agricultural land to timberland or grassland that can use or store more water, and building higher and stronger levees that are located farther from the riverbanks to widen the river flow channel.

“It would also be logical to accept periodic levee breaks or stop using the floodplain soil for agricultural crop production. Instead the land could be converted to conservation use and the periodic water storage function restored to the natural floodplain.”

Olson contends that strategically placed wetlands, settling basins, nutrient filtering, and levees are effective management for internal control of water and sediment. He points to Sny Island Levee Drainage District as a model for what could be accomplished with additional effort.

“The Sny Island District has developed pioneering ways to reduce local flooding and decrease the sediment and nutrient loads being discharged into the Mississippi River,” Olson said.

But Olson added that more than half of Sny Island’s $2-million annual revenue is spent on fuel costs to run its three pumping stations continuously during periods of high water runoff.

“As the price of fuel oil increases, high commodity prices will be needed,” he said. “One way to mitigate this treadmill is to build on the diverse habitat created by wetlands, sediment basin, and levees and to purposefully develop an economic tourism plan to increase the recreational use of this region.”
in football, line backers are usually the team’s largest players and have the endurance required to get through a game plus overtime. But when it comes to fish, bigger doesn’t always mean stronger. A University of Illinois study showed that smaller fish recover from exertion faster than larger ones. “The point of the study was to replicate an angling situation where anglers catch and release fish,” said researcher Cory Suski. “We wanted to know if large fish and small fish had similar physiological responses to being exercised and released, particularly regarding the time it takes to recover from exercise.”

“What we found is that the large fish take longer to recover from exercise than the small fish do. None of the fish really experienced any major hardships, and they all survived easily, but the small fish recovered faster.” Suski said the findings will be important for fisheries conservation. “Big fish are reproducibly valuable, as they tend to have more babies than small fish. Big fish are also rarer than small fish, and they are more often targeted by anglers. If anglers are planning to release a large fish after catching it, the results from this study emphasize the importance of angling the fish for a short duration, handling the fish gently, and getting it back into the water quickly so that excessive disturbances are minimized and the fish can recover quickly, begin feeding, and get back to normal.”

“The fish in the study were largemouth bass. They were caught in nets, put into dark tanks, and allowed to rest. Later they were chased for 60 seconds to simulate angling and the amount of energy they might spend during a catch-and-release episode. They were allowed to recover for 0, 1, 2, or 4 hours before being sampled for plasma and white muscle.

Large largemouth bass exhibited elevated concentrations of plasma glucose and sodium relative to small fish following the exercise challenge. Large fish required additional time to clear metabolic disturbances in plasma and failed to restore potassium to basal levels even following 4 hours of recovery, indicating an improved ability of the smaller fish to recover from disturbances.

“Before we began the research, we predicted that the larger fish would respond and recover from exercise more quickly, providing another size-based advantage for larger fish, but we found the opposite to be true,” Suski said.

Suski said anglers have always known big fish are special, and the results of this study emphasize the need to treat them gently so they can be caught again in the future.

In one experiment using tanks, we could actually chase the fish with the gas,” Suski said. “Once CO2 reached a threshold, fish would choose to leave the area of the tank that had it. The fish initially showed signs of being irritated or agitated after exposure, and eventually they lost equilibrium. If fish cannot leave or are slow to leave, the CO2 accumulates to a point where it will act like an anesthetic gas used for patients who are undergoing surgery.”

Suski knew that CO2 had already been used for patients who are undergoing surgery and the threat is monitored of invasive species entering Lake Michigan through one of the Chicago canals, researcher Cory Suski believes two barrier methods are better than one. Suski experienced adding carbon dioxide (CO2) to the canal water to work in tandem with the electric fence being used to divert carp from entering the canal, with the goal of providing a second line of defense. Suski found that carbon dioxide is quick and effective in repelling fish from an area.

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Suski said Asian carp are already in Minnesota, as well as in South Dakota. “There is concern that once the carp get into the Great Lakes, they could do well there and spread to other canals throughout eastern North America.”
South Farms pig gets international attention

Researchers compared the reference genome from T.J. Tabasco with genomes of wild and domestic pigs from Europe and Asia (including archaeological and museum samples) and to human, mouse, dog, horse, and cow genomes.

“The pig is interesting because the wild boar still exists,” Schook explained. “We could look at domestication, and we also looked at speciation. From an evolutionary perspective, these Sus species diverge in a very short time.”

The researchers traced the domestic pig back to Southeast Asia. From there, it spread across Eurasia. The glaciation period separated the pigs into two groups about one million years ago. Today they are almost sub-species. “However, their chromosome structures have stayed very similar,” Schook noted.

Pigs were independently domesticated in western Eurasia and East Asia 10,000 to 15,000 years ago. There is evidence that as the early European settlers moved around, they bred the domesticated females with wild boars. Pigs in Central and South America are thought to have originated on the Iberian Peninsula.

As well as providing insights into how the pig evolved, the genome sequencing provides valuable new tools for animal breeding. One is a DNA test that can identify individual pigs that are less susceptible to certain diseases or have a genetic predisposition to fattening rapidly, eating less, and bearing many offspring.

On the biomedical side, researchers will build on ongoing efforts to use the pig to model human diseases, including lifestyle diseases such as obesity, diabetes, and cardiovascular disease. The sequencing identified 112 genes in pigs that are also responsible for diseases in people, suggesting that pigs could be used for drug testing. Pigs may also be used as a source of organs for humans.

Other U of I researchers involved in the swine genome project are Jon Beever, Laurie Rund, Sandra Rodriguez-Zas, Bruce Southy, and Jonathan Sweedler, as are Harris Lewin and Denis Larkin, who have left the U of I.

Researchers evaluated how feeding MOS can modulate immune responses in pigs infected with PRRSV.

“MOS can enhance immune responses in pigs, but it can also alleviate the overstimulation of the immune system,” Che said. “MOS increases the total number of immune cells such as leukocytes and lymphocytes in the blood at the early stage of infection.”

This combination of responses explains the enhanced immune response and the reduction of fever, Che said.

“MOS stimulates the immune system and enhances the immune response, except when the immune system is already challenged,” Pettigrew explained. “MOS actually reduces the inflammatory response in pigs with challenged immune systems. This may be how the product improves growth performance, because it redirects nutrients to growth rather than the immune system.”

Che said MOS also improves feed efficiency from day 9 to day 14 after inoculation with PRRSV.

“PRRSV interferes with the immune response and makes pigs more susceptible to bacterial infections,” Pettigrew said. “This product seems to counteract this effect. It may even reduce bacterial infections associated with PRRSV, although we did not test that specifically.”

Mannan oligosaccharides offer health benefits to pigs

A detailed annotation of the genome of T.J. Tabasco, a pig from the University of Illinois South Farms, is the outcome of over 10 years of work by an international consortium. It is expected to speed progress in both biomedical and agricultural research. U of I vice president for research Lawrence Schook said that the College of ACES played a crucial role in getting the work started.

Funding that came through ACES allowed Schook and others to put together the Swine Genome Sequencing Consortium, an alliance of university, industry, and government laboratories in the U.S., Europe, and Asia. Today the project includes scientists from more than 50 research groups.

Schook said that the project has three main objectives: to serve as a blueprint for understanding evolution and domestication, to advance research on animal production and health, and to explore ways to use the pig in biomedical applications.

The first publication, which appeared in Nature, focuses on the pig’s evolution. Researchers compared the reference genome from T.J. Tabasco with genomes of wild and domestic pigs from Europe and Asia (including archaeological and museum samples) and to human, mouse, dog, horse, and cow genomes.

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The swine industry has come a long way in the past 10 years to improve pig transportation and handling. In a U of I study led by graduate student Chad Pilcher, researchers discovered that, both an optimum allocation of floor space per pig during transport and a longer journey time allow pigs to better handle transportation stress.

Mike Ellis, professor of animal sciences, said the research started 10 years ago, when it became apparent that losses of pigs during the transportation process had increased since the early 1990s. This caused great concern in the swine industry, from both animal welfare and economic perspectives.

“Our goal was to understand why those losses were occurring and develop approaches to minimize them,” Ellis said. “Significant funding from the National Pork Board and several commercial companies, including ELANCO Animal Health and The Maschhoffs, allowed us to perform research in a controlled commercial setting. It’s a great example of how the industry came together to attack a problem and make positive change.”

One of the challenges of this type of research is controlling the factors that contribute to losses, such as animal handling, he said. By working with commercial producers to perform on-farm research, Ellis’s team could better control who worked with the pigs and how the animals were handled while remaining in typical commercial conditions.

“We were able to perform controlled research, where all pigs were handled the same, so we could evaluate journey time and floor space,” Ellis said. “We discovered that the lower the floor space available per pig, the higher the losses can be. However, there is evidence that you can give them too much floor space. When pigs are transported, they are more likely to be thrown about if there is too much open space. If they are closer, but not too close, they can help support each other.”

Journey time also affected the pigs’ ability to handle the stress of loading and unloading, Ellis said.

“There’s not much research on this topic as it pertains to transportation loss,” he added. “But we have evidence that suggests short journey times could actually lead to higher incidences of losses because the pigs need a minimum amount of time to recover from the stress of loading at the farm. Normally, a pig will recover if given enough time. On short journeys, you may superimpose the stress of unloading onto animals who haven’t yet recovered from the stress of loading.”

Although previous recommendations from Ellis and his team of researchers regarding floor allocation space have resulted in lower transportation losses (less than half of a percent of pigs in most well-managed systems), they remain a concern because the producer has invested a great amount of money to get pigs to that stage.

“Co-author Bradley Wolter, chief operating officer of The Maschhoffs in Carlyle, Ill., said working with the Ellis lab has allowed their company to lower pig losses within the supply chain between The Maschhoffs and its customers by more than one percentage unit.”

“The 1 percent reduction experienced in animal losses during transport and handling represent pigs that are carrying the full value of current market prices and creates a significant impact to the profitability of the company,” Wolter said. “Moreover, minimizing the loss of pigs within our production system is a moral obligation we have to society that is consistent with our core values. This important area of research continues to enhance our understanding of how we can achieve this very important commitment.”

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Because the industry has made such great strides to improve transportation and animal handling, this study did not show the trends and differences Ellis expected to see.

“We did visual assessments of how stressed the pigs were upon arrival at the plant,” he said. “They were definitely more stressed after being unloaded from shorter journeys. But any time the losses are low to start with, you won’t find many factors that will lower them further. As losses are reduced, it’s more difficult to show how these factors are involved.”

This is a good problem—and a win for everyone involved, Ellis said. Wolter added that this particular study validated previous recommendations employed by the company’s animal transporters.

“The results from U of I’s science-based program have been incorporated in a comprehensive set of standard operating procedures within our organization that are implemented by producers in the barns prior to loading the truck all the way through the process to the pig handler within lagerage at our customers’ operation,” Wolter said.
Seeing double: Africa’s two elephant species

Contrary to the belief of many scientists (as well as many members of the public), new research confirms that Africa has two—not one—species of elephant. Scientists from the U of I and other major institutions used genetic analysis to prove that the African savanna elephant and the smaller African forest elephant have been largely separated for several million years.

The researchers compared the DNA of modern elephants from Africa and Asia to DNA that they extracted from two extinct species: the woolly mammoth and the mastodon. Not only is this the first time that anyone has generated sequences for the mastodon nuclear genome, but it is also the first time that the Asian elephant, African forest elephant, African savanna elephant, extinct woolly mammoth, and extinct American mastodon have been looked at together.

The major challenge was to extract DNA sequences from two fossils—mammoths and mastodons—and line them up with DNA from modern elephants over hundreds of sections of the genome.

The surprising finding was that forest and savanna elephants from Africa, which some have argued are the same species, are as distinct from each other as are Asian elephants and mammoths.

Researchers had DNA from only a single elephant in each species, but they had collected enough data from each genome to traverse millions of years of evolution to the time when elephants first diverged. They believe the divergence of the two species took place around the time of the divergence of the Asian elephant and woolly mammoths. The split between African savanna and forest elephants is almost as old as the split between humans and chimpanzees.

The possibility that the two might be separate species was first raised in 2001, but this is the most compelling scientific evidence so far that they are indeed distinct.

Previously, many naturalists believed that African savanna elephants and African forest elephants were two populations of the same species, despite the significant size differences. The savanna elephant has an average shoulder height of 3.5 meters, compared with 2.5 meters for the forest elephant. The savanna elephant weighs between six and seven tons, roughly double the weight of the forest elephant.

DNA analysis revealed widely differing genetic diversity within each species. The savanna elephant and woolly mammoth have very low genetic diversity, Asian elephants have medium diversity, and forest elephants have very high diversity. Researchers believe that this is due to varying levels of reproductive competition among males.

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The first comprehensive survey of birds in Illinois was conducted from 1906 to 1909. It was repeated from 1956 to 1958, and a technical book was written comparing the two surveys. When the 100-year anniversary of that first survey was approaching, ornithologists Mike Ward, Jeff Walk, Steve Bailey, and Jeff Brawn seized the opportunity to again write *Illinois Birds: A Century of Change* drawing from 100 years of data, lots of pictures, and a broader appeal.

“Shrubland and grassland birds don’t need a lot to survive, just some messy shrubbery. But everything is so manicured today. If we don’t mow roadsides until July, that would serve as a good habitat for them.”

1900s survey provided a baseline. “In the 1950s they had seen some changes, but they had only two data points. Now we have three, plus better statistical tools to look at long-term trends, so we have a much better grasp on how things have changed over 100 years.”

With three surveys spanning a century, there are huge amounts of data to crunch, Brawn, T.J. Benson, and Jill Deppe provided technical expertise in developing population models using techniques that weren’t available 100 or even 50 years ago. “We were able to take the 1900s data, the 1950s data, and the modern data and model it to make stronger inferences about what’s gone up, what’s gone down, and what hasn’t changed,” Brawn said.

The book’s last chapter offers some predictions for what might happen in the future. “We think species such as hawks are going to be fine,” Ward said, “because they appear to be adapting to living with humans in urban areas. Currently, crows can be seen in urban areas, having learned to eat French fries out of garbage cans at fast food restaurants. One hundred years ago, they avoided towns. The species that will thrive in Illinois are likely the ones that can cope with humans.”
Assessment of online divorce education programs finds weaknesses

In many states, including Illinois, married couples with children who want to untie the knot must complete court-mandated educational programs—either in group settings or through online classes—before judges will finalize their divorces.

While online programs provide a convenient means for some parents to satisfy court mandates, there have been no formal assessments of the programs’ quality and effectiveness, found a U of I research team when it reviewed six popular online divorce education programs used by courts throughout the U.S.

In Illinois, divorcing couples who have minor children are required to complete at least four hours of parenting education programs, under a rule adopted by the Illinois Supreme Court in 2006. The Sixth Judicial Circuit Court in Champaign County uses—as do about 30 other family courts throughout Illinois, other states, and Canada—the Children First parenting program, which was created in the late 1980s by a task force of family court judges, attorneys, and mental health professionals in St. Clair County, Ill., hoping to curb the amount of post-divorce child custody and child support litigation clogging the courts by sensitizing parents to the impact of divorces and custody battles on children.

Family Service of Champaign County administers the program for Champaign County, which has used it since 1990. In special circumstances and with court approval, parents can complete an online version of the face-to-face class.

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According to the program’s coordinator, Dawn McKinley, 663 Champaign County parents participated in Children First during 2010, at costs ranging from $5 to $160, depending on their income.

“Divorce is a time when resources such as time, money, and child care are often limited, making an online class more feasible to divorcing parents,” Bowers said. “Face-to-face classes might not be the best option—or an option at all—for some families.”

Accordingly, the research team found it “surprising and concerning” that few of the online programs addressed special circumstances such as domestic violence and substance abuse. Likewise, fewer than half of the programs addressed the emotional turmoil and complexities that many adults experience during divorce, such as changes in economic status and the challenges of maintaining relationships with friends and extended family members. Most of the adult-focused content in the videos dealt with co-parenting issues and parent-child relationships.

While divorce education programs have been around since the mid-1970s, online training is much more recent. The oldest of the six online courses that the researchers examined became accessible on the Web in 2007.

All of the online programs reviewed were first-generation versions, apparently created by transferring the face-to-face presentations directly to the Web, with few modifications. As a result, many of the limitations and problems with the face-to-face programs identified by previous researchers also applied to the online versions, the U of I team said.

Program administrators could make better use of the enhanced capabilities that technology offers by deploying online tools such as chat rooms or blogs or by creating online communities—where users could pose questions to experts and peers, share information, and support one another—to make the material more engaging and broaden its educational potential, Mitchell said.

“A lot of the technology that allows interactivity has just been developed in the last few years, so I think we’re going to see more [online programs using it],” Bowers said.

“The program administrators allowed us to go in and assess these innovative programs,” Bowers said. “Each of their efforts is noteworthy, and their intentions are similar to ours in that they really want parents to have adequate coping skills and the abilities to help them navigate the divorce process as co-parents. When we shared our results with them, the administrators were receptive to the feedback that we offered.”

“Divorce is a time when resources such as time, money, and child care are often limited, making an online class more feasible to divorcing parents,” Bowers said. “Face-to-face classes might not be the best option—or an option at all—for some families.”
A lot of time, effort, and money are spent by various agencies, municipalities, and nongovernmental organizations to inform and educate the public about environmental concerns. Could such groups collaborate to inform the public even though their beliefs may be very different? Two studies suggest that they can and should. 

U of I professional geographer Bethany Cutts tracked messages to the public about water quality and usage from a variety of sources in Phoenix, Arizona. She found that considerable overlap in the messaging already existed, but there was little understanding or direction to collaborate and reach specific audiences, such as Spanish speakers in the community. 

“When I began interviewing agencies in a fact-finding mission, I kept hearing the same things. They referenced each other, shared ideas, collaborated, and co-funded projects,” Cutts said. 

As her research progressed, Cutts determined that although the organizations’ biggest strength seemed to be their connectivity and ability to share information, they haven’t found a good way to manage and maximize the connections that already exist between specific groups within the public and the network of water educators. 

“Everyone is trying to reach the entire public,” Cutts said. “The really strong environmental groups are reaching people who already have a lot of interest in environmental and ecological issues, so they’re not the target audience.” 

Cutts suggests that even though their goals may be different, there could be more information and even financial sharing between organizations. They can work together to build public knowledge and empowerment in environmental decision making. “Some of these organizations have dissolved due to budget cuts,” she said. “I wanted to see if their cumulative effort stacked information higher in some neighborhoods while missing other neighborhoods completely or if information was more randomly or evenly distributed so that everyone got some sort of information.” 

Cutts found that generally the public she interviewed had more information if they had heard it from several sources. “I was interested in the total number of messages a person would pass in their daily life,” she said. “Someone might see a billboard and later get information in their water bill, and their child might be in an after-school program where there are puppet shows about water conservation. So some neighborhoods might be barged with a lot of messages, whereas other neighborhoods even within the same city, might not.” 

“Efficiency would improve if organizations could be more strategic about the ways they get information distributed,” she said. “They need to recognize that they can all be moderately successful at reaching the public at large or they can collaborate to engage in experimentation and to reach audiences they may be missing, such as the Spanish-speaking community.” 

Cutts found that the biggest strength seemed to be their determination that although the organizations’ biggest strength seemed to be their diversity, they need to recognize that they can all be moderately successful at reaching the public at large or they can collaborate to engage in experimentation and to reach audiences they may be missing, such as the Spanish-speaking community. 

Environmental groups should pool efforts to reach the public

The Erosion Control Research and Training Center was originally created under a research project administered by state and federal organizations to provide a multitude of research and training opportunities in erosion and sediment control and stormwater management. 

An earthen berm 300 feet long and 13 feet high is the focal point of the facility, located on the Department of Agricultural and Biological Engineering research farm south of the Urbana campus. The berm’s slope is three-to-one on the front side and two-to-one on the back side; three ditches with check dams at the base of the berm drain into a small pond. One purpose of the site is to evaluate products used for erosion and sediment control. 

“The Illinois Department of Transportation (IDOT) and other agencies are major partners on erosion and sediment control products, and they need to know which products are the most durable, which do the best job, and what the best management practices are,” said U of I agricultural engineer Prasanta Kalita, a co-investigator for the project. 

To that end, graduate students Joseph Monical and Carlos Buines are working on a variety of projects, including evaluating vegetation cover and studying erosion control blankets and sediment control check dams. 

Monical, a Ph.D. student, said, “We started a vegetation demonstration study to look at different types of vegetation cover—compost, mulch, and hydro-mulch—on slope seed conditions. We also had an uncovered control plot. Now we are expanding that study to compare those to erosion control blankets to see how each reduces erosion and sediment runoff that occur under natural conditions.” 

Buines, a master’s student, has developed a protocol to test different types of check dams by subjecting them to a sequence of different flows, then taking sediment samples and suspended samples before and after the check dams. 

Research facility provides education in erosion control and stormwater management

“We’ve installed two ditch inlets in one of the channels,” said Monical, “so we’re also evaluating different types of inlet protection practices and products that IDOT contractors currently use.” Monical said there are plans to install a flared-end inlet for study and evaluation, and they will be working with IDOT to look at curb and gutter inlet protection at the Pesotum rest area on I-57. 

Kalita said that IDOT, the Illinois Land Improvement Contractors Association, and other agencies will also use the facility to train their engineers and technicians to install effective erosion control practices and develop stormwater management plans. “We have developed one class that covers the fundamentals of erosion and sediment control practices and are working on two more classes to provide this training,” said Kalita. He added that IDOT is drafting a policy that will require this training for engineering consultants and contractors who work with the agency.
Events that take place early in life almost certainly have consequences for later cognitive development. Establishing the connections is difficult, however, because human infants cannot be used as laboratory subjects.

Rodney Johnson and his collaborators have developed an alternative model for studying infant brain development. "Assistant professor Ryan Dilger and I became interested 3 or 4 years ago in establishing the neonatal piglet as a model of human brain and cognitive development," he said.

The idea came to Johnson when a former student, who was working for an infant formula company, asked about using rodent models to study learning and memory; they also had done some research looking at infectious disease in pigs. "It is very willing to work for chocolate milk," Johnson said that it would be difficult to do this kind of research anywhere else because of the resources of the Beckman Institute and the U of I's unique research facility for housing pigs.

"Human breast milk is the gold standard, but not every infant can be breast fed. A major goal for many infant formula companies is to improve the formulation to capture all of the benefits of breast milk," said Johnson. "There is a lot of interest in the concept of programming, the notion that things that occur early in life set that individual up for problems that occur many years later," he continued. "Because the pig brain grows so much like a human brain, we thought this could be a very attractive model." The researchers have used the piglet model to demonstrate that an iron-deficient diet causes iron depletion in specific brain areas and is accompanied by cognitive deficits. They are using structural MRI and the T-maze task to study how viral pneumonia in the early neonatal period affects brain and cognitive development.

"We want to know if this will alter the trajectory of normal development in a way that makes individuals more susceptible to behavioral disorders that occur later in life, such as autism and depression," Johnson said. "Exposure to environmental insults early in life may also reduce stress resilience," he added.

The next step is to look at maternal viral infections. "We will infect pregnant gilts at the beginning of pregnancy that would be the third trimester in humans and then study brain and cognitive development in the offspring," Johnson said. "This is the type of interesting question we can pursue now that the piglet model is in place." Through the USDA-NIH Dual Purpose with Dual Benefit program, Johnson was awarded a 5-year grant to do just that. The program supports research that is considered beneficial to animal agriculture and biomedicine alike.

Johnson said that it would be difficult to do this kind of research anywhere else because of the resources of the Beckman Institute and the U of I’s unique research facility for housing pigs.

Johnson and his group had been working with rodent models to study learning and memory; they had also done some research looking at infectious disease in pigs. They wondered if it would be possible to develop tests to look at learning and memory using neonatal piglets. It seemed like a reasonable idea because the growth and development of the piglet brain is similar to that of the human brain. The brain growth spurt is a perinatal event in both humans and pigs. At birth, the human brain is about 25 percent of adult size. In the first 2 years of life, it reaches 85 to 90 percent of adult size. The piglet brain grows in a similar way but in a shorter time.

Johnson’s team first developed structural MRI methods for quantifying brain volume in the neonatal piglet. They then used these techniques to determine total brain and brain region volumes in a cohort of male and female domestic pigs, taking repeated measurements every 4 weeks starting at 2 weeks of age and finishing near sexual maturity at 24 weeks of age.

They found that at 4 weeks, the piglet brain had grown to approximately 50 percent of its maximum volume, and it continued to grow rapidly for the next 8 weeks. Human infant brains grow in a similar way in the postnatal period. The results suggested that environmental insults during this period could affect brain structure and function.

The researchers’ next task was to develop a test to assess the piglets’ learning and memory, using a T-maze. They thought that this would be easy. They were wrong.

"It actually turned out to be very complicated, because there were a lot of things that went wrong that we didn’t predict," said Johnson. "For example, when we first started these studies, we used things like Skittles and apple slices as a reward because that’s what people using older pigs had done."

The piglets, which were being fed on infant formula, had no interest in solid food, nor were they motivated to perform the tasks if the reward was the same as their regular food. They were, however, very willing to work for chocolate milk.

Tests were conducted in a plus-shaped maze, with one arm blocked off to leave a T-shape. Piglets were trained to locate the milk reward in a constant place in space as well as direction, using visual cues from outside the maze. When they learned to perform the task correctly, the reward location was reversed, and the piglets were retested to assess learning and working memory. Correct choices decreased in the reversal phase but improved over time.

The results demonstrate that the T-maze can be used to measure cognitive abilities. Johnson and his collaborators will use these new tests to examine how stresses such as nutrient deficiencies and infections affect the human brain during this time of early and rapid growth.

"We want to know if this will alter the trajectory of normal development in a way that makes individuals more susceptible to behavioral disorders that occur later in life, such as autism and depression," Johnson said. "Exposure to environmental insults is to improve the formulation to human cognitive development.
I will briefly discuss some tools that dietitians can use to better categorize clients’ needs. For example, dietitians may want to know if a client needs information on portion sizes or sodium content. One tool that is effective in reducing sodium intake and improving health literacy is the Sodium Savers Guide, which is available from the American Dietetic Association. This tool helps dietitians deliver info clients need and can understand.

**Nutritional Science**

One of the findings from the U of I study is that dietary fiber helps protect against the development of diabetes. The study found that people who consumed fiber-rich diets had a lower risk of developing diabetes than those who consumed diets low in fiber. Additionally, the study found that dietary fiber helps lower blood pressure and cholesterol levels, which are risk factors for heart disease. These findings highlight the importance of consuming a diet rich in fiber for overall health.

**Tool helps dietitians deliver info clients need and can understand**

**Dietary fiber alters gut bacteria, supports gastrointestinal health**

The research suggests that fiber is good for more than just nutrition, which means helping food move through the intestines, he added. Unfortunately, people eat only about half of the 30 to 35 grams of daily fiber that is recommended. To achieve these health benefits, consumers should read nutrition labels and choose foods that have high fiber content, said Swanson. In the placebo-controlled, double-blind intervention study, 20 healthy men with an average fiber intake of 14 grams a day were given snack bars to supplement their diet. The control group received bars that contained no fiber; a second group ate bars that contained 21 grams of pectin; a third group received bars with 21 grams of soluble corn fiber.

On days 16 to 21, faecal samples were collected from the participants, and researchers used the microbial DNA they obtained to identify which bacteria were present. DNA was then subjected to 454 pyrosequencing, a “fingerprinting” technique that provides a snapshot of all the bacterial types present. Both types of fiber affected the abundance of bacteria at the level of the phyla, genus, and species. When soluble corn fiber was consumed, Lactobacillus, often used as a probiotic for its beneficial effects on the gut, increased. Faecalbacterium populations rose in the groups consuming both types of fiber.

According to Swanson, the shifts in bacteria seen in the study—which occurred when more and differing types of fiber were consumed—were the opposite of what you would find in a person who has poor gastrointestinal health. That leads him to believe that there are new possibilities for using pre- and probiotics to promote intestinal health. For example, one type of bacteria that thrived as a result of the types of fiber fed in this study is inherently anti-inflammatory, and its growth could be stimulated by using prebiotics, foods that promote the bacteria’s growth, or probiotics, foods that contain the live microorganisms, he said.
A new strategy to manage invasive species and achieve broader conservation goals is being tested in the Grand River Grasslands, an area in the North American tallgrass prairie ecoregion. A UI researcher and colleagues at other major institutions are enlisting private landowners in a grassroots community building effort to establish a more diverse landscape for native wildlife.

The area has three main problems that challenge conservation efforts: invasive juniper trees, tall fescue, and heavy cattle grazing. U of I ecologist Jim Miller and his team developed a new model for conservation goals is being tested in the Grand River Grasslands, an area in the North American tallgrass prairie ecoregion. A UI researcher and colleagues at other major institutions are enlisting private landowners in a grassroots community building effort to establish a more diverse landscape for native wildlife.

Miller’s team invited landowners to hands-on educational field days at nearby nature reserves to show them how grazing and burning techniques work. Participants got experience with drip torches and learned how to work with the wind and moisture levels.

“We followed that up with a burn on one of the landowner’s properties in a savanna that he was trying to restore,” Miller said. “It went really well and was a key step for us in our process, because now we’re getting landowners to try new strategies on their own properties.”

Miller said the next step in the model is to encourage the landowners to champion these new practices to the larger community. “They go down to the coffee shop and meet their neighbors and friends and tell them about the success they’re having with the new practices to control the juniper trees and tall fescue and how well their cattle are doing on these pastures. The neighbors start to pick up on this, and then we have the whole process repeat itself with a larger group of landowners.

“If we’re successful with this, we’ll start to see changes, not just on individual properties here and there for key landowners but over the whole landscape or the whole region,” he said.

According to Miller, the fastest-growing category of landowners in the area is nontraditional. They don’t live in the region or come from a farming background; instead they buy land to hunt deer, turkey, or quail, or maybe just to bird-watch. He said that on land with intensive cattle grazing, the cedars can be kept at bay.

“Without burning or grazing, the cedars will take over,” Miller said. “Trees seem like a good thing to wildlife enthusiasts, but they don’t see that their land will go from being an open grassland to a closed-canopy cedar stand in 20 to 25 years. Under those conditions, there are no deer, no turkey, no quail—it’s a biological desert, and it’s too late to do much with it. We think we can make the most inroads with the nontraditional owners.”

Juniper trees are invasive, largely due to fire suppression. Junipers are a fire-intolerant woody plant. This particular species of juniper is also called eastern redbud. Although that may sound appealing for patio furniture or decking or biofuels, it’s not. Miller said there’s no market for this type of tree. The trees produce a prodigious seed rain that facilitates rapid colonization of an area when left unchecked. With a survey from aerial photography dating back to 1983, Miller estimated a 3 percent increase in cedar coverage per year.

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“Heavy stocking of cattle is an issue,” Miller said. “Cattle reduce available forage quickly, to the point that some ranchers feed hay by July and August. That’s not quality habitat for grassland birds, which have seen the steepest declines in North America since we’ve been monitoring bird populations. There are at least two things necessary for this model to work: ecological potential in the landscape and some level of social readiness. In the Grand River Grasslands, there is ecological potential, but landowners don’t all recognize that eastern redbud trees are invasive. We’re working on that.”

Miller says that with conservation, you need a plurality, a variety of approaches, because one size doesn’t fit all.
Although declaring bankruptcy was once thought to be a desperate, when-all-else-fails decision, in this new millennium of economic uncertainty, it has become a common choice for people who are in deep debt. The question is, can they learn from their mistakes, change their behavior, and recover? A U of I study says yes, with counseling and education. In 2005, Congress passed the Bankruptcy Abuse Prevention and Consumer Protection Act to provide counseling and education requirements appear to work. The results of this study provide insight into whether the counseling and education are working.

Counseling and education require the impacts of both the bankruptcy and the consequences. Then, after filing for bankruptcy, individuals can work with job loss, health, child care expenses, and unexpected house and auto expenses were significantly less likely to show improvements in behavior.

A multiphase bankruptcy study was conducted by U of I economist Angela Lyons, in partnership with Money Management International. The study measured the impacts of both the counseling and the education requirement is working.

People who, postbankruptcy, continued to face challenges with job loss, health, child care expenses, and unexpected house and auto expenses were significantly less likely to show improvements in behavior.

Some of the practices emphasized during the counseling and education were setting short- and long-term financial goals; saving money each month; tracking income and expenses; reducing impulse spending and cutting unnecessary expenses; paying bills on time each month; and managing credit wisely, such as by maintaining a debt-to-income ratio below 20 percent.

“People who, postbankruptcy, continued to face challenges with job loss, health, child care expenses, and unexpected house and auto expenses were significantly less likely to show improvements in behavior.”

Lyons said that from a policy perspective, the results of this study provide insight into whether the counseling requirement is working.

Although 40 percent of the country’s children are now born to unmarried couples, law and public policy have failed to adapt to this fundamental change in American family life, said Elizabeth H. Pleck, author of Not Just Roommates: Cohabitation after the Sexual Revolution.

“Despite growing social acceptance, couples who live together without marrying have been—and continue to be—treated as second-class citizens, subject to discriminatory laws in a culture that promotes marriage as the foundation of family life and children’s well-being,” said Pleck, a U of I professor emeritus of history and human development and family studies.

Pleck has a gift for bringing social issues to life, and the book contains extensive legal and historical discussion of unmarried couples who live together.

With counseling and education, there is life after bankruptcy

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“People who, postbankruptcy, continued to face challenges with job loss, health, child care expenses, and unexpected house and auto expenses were significantly less likely to show improvements in behavior.”

Civil Rights movement and as part of the backlash against the sexual revolution.

Many of the original laws against cohabitation were designed to keep interracial couples from living together, Pleck said. "In the 1960s, welfare recipients were required to sign a chastity pledge indicating that they would not allow male callers into their home, and social workers conducted mid-night raids to learn if there was a man living in the house so they could deduct his salary from the woman’s welfare checks." In that era, newspaper advertisements across the United States frequently advertised rental housing to married couples only, and even today it is not against the law to discriminate against cohabiters in housing. Cohabiting college students were expelled and cohabiting public officials forced to resign when their living arrangements were discovered, she said.

According to Pleck, the social issue of our time is legal marriage for gay couples. Though same-sex couples are fighting for the right to marry rather than the right not to have to marry, the gay liberation movement has been the greatest engine providing legal benefits for unmarried straight couples who are living together, she said. “Although gay people are organizing for themselves, they sometimes broaden their constituencies in such a way that it benefits cohabiters as well,” she noted.

One trend that has caused attitudes to shift among even the most hardened opponents of cohabitation has been a rise in this practice among the elderly. "Somehow it’s different when Grandma moves in with her gentleman friend because she doesn’t want to give up her Social Security survivor benefits," she said. North Dakota lawmakers were swayed by those sentiments and overturned a state law against cohabitation in 2004.

Exploring legal and historical difficulties of unmarried couples who live together
A tool commonly employed by financial strategists to determine what shares to purchase to create a diversified stock portfolio was used to develop a diversified portfolio of another kind—land to be set aside for conservation purposes given the uncertainty about climate change.

Instead of plugging into the formula data for the histories of stocks, U of I environmental economist Amy Ando and agricultural economist Mindy Mallory used data on climate and habitat-quality forecasts for the Prairie Pothole Region of the northern Great Plains to develop a new application of the financial tool called Modern Portfolio Theory.

“It’s a very well-known tool in finance,” said agricultural economist Mindy Mallory. “There are many tools that are widely available to solve a portfolio problem. So it was really just a new marriage of the tool with a different kind of portfolio problem.”

Mallory and Ando used Modern Portfolio Theory to develop a diversified land portfolio for conservation in the Prairie Pothole Region, which contains thousands of shallow wetlands created by glaciers and serves as breeding grounds for almost 200 species of migratory birds. The region, about 276,000 square miles, includes portions of Saskatchewan, Manitoba, and Alberta in Canada and of Minnesota, Iowa, North and South Dakota, and Montana in the United States. Ando said the U.S. Fish and Wildlife Service has already protected over 3 million acres in the region and seeks to quadruple that investment. The techniques incorporated in this study could help the agency make decisions based on the cost, risks, and benefits of the land.

Mallory explained that in the stock analogy, simple diversification would be like someone buying one share of every kind of stock in the entire market. Ando seconded that simple land diversification, such as buying one acre in every county, would be just as farfetched a plan.

“For a long time, uncertainty due to climate change wasn’t a problem, so conservationists weren’t even looking at diversifying,” Ando said. “More recently, people have been thinking like that old phrase ‘Don’t put all of your eggs in one basket.’ So simple diversification would be the first natural step to take—and you wouldn’t need a mathematical model. But buying some land in each area doesn’t work very well.”

The researchers used models of wetland quality under different future regional climate scenarios in the Prairie Pothole Region: historic conditions, warming of 2 and 4 degrees Celsius, and warming plus a 10 percent increase in precipitation.

“What we found was that when we looked at benefits only, the area in the east was best,” Mallory said. “But when we considered both benefits and costs, the less expensive land in the region’s central area achieved the highest expected benefit.” Ando said there are major cost factors for buying the land or putting land under conservation easement. The fact that the eastern portion of the region includes high land-cost states (Minnesota and Iowa) became a big driver of their results.

“Setting aside land in that area for conservation is pretty expensive,” Ando said. “In our study, we didn’t include restoration of the land, which would result in additional costs.”

Ando said the study results showed that if climate change wasn’t likely, “the current Fish and Wildlife holdings were pretty close to being on the efficient frontier. And while simple diversification schemes may be appealing, they did not perform well. Before we began the research, we didn’t realize just how important it would be to think carefully about the diversification and not just to divide the investment between the regions.”

Mallory said that one of the biggest challenges of implementing this approach in planning is that to truly use this method, it’s important to know the probability distribution of the climate change outcomes.

“It’s a really hard question, even for climate scientists who study the topic,” Mallory said. Another challenge is that the results are dependent on policies as well as physical processes.

“There’s uncertainty about whether countries will agree on climate change policy,” Ando said. “If they do agree, you get one trajectory of carbon emissions with an associated set of probabilities of climate change. If they don’t agree on policies, you get a different trajectory of carbon emissions with a different probability distribution over climate outcomes. So there’s that uncertainty, on top of all of the physical uncertainties,” she said.

Ando said the U.S. Fish and Wildlife Service has already protected over 3 million acres in the region and seeks to quadruple that investment.
Livestock industry beets up the Illinois economy

A report conducted by the University of Illinois provides an economic snapshot of the livestock industry, giving the industry in Illinois data to back up its importance to the state. The data show the production sector of the industry contributing to more than 25,000 jobs and $3.5 billion to the Illinois economy. When combined with meat and dairy processing, the numbers are an even more impressive 99,000 jobs and $27 billion.

“The meat and dairy complex, which includes the livestock industry, is big, approaching 5 percent of the gross state product,” said Peter Goldsmith, U of I agricultural and consumer economist.

“But that’s a lot of employees and a lot of taxes, and much of its impact occurs in urban areas through industrial processing and food manufacturing where we don’t have a lot of agricultural votes. So, strategically, the meat and dairy processing sector seems like a really good partner,” Goldsmith said that for the most part, the trends were fairly consistent, except for pork.

“The expansion of pork is really a high note,” he said. “Pork exports are quite strong because of our weak dollar and high-quality products. It’s a bright spot nationally. There has been about 10 percent growth nationally since 2000 because of the success with international exports. Here in Illinois, pork had 5 percent growth. In terms of beef, we don’t have big feedlots here to complement our cow-calf industry, so much of the new investment in beef packing occurs out west, where cattle can be more efficiently fattened.”

Goldsmith said the report gives the livestock industry legitimacy as an economic engine for the state and helps its stakeholders better understand the industry.

“Dairy has seen new technologies and new business models emerge, such as large-scale dairy operations with 3,200 cows in a facility and more profitability,” Goldsmith said. “We still struggle to site those large facilities here in Illinois, even though business models have improved and nationally attracted a lot of capital investment.”

Goldsmith explained that the real growth in dairy demand is being met by the new large facilities—but they’re being built elsewhere. Interestingly, the majority of the livestock products utilized by the meat and dairy processing sector in Illinois originate from outside the state.

“We need new ideas for how to move the needle to improve the policy environment for livestock. Investors only work with you if you grow. One opportunity is to develop a broader strategic process of working to improve Illinois’s overall business climate. A healthy business environment for meat and dairy processors is good for the state’s livestock producers,” Goldsmith said. These new markets would reside close by, and Illinois producers would be well positioned to meet the demand.

The report indicated that Clinton County has the largest livestock production in the state, with $122 million in direct output and $169 million in total output. The industry in the county generates annual taxes of $13 million and direct employment of 1,089 full-time workers. The livestock industry in Jasper County generates the greatest share of the county’s economic activity, at 9.9 percent of all the personal income.

Kentucky tobacco farmers provide model for deregulation, increased production and profit

Livestock

I t someone agreed to buy your home as is a year from now, you’d likely cancel the kitchen remodel. According to a University of Illinois study, Kentucky tobacco farmers adopted that same logic when the tobacco companies announced the buyout—officially known as the Tobacco Transition Act of 2004—that ended a 66-year-old federal farm program.

However, the immediate drop in productivity was followed by startling changes. Over the 10-year period of the study, the number of farms declined from just over 40,000 to just over 8,000—but productivity increased by 44 percent.

“The quota system limited the amount of tobacco that could be grown,” said U of I agricultural economist Barrett Kirwan. “Reducing the supply guaranteed farmers their price, but it also guaranteed that less productive farms would keep producing because they’d see a price higher than what they should have been getting. As soon as that was removed, the less productive farms couldn’t survive. There was a massive reallocation and massive shift of production to more productive farms. Those farms weren’t realizing their full production potential.”

After the buyout, the total acreage of tobacco in Kentucky declined, but the remaining acres became more productive. Farmers began producing more tobacco per acre on fewer acres. The acreage also relocated to the western part of the state, where the soil is more suitable.

“The farmers who stayed began growing specialty tobacco used for cigars or chewing tobacco,” Kirwan said. “The niche markets for tobacco haven’t been hit as hard as the main cigarette market, so without the quota system, restrictions were lifted. Farmers no longer had to grow only burley tobacco; they could diversify in chewing tobacco or cigar tobacco, which are specially, higher-value tobaccos.”

The study found that the most productive farmers were also the most diversiﬁed, with crops other than just tobacco. “They didn’t have a decline in productivity leading up to the buyout,” Kirwan said. “Their tobacco production did not decline, and after the buyout their tobacco productivity rose dramatically and so did their acreage. Their acreage more than doubled.”

According to Kirwan, after the quotas were lifted, the diversified farms were able to capture the economies of scale by ﬁlling their drying barns to cure the tobacco for better efﬁciency. They were also able to save due to input reallocations, such as being able to shift fertilizer, electricity, and workers.

“You get this double kick from removing the quota,” Kirwan said. “When the quota was removed, it allowed resources to move, giving an 8.3 percent increase, but the removal of the quota itself gave 22 percent. That’s a total of a 30 percent increase just by removing this regulation.”

Kirwan said the findings from the study can be analogous for other commodity programs.

“In agriculture, there have been these types of farm programs for about 80 years and there is some variance, but this was one of the few times that we could see an absolute end to a program with no hope of coming back.”

“Other programs may not be as binding as the tobacco program with quota limits, but when we’re distorting the market price with subsidies or we’re distorting a farmer’s production choices by saying, ‘If you grow vegetables, then you no longer get subsidies for your corn,’ then we’re distorting productivity,” Kirwan said. He noted that the study focused on productivity, not equity. So although the farms were much more productive, the policy change did put many small farmers out of business. Kirwan said the findings could help guide policy makers who are deciding whether to change quota or subsidy programs.

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A new source of maize hybrid vigor

Steve Moose, an associate professor of maize functional genomics, and his graduate student, Wes Barber, think they may have discovered a new source of hybrid vigor, or heterosis, in maize. They have been looking at small RNAs (sRNAs), a class of double-stranded RNA molecules that are 20 to 25 nucleotides in length.

“Hybrid vigor” refers to the increased vigor or general health, resistance to disease, and other superior qualities that arise from crossbreeding genetically different plants. “We’ve always known that there’s a genetic basis for this heterosis,” said Moose. “Charles Darwin noticed it and commented that corn was particularly dramatic.”

Scientists have been debating the sources of hybrid vigor since the early 1900s, when Mendel’s laws were rediscovered. Edward Murray East, the first Ph.D. graduate from the Department of Agronomy (now Crop Sciences), was an early scientist who studied the problem. Many scientists disagreed with the model that prevailed from the 1920s to the 1950s, which linked heterosis to a single gene or to the interaction of several genes. “It seemed that the whole genome was involved,” said Moose.

Small RNAs were originally found in 1998 in roundworms. Researchers studying virus resistance in plants then began to notice them and observed that the way they function is very different from the functioning of protein-coding genes. “Every time we have a breakthrough in our knowledge of genetics, people have looked to see if that breakthrough brings any insight into the mystery of the hybrid vigor,” said Moose. “That’s what we’ve done with the small RNAs.”

“It seemed that the whole genome was involved,” said Moose. The discovery of DNA in 1953 eventually caused a paradigm shift in the way people looked at hybrid vigor, but there was no unifying theory, Moose said. Even as new genetic technologies were developed, the genes did not seem to explain everything. “We thought that maybe it’s the rest of the genome, the remaining 85 percent of the corn genome, that’s important,” said Moose.

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When you think about what small RNAs do, they participate in regulating growth and they tell other genes what to do,” he continued. “So they have the two properties that we know fit what has been described [about heterosis], even though we do not have an explanation. We would argue that, while they are part of the explanation, they may not be the whole explanation.”

Moose and Barber sampled sRNAs from the seedling shoot and the developing ear of maize hybrids, two tissues that grow rapidly and program yield, to investigate how the sRNA profiles of these hybrids differed from those of their parents. In collaboration with associate professor of crop sciences Matt Hudson, they analyzed what they described as a “deluge” of data. “There were 50 million data points, but we whittled them down to the most important ones,” said Barber. They found that differences are due mainly to hybrids’ inheritance of distinct small interfering RNAs (siRNAs), a subset of sRNAs, from each parent. The siRNAs influence gene expression in a variety of ways.

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Moose and Barber hope that their work might provide more insight into how to decide which inbred maize lines to cross. “We don’t want to alter how the plant grows, but if we can tweak it to do whatever it already does either faster or more, that could be an advantage,” said Moose.
A s dding prebiotic ingredients to infant formula helps colonize the newborn’s gut with a stable population of beneficial bacteria, and probiotics enhance immunity in formula-fed infants, two U of I studies report.

“The beneficial bacteria that live in a baby’s intestine are all-important to an infant’s health, growth, and ability to fight off infections,” said Kelly Tappenden, a U of I professor of nutrition and gastrointestinal physiology. “Breast-fed babies acquire this protection naturally. Formula-fed infants get sick more easily because the bacteria in their gut are always changing.”

The idea is to make formula more like breast milk by promoting the sorts of intestinal bacteria in breast-fed babies’ intestines, she added.

Prebiotics are carbohydrates that resist digestion by human enzymes and stimulate the growth and activity of beneficial bacteria in the gastrointestinal tract. Probiotics are actual live bacteria that are beneficial to intestinal health, Tappenden noted.

“A strong, robust population of beneficial microbes in the gut provides colonization resistance, and pathogens can’t as easily invade and infect an infant who has that resistance,” she added.

The researchers compared the effects of feeding pre- and probiotics with feeding breast milk and control formulas. They also compared the enhanced formulas’ effects in both vaginally delivered and Caesarian-delivered babies.

“The probiotic formula significantly enhanced immunity in formula-fed infants,” Tappenden said.

Babies delivered by C-section had an especially improved immune response, an important finding because they are a more vulnerable group.

Why? “Babies delivered naturally are exposed to the mother’s bacteria as they travel through the birth canal, and they develop a healthier population of gut bacteria as a result. Babies delivered by C-section enter a sterile environment, and their gut microbiota are quite different,” Tappenden noted.

In the probiotics study, scientists at five sites divided 172 healthy six-week-old infants into three groups, two fed formula and one fed breast milk. The formula-fed groups received either a control formula or a formula that contained the beneficial bacteria Bifidobacterium animalis subspecies lactis (Bb12) for six weeks.

The infants who received the probiotic formula had increased concentrations of secretory, antirotavirus, and anti-poliovirus-specific immunoglobulin A (IgA). Fecal samples from babies receiving the probiotic formula revealed significantly heightened immunity, especially among Caesarian-delivered infants, Tappenden said.

Infants who consumed the formula with the prebiotic ingredients also benefited. In that study, 139 healthy babies were divided into three groups. Breast-fed infants were compared with babies fed either a control formula or a formula supplemented with galacto- and fructo-oligosaccharides for six weeks. Oligosaccharides, found in breast milk, contribute to the healthy population of bacteria found in the guts of breast-fed infants.

When fecal samples were tested, babies fed the prebiotic formula showed modest improvement in the number of beneficial bacteria and decreases in the types of bacteria that are often associated with illness.

“Infants who consumed the formula were less likely to get ill because the beneficial populations in their guts were kept stable. This was true in infants born vaginally and C-section,” Tappenden said.

A new infant formula ingredients boost babies’ immunity by feeding gut bacteria

W ho knew that male fertility depends on sperm-cell architecture? A U of I study reports that a certain omega-3 fatty acid is necessary to construct the arch that turns a round, immature sperm cell into a pointy-headed superswimmer with an extra-long tail.

“Normal sperm cells contain an arc-like structure called the acrosome that is critical in fertilization because it houses, organizes, and concentrates a variety of enzymes that sperm use to penetrate an egg,” said Manabu Nakamura, associate professor of biochemical and molecular nutrition.

The study shows for the first time that docosahexaenoic acid (DHA) is essential in fusing together the building blocks of the acrosome. “Without DHA, this vital structure doesn’t form and sperm cells don’t work,” said Timothy Abbott, a doctoral student who co-authored the study.

Men concerned about their fertility may wonder what foods contain DHA. Marine fish, such as salmon or tuna, are excellent sources of this omega-3 fatty acid.

“Infertile men who lack DHA are likely to experience a lowered sex hormone level,” Nakamura said.

The scientists then used confocal laser scanning (3D) microscopy to look at thin slices of tissue in progressive stages of a sperm cell’s development. By labeling enzymes with fluorescence, they could track their location in a cell.

“With DHA, this fusion process is normal, and we can see sperm heads are formed,” Nakamura said. “Without DHA, the heads never form completely.”

When fertility problems arise, “we look for DHA deficiency in sperm,” Abbott said.

The Illinois scientists link dietary DHA to male fertility

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A 150-foot-high garbage dump in Colombia, South America, may find new life as a public park. Researchers at the University of Illinois have demonstrated that bacteria found in the dump can be used to neutralize the contaminants in the soil.

Jerry Sims, an associate professor of crop sciences and USDA Agricultural Research Service research leader, and Andres Gomez, a graduate student from Colombia, South America, may determine that the organisms involved changed at every depth. Based on these results, the Colombian government decided to go ahead with the bioremediation project using the indigenous organisms.

Findingss prove Miscanthus x giganteus has potential as alternative energy source

Concerns about worldwide energy supply and national, environmental, and economic security have resulted in a search for alternative energy sources for the United States. A new University of Illinois study shows that Miscanthus x giganteus (M. x giganteus) is a strong contender in the race to find the next source of ethanol if appropriate growing conditions are identified.

M. x giganteus grass is a bioenergy crop that can be grown to produce ethanol. The study investigated the establishment success, plant growth, and dry biomass yield of the grass. Tom Voigt, lead scientist and associate professor in the Department of Crop Sciences, said the overall goal is to promote biomass yield per acre for ethanol production using the fewest inputs with no environmental impact. Researchers compared establishment and growth rates and biomass yield at four locations over the past three years to identify regions best suited for the grass.

Researchers manipulated growing conditions to identify regions best suited for the grass.
A question that has baffled researchers for more than 15 years has been answered: How does the western corn rootworm—an insect that thrives on corn but dies on soybeans—persist in fields that alternate between the two crops? The answer, researchers say, has to do with enzyme production in the rootworm gut.

Crop rotation declined in the middle of the 20th century as the use of insecticides and fertilizers expanded in the U.S. Then in the 1960s and ’70s, when some insecticides began to fail, growers again turned to crop rotation to kill off the rootworms that fed on corn. The method was effective for decades, but by 1995 some growers started seeing rootworm damage.

“Crop rotation in east-central Illinois imposed intense selection pressure on rootworms, leading to the emergence of resistant insects,” said Ulrich. “There was limited economic and environmental fate of atrazine remains unknown, and voices are heard pro and con.”

Williams, said, his team’s recent findings demonstrate room for improvement in nonchemical components of weed management, such as with cultural tactics,” Williams said. “Because atrazine is expensive, its use enables growers to reduce the risk of variable weed control and potential crop losses at minimal cost, which means there is little economic incentive for alternatives—unless, of course, the herbicide is restricted further or no longer available.”

Although weed management systems in corn are dominated by herbicides, a simple replacement herbicide for atrazine doesn’t exist in sweet corn.

“belief overcoming such a challenge would be possible,” Williams said. “But knowing how to make the transition will require an investment in sound research.”

Atrazine is one of the most widely used herbicides in North American corn production, but heated controversy remains over the 50-plus-year-old product. Several other herbicides are used in corn production, and a host of nonchemical tactics are sometimes used, too. If the use of atrazine is restricted or banned altogether, how will sweet corn growers cope?

Previous studies focused primarily on the behavioral changes that led rootworm beetles into soybean fields, but Seufferheld and his colleagues focused instead on the rootworm gut. Their focus was prompted by observations made by Lange Zavisil, a former postdoctoral researcher at Illinois and a co-author of the study. He knew from previous research that levels of protein-degrading enzymes, called proteinases, in the insect gut rise and fall in response to chemical defenses in soybean leaves. He saw that rotation-resistant rootworms survived longer on soybeans and inflicted more damage on soybean leaves than their non-resistant peers. He also detected differences in levels of proteinases in rotation-resistant and non-resistant (wild-type) rootworms.

Tests confirmed that rotation-resistant rootworms had higher levels of a special class of proteinases than wild-type rootworms to begin with, and that they increased production of one of these proteinases, cathepsin-L, in response to soybean defenses. The wild-type rootworms increased levels of another proteinase, cathepsin-B, when feeding on soybeans. But this enzyme appears to be ineffective against the plant’s defenses. This difference allows the rotation-resistant beetles to survive on soybeans for two or three days—just long enough, the researchers said, for some of them to lay their eggs in bean fields. In spring, when the same fields are planted in corn, the rootworm larvae emerge to feed on corn roots.

“We indeed found that the rotation-resistant rootworms could eat more foliage than the wild-type insect,” Seufferheld said. “They are also able to survive a little longer on the soybean than the wild-type rootworms.”

When insects feed on them, soybeans ramp up production of proteinase inhibitors to combat the insects’ ability to digest proteins in their leaves. The researchers hypothesized that the rotation-resistant rootworms had evolved the ability to compete a little longer in this chemical warfare with the soybeans.

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Tests confirmed that rotation-resistant rootworms had higher levels of a special class of proteinases than wild-type rootworms to begin with, and that they increased production of one of these proteinases, cathepsin-L, in response to soybean defenses. The wild-type rootworms increased levels of another proteinase, cathepsin-B, when feeding on soybeans. But this enzyme appears to be ineffective against the plant’s defenses. This difference allows the rotation-resistant beetles to survive on soybeans for two or three days—just long enough, the researchers said, for some of them to lay their eggs in bean fields. In spring, when the same fields are planted in corn, the rootworm larvae emerge to feed on corn roots.

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