How Our Zoos Help Hellbenders

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Zoos Create Wonder

For children, few places offer the same sense of real-life, fantastical wonder as the zoo. On a trip to the zoo, children see animals as large as elephants and as small as ants. However, zoos offer much more than just a fun afternoon. Behind the scenes, a community of researchers, conservationists, and zookeepers work tirelessly to protect not only plants and animals, but also our natural resources around the world.

Zoos work at the forefront of species conservation efforts worldwide. The classic image of zoos as places where animals live in cramped cages and perform for the public is, for the most part, a thing of the past. Similarly, the focus on charismatic Asian and African animals has broadened to include less charismatic and more local species. Zoos have evolved into holistic institutions focused not only on responsible animal husbandry, but also on conservation, research, and education. In some parts of the world they are the primary source for animal conservation efforts, helping pave the way for the preservation of many threatened species.

For example, the Hellbender (*Cryptobranchus alleganiensis*) is a giant, fully aquatic salamander that has experienced range-wide declines throughout the past several decades. To help combat these declines and ensure a future for the species, many zoos have joined with universities, government agencies, and other conservation groups to implement much-needed conservation initiatives.

Top: Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*). Photo by Bart Kraus

Middle & Bottom: Zoos have evolved from cramped tourist attractions to expansive, holistically focused conservation organizations. Fort Wayne Children's Zoo's reptile exhibit from the 1970s (middle) has been extensively updated and modernized (bottom). The current exhibit includes areas for keepers to safely work with animals behind the scenes, something the previous exhibit lacked. Photo by Fort Wayne Children's Zoo

Zoos Protect, Study and Teach

Zoos are conservation and research organizations that play critical roles both in protecting wildlife and their habitats and in educating the public. Over the past few decades, zoos have devoted more resources to conservation and research. Zoo staff members now conduct research throughout the world on life history, habitat needs, human-wildlife conflicts, and a variety of other wildlife-related topics that influence the conservation of many species. They have spent considerable time, energy, and funds to educate the public about the animals in their collections. Zoos continue to capture the attention of the public and provide them with information about how we can reduce threats faced by the world's wildlife, particularly endangered and threatened species and species of concern.

Conservation

Zoos and their personnel know the importance and value of a balanced ecosystem. They realize that greatly disturbed ecosystems cause problems for many of the world's species—problems that only become harder and harder to fix. Through partnerships with government wildlife agencies, universities, and conservation organizations, zoos help to lead the way for ecosystem conservation. Moreover, they help train workers to protect native wildlife in emerging countries.

Zoos play a critical and increasing role in conservation. Current zoo conservation projects include everything from the largest mammals to the smallest insects. In the past, zoos gave mammals and birds priority because of their popularity with zoo visitors, but now they include conservation projects focused on less charismatic species, including amphibians and reptiles. Salamanders and frogs have recently become important conservation species, because habitat destruction and infectious diseases caused population collapses and now threaten many species with extinction. Although a large number of amphibian species are believed to be extinct or near extinction, there is hope for those that are surviving in zoos around the world (e.g., Hellbender, Panamanian Golden Frog, Wyoming Toad, Axolotl).

Zoo biologists participate in projects to prevent habitat destruction and are planning habitat improvement projects for both terrestrial and aquatic amphibians. Conservation planning is one of the tools that may help reduce the high extinction rate in amphibians, and zoos are helping to lead the way to find solutions to these problems.

St. Louis Zoo has had success breeding the Ozark Hellbender (*Cryptobranchus alleganiensis bishopi*) subspecies in its state-of-the-art artificial streams. They have produced over 5,130 hatchlings without using hormonal induction. They have released over 3,500 individuals from a combination of captive-bred and wild-collected eggs. Photos by Mark Wanner/St. Louis Zoo (left) and Nick Burgmeier (right)

Research

Zoo personnel realize that to fight the current extinction crisis, we must understand its causes. In the fight to conserve species, researchers learn as much about a species' life history and its associated ecosystems as possible. This information is lacking for many wildlife species, and zoo personnel are helping to fill in the gaps. Husbandry, reproductive biology, and behavioral and veterinary research on many animals can best be accomplished in the well-controlled settings of zoos. However, zoos are not restricted to research within their facilities. Zoo personnel also conduct field research to study population demographics and the health of wild animal populations, as well as to promote science-based conservation practices.

Research, a trademark of modern zoos, advances the understanding of animals in their care and enhances the conservation of wild populations. Much of this research helps researchers develop conservation plans for wildlife species. In recent years, research has been applied to the rearing of both Ozark and Eastern Hellbender larvae for reintroduction programs in several states. Several frog species around the world have also been reared in zoos for reintroduction programs. All of these programs were developed and successfully implemented through research in zoos, research that has proven invaluable for the success of conservation projects worldwide.

Nashville Zoo has heavily invested in studying reproductive technologies for the Eastern Hellbender. They successfully hatched larvae using artificial fertilization in 2012 and recently were the first to successfully hatch a larva from cryopreserved sperm. Photos by Christian Sperka

The WAVE Foundation and the Newport Aquarium have partnered to help bring education to the public. They use state-of-the-art equipment to transport sharks and other marine species to schools and events to teach people about the species' biology and the importance of conservation. Photo by Larry Flinner

Outreach

When people understand the need for conservation, they are generally more supportive of it. Zoos have over 600 million visitors annually, worldwide, and they have developed educational programs that teach zoo visitors and the public about conservation, research, environmental issues, and economical connections. These programs spread their messages through the Internet, magazine and newspaper articles, community festivals, radio and television, and at their facilities through special events and exhibits. Zoos tie their conservation messages to specific work they do to protect wildlife.

Many zoos have traveling school programs that take their conservation messages on the road to community schools and teach about wildlife. These school programs help bring environmental messages to children in urban communities where nature is experienced in a different way than it is in rural areas. The Newport Aquarium in Newport, Kentucky, has partnered with WAVE Foundation to bring a traveling exhibit to local schools and businesses. Additionally, zoos are now developing programs for citizen scientists so that schools and university students can participate in research relevant to the conservation of animals and their habitats. These include programs for adults and children of all ages.

Many conservation and research projects in zoos are funded through zoo societies, national and international wildlife organizations, governmental wildlife agencies, and the general public. Some social media and Internet websites help raise funds for conservation and research for wildlife. Some of these sites contribute money directly to zoos. Larger zoo associations also help raise these funds in their individual taxonomic advisory groups by holding festivals and through educational events. Without these funds, it would be difficult to accomplish the goals of their many conservation and research programs.

Outreach is critically important for raising awareness of these programs and getting people interested and involved in wildlife conservation. Zoos are helping to spread the conservation message worldwide.

Hellbenders are easily identified by the conspicuous fleshy folds of skin that extend along the sides of the body. These folds increase the skin surface area of Hellbenders allowing them to absorb oxygen more efficiently. Photo by Rod Williams

What Is a Hellbender?

The Hellbender is North America's largest salamander. It consists of two subspecies: the Eastern Hellbender (*C. a. alleganiensis*) and the Ozark Hellbender (*C. a. bishopi*). It is fully aquatic and can be found in cool, rocky rivers and streams throughout parts of the midwestern, eastern, and southern United States. The Hellbender has semipermeable skin and breathes by absorbing oxygen directly from the water through its skin and the fleshy folds along the sides of its body. Because of this, it requires clean water and its presence is considered an indicator of a healthy stream.

Hellbenders have a life cycle similar to many fish. Hellbenders start out life as eggs. A male Hellbender will pick a suitable nest rock and wait for a female to locate him. Once she enters the den, she will deposit up to 300 eggs; he will externally fertilize them; and she will leave. He will guard the eggs for 2–3 months until they hatch and, in some cases, will stay with the larvae for several more months. Hellbender larvae are approximately 1.5 inches long and gilled. They will remain in this stage for 1–2 years until they reach 4–5 inches, absorb their gills, and resemble small adult Hellbenders. This stage lasts approximately 3–4 more years until they reach 11 inches and are sexually mature.

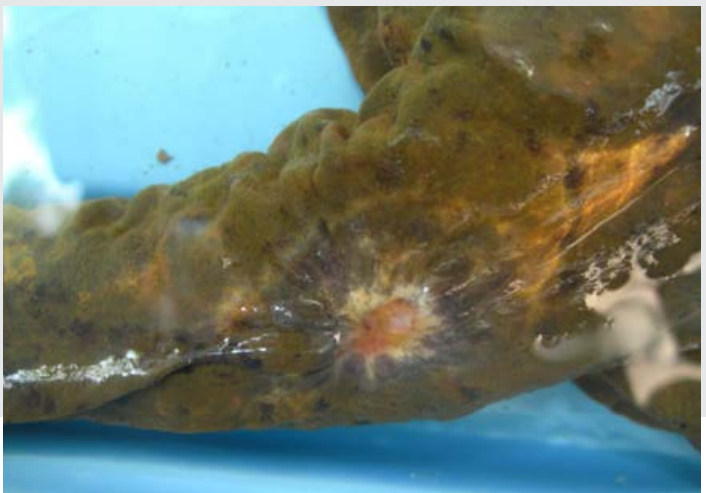
Hellbenders are nocturnal. They typically inhabit areas with abundant gravel and cobble substrates, and require large, flat boulders or bedrock crevices. Larvae and small juveniles spend their time hiding in the spaces between gravel and cobble while larger juveniles and adults spend their days hidden under boulders. At night, the smaller individuals feed on aquatic insects while larger Hellbenders feed mostly on crayfish and small fish.

Why Are They Protected?

Hellbenders have experienced precipitous declines over the past several decades. Hellbender populations in several states have been reduced to such low numbers that they are nearly undetectable or restricted to only a very small portion of their previous range (i.e., Alabama, Arkansas, Illinois, Indiana, Mississippi, and New York). In some states, their populations continue to decline (i.e., Kentucky, Maryland, Missouri, Ohio, Pennsylvania, western Tennessee, West Virginia). The only remaining healthy populations are found in the mountainous regions of Georgia, North Carolina, parts of Pennsylvania, eastern Tennessee, and Virginia.

The causes behind these declines are not well understood and likely vary. On a broad scale, habitat destruction resulting from channel alterations and impoundments caused the decline in some populations. In many parts of their range, the declines are likely due to the loss of riparian zones and sedimentation from agricultural runoff. Sediment fills the spaces between gravel and cobble and makes this habitat unsuitable for younger Hellbenders. In many parts of the Hellbender's range the populations consist of only older adults. Another contributor is persecution by anglers. Many people thought that Hellbenders were poisonous or depleted fish stocks, neither of which is true. When captured, Hellbenders would be killed. In some areas, there were Hellbender culling contests.

Whatever the cause, Hellbenders are critically endangered in some states and declining in others. It will take the full support of universities, government agencies, nonprofits, zoos, and the public to help them recover. Zoos have stepped into a leading role to ensure their continued survival.



Top: Erosion and sedimentation caused by poor agricultural practices are thought to lead to egg failure. They also reduce habitat for larval Hellbenders. Herbicides and fertilizers reduce water quality and lead to poor health for the species. Photo by Nick Burgmeier

Middle: Dams reduce habitat quality and prevent the migration of aquatic animals throughout the river system. Photo by Nick Burgmeier

Bottom: In some areas, Hellbenders display large sores and missing limbs. Some are affected by diseases such as chytrid fungus and ranavirus. Photo by Cody Marks

Fort Wayne Children's Zoo included the Eastern Hellbender in its Kids4Nature voting campaign to distribute funds for conservation. They contributed proceeds to Purdue University for Hellbender conservation projects. Photos by Fort Wayne Children's Zoo

Zoos Help Protect the Hellbender

The plight of the Eastern Hellbender is an unfortunate reality. The cryptic nature of the species allowed its declines to go relatively unnoticed. However, the species has reached a point throughout most of its range where active intervention is needed to prevent large-scale population losses and extinction.

Zoos have stepped forward to help prevent these losses. They've developed innovative approaches to captive rearing and to outreach and are continuously refining their methods to increase success. Some zoos have even started captive breeding to ensure a continuous, healthy, captive population for eventual reintroduction. The following are a few of these projects highlighting the various roles of zoos helping the Hellbender.

Columbian Park Zoo

Columbian Park Zoo, in partnership with Purdue University, held the first annual Help the Hellbender Day on August 29, 2015. This special event was dedicated to Hellbender and watershed conservation and was hosted as a free community event as part of the Hellbender conservation campaign at the zoo. This multifaceted event saw local community partners, Purdue University, and the Columbian Park Zoo come together to educate the public regarding Hellbenders and watershed conservation through engaging science activities, interpretative talks, live animal demonstrations, and tours.

Patrons learned how their daily activities affect wildlife throughout the watershed. Local community conservation partners (Wabash River Enhancement Corporation, Illinois-Indiana Sea Grant, TippCo Water Quality, and Purdue Environmental Educators) manned booths that allowed children to participate in interactive educational activities, such as pretending to be water droplets moving through a watershed. Purdue University students brought a research component to the event by discussing current research and conservation. After actively learning about watersheds and current Hellbender research, patrons were able to explore A Salamander's Tale, professionally designed by Purdue Traveling Exhibits.

Zoo staff hosted several family-friendly activity stations that allowed children to make environmentally friendly household cleaners, identify possible water contaminants, and understand the issues with yard waste entering waterways via storm water drains. Zoo patrons were also treated to a live amphibian display where zoo educators were on hand to discuss the role of amphibians in ecosystems and their importance to humans as indicator species.

Top: Children demonstrating how water droplets transport materials through the environment. Photo by Columbian Park Zoo.

Middle: A Salamander's Tale traveling exhibit was designed by Purdue University as a traveling information booth complete with a life-size Hellbender model and an interactive video game about the species' life cycle. Photo by Purdue Agricultural Communications.

Bottom: Purdue University biologist Nick Burgmeier discusses the methods researchers use to study and conserve Hellbenders in the wild. Photo by Columbian Park Zoo.

One of the highlights of the day was the "Selfie with Herbie" contest. Columbian Park Zoo Junior Zookeepers volunteered to dress in costume as Herbie the Hellbender and interact with event guests throughout the day. Guests were instructed to take a photo with Herbie and post this to the zoo's Facebook page in order to be entered for a prize drawing. This activity not only served as another interactive component, but also helped broaden the event's social media reach and awareness.

After participating in the day's events, patrons were treated to a behind-the-scenes tour of the zoo's three resident Eastern Hellbenders. These three animals are being head-started at the zoo with the intended goal of releasing them into the wild. The zoo's Hellbenders are housed off-exhibit so this component of the day's activities was very popular. Approximately 180 individuals were guided through the area in small groups to experience a more in-depth explanation of Hellbender conservation and the role the zoo plays.

Help the Hellbender Day represents a synergistic approach to community collaboration around the conservation of an endangered species. It was the first event of its kind hosted by the Columbian Park Zoo, achieving the goal of educating the public about watershed conservation and the Eastern Hellbender. In the future, the zoo hopes to continue focusing on Hellbenders and watershed conservation. Events like Help the Hellbender Day will ensure the success of this mission in the future.

Top: Zoo patrons enjoy posing for photos while showing their love for Hellbenders. Photo by Rebecca Busse

Middle: Members of the Columbian Park Zoo Hellbender staff and Purdue University's Williams' lab stand with the newly established Hellbender rearing facility. Photo by Columbian Park Zoo

Bottom: A family watches as a Purdue University student describes how pollution causes poor water quality, which can negatively impact the Hellbender. Photo by Rebecca Busse

Mesker Park Zoo recently opened Indiana's first behind-the-scenes Hellbender exhibit allowing zoo visitors to view the growing juveniles. Photo by Nick Burgmeier

Mesker Park Zoo

In 2015, Mesker Park Zoo and Botanic Garden (MPZ) teamed with Indiana Department of Natural Resources, Purdue University, Fort Wayne Children's Zoo, and Columbian Park Zoo to form a state-wide partnership with the goal of assisting captive propagation efforts for the endangered Eastern Hellbender in Indiana. Expanding the captive propagation program to three Indiana zoos allowed for greater public exposure of the plight of the Eastern Hellbender, as well as a greater capacity for rearing young Hellbenders in safe and secure environments before being released into the wild. Unfortunately, the wild population of Hellbenders in Indiana is on the razor's edge, and captive rearing alone will not be enough to save the species; captive breeding is also necessary.

From this disheartening news, an idea was born. MPZ constructed a captive-rearing system for young Hellbenders in their veterinary complex and then increased those efforts to include a Hellbender propagation facility that allows the public to see this important conservation effort first-hand. Uniquely, MPZ also has the capacity and facilities to do something never before attempted in Indiana: breed adult Hellbenders! A plan was developed to create an artificial stream that would emulate the Hellbenders' ideal conditions.

In the spring of 2016, construction began on the 2,200-gallon artificial stream system at MPZ. The stream will have an abundance of natural prey, crystal-clear water, and both natural and artificial nest locations where the adult Hellbenders can make their homes-away-from-home. Purdue University biologists will first collect wild Blue River Hellbenders for use in the project, and then chaperone them from their imperiled home in the Blue River system to settlement in their new surroundings at MPZ. With a great deal of time, love, and skill (and a little luck!), zoo professionals will help these amazing amphibians produce the first-ever fertile Hellbender eggs laid in an Indiana facility!

These eggs will then start a long journey that will culminate in the first of many Hellbender releases back into waterways where Hellbenders once roamed in large numbers. Hopefully, thanks to both the efforts of captive propagation programs and MPZ's captive breeding program, the state of Indiana can bring the Eastern Hellbender back from the brink of extinction and ensure its future as part of Indiana's native fauna.

Zoo Profiles

Columbian Park Zoo

1915 Scott Street
Lafayette, IN 47904

columbianparkzoo.org

Columbian Park Zoo is a six-acre zoological facility located in historic Columbian Park in Lafayette, Indiana.

Founded in 1908, Columbian Park Zoo has a long history within the local community. In 2004, the zoo closed to the public to embark on a comprehensive master plan with the goal of accreditation by the Association of Zoos and Aquariums (AZA). This process has seen a total redesign of the zoo with improvements and renovations, allowing the zoo to meet its mission to encourage the appreciation of the world's wildlife, to enhance the preservation and conservation of biodiversity and to inspire educational discovery and exploration in a fun, family-oriented environment for all citizens of the Greater Lafayette Area.

In 2015, Columbian Park Zoo partnered with Dr. Rod Williams and his staff at Purdue University to design a zoo-specific conservation campaign focused around their Eastern Hellbender head-start program. Three juvenile Eastern Hellbenders were delivered to the zoo to live until their scheduled release back into the Blue River. These three animals will live in the safety and care of professional zoo staff behind-the-scenes at the zoo. The outreach components of the campaign focused primarily on watershed management and Hellbender conservation, which included a dedicated school interpretive outreach program, VIP behind-the-scenes tours, incorporation into existing educational programming, and the first Help the Hellbender Day special event.

Fort Wayne Children's Zoo

3411 Sherman Blvd,
Fort Wayne, In 46808

kidszoo.org

With more than 1,000 animals, 600,000 annual visitors, and 40 acres of exhibits, the Fort Wayne Children's Zoo is northeast Indiana's most-visited tourist attraction and is consistently named a top-ten zoo by national media outlets. Renowned for excellent animal care and innovative conservation programs, the zoo is uniquely suited to support Hellbender conservation through a partnership with Purdue University and the Indiana Department of Natural Resources.

Through established systems and keepers experienced in amphibian care, the zoo is providing a stable environment for 20 young Eastern Hellbenders until they are old enough to be released into the wild. This head-starting process will dramatically increase the young Hellbenders' chances of survival in the wild.

Programs such as the Hellbender project inspire zoo guests to care about wildlife. In 2015, Hellbenders were featured in the zoo's Kids4Nature program, which allowed guests to direct more than $90,000 toward local and international conservation programs. Hellbenders were also highlighted in zoo publications, at interpretive stations, on the zoo website, and at zoo events. In 2015, more than 278,000 people were exposed to messages about Hellbender conservation through these outlets.

"Hellbenders are not well known, but they're important indicators of healthy ecosystems," says Dr. Joe Smith, Director of Animal Programs for the Fort Wayne Children's Zoo. "We're pleased to lend our expertise to this project and protect a species native to our state."

Mesker Park Zoo

1545 Mesker Park Drive
Evansville, IN 47720

meskerparkzoo.com

Mesker Park Zoo (MPZ) opened in 1928 in Evansville. Accredited by the AZA, MPZ is home to over 700 animals representing nearly 200 species. Staff at MPZ have long been interested in Hellbenders, but zoo staff did not want to simply exhibit the Eastern Hellbender; it hoped to someday be part of the greater effort to conserve the species.

In April 2015, MPZ welcomed its first group of Eastern Hellbenders, receiving 19 yearlings and one two-year-old. MPZ renovated a quarantine room in the veterinary building for an off-exhibit propagation room with the ultimate goal of moving this operation into an area where the public could witness the day-to-day care of the larvae and learn more about how they could help support efforts to save this endangered species. The public exhibit opened in April 2016 in The Discovery Center, where they house endangered species and conduct education programs.

MPZ is also working with Purdue and the Indiana Department of Natural Resources to create an indoor breeding stream or "raceway," a technique that has been successful for breeding Ozark Hellbenders. MPZ finished the raceway in late 2016, and will introduce adult Eastern Hellbenders in early 2017. If all goes as planned, the newly housed Hellbenders will begin breeding and produce fertile eggs before the end of the year.

Nashville Zoo

3777 Nolensville Pike,
Nashville, TN 37211

nashvillezoo.org

Nashville Zoo attracts more than 800,000 visitors annually and is Middle Tennessee's number-one family attraction. Nashville Zoo is actively involved in research, habitat protection, breeding programs, and education initiatives around the globe. As a founding member of the Clouded Leopard Consortium, Nashville Zoo has been instrumental in the conservation and propagation of clouded leopards. Nashville Zoo is also successfully breeding Puerto Rican Crested Toads for reintroduction into their native range. Nashville Zoo actively supports conservation in Southeast Asia and South America.

Nashville Zoo has a long-term commitment to conserving Hellbenders in Tennessee. The zoo helped develop reproduction technologies to breed Hellbenders in captivity and, along with researchers from Middle Tennessee State University and Lee University, has conducted field surveys to collect samples for genetic analysis and disease testing. The zoo is collaborating with the Tennessee Wildlife Resource Agency on a head-start program for the genetically unique Duck River population.

In 2011, the zoo developed techniques to freeze sperm for preservation (cryopreservation). In 2012, zoo staff successfully hatched the first Hellbenders ever produced by artificial fertilization. That same year, zoo staff began cryopreserving sperm from wild Hellbenders to create the first gene bank for any salamander species. In 2015, the zoo hatched the first Hellbender from an egg that was fertilized with cryopreserved sperm.

Where to See Hellbenders

There are numerous wonderful zoos around the country that have thousands of unique animals. However, not every zoo has Hellbenders! Eastern Hellbenders are amazing animals to see, but they're protected throughout their range and actively handling them is not legal in most places. If you would like to see and learn about Hellbenders and how to help, please visit a nearby zoo which has them on display. The following is a map of zoos from the eastern half of the United States that either have Hellbenders on display or are actively promoting Hellbender research.

Above: Children on a behind-the-scenes tour of the juvenile Hellbenders. Photo by Columbian Park Zoo

Below: This map shows zoos in the eastern U.S. that either have Hellbenders on exhibit or are actively working with the Hellbender conservation community. Please confirm exhibit availability before your visit.

How You Can Help

There are many ways to help your local zoos and Hellbenders. Most zoos have foundations that graciously accept donations to help support their conservation programs. Many zoos also have internship programs that teach children and young adults what it is like to work in zoo-related fields and how to grow up to be conservation-minded individuals. Below is a list of additional ways to help zoos and Hellbenders!

- Support your local zoos by participating in their public conservation initiatives
- Use practices promoted by your local watershed group or soil and water conservation district
- Do not pour oil, antifreeze, or paint thinner down drains
- Properly dispose of household chemicals
- Maintain septic systems
- Please report any person(s) collecting or engaging in behavior harmful to Hellbenders to your local conservation officer.
- Follow label use of lawn-care products, herbicides, and pesticides

Acknowledgments

We would like to thank J. Brooke, A. Frederick, and C. Schuette for reviewing this publication. We would like to thank the staffs of Mesker Park Zoo and Botanic Garden, Columbian Park Zoo, Fort Wayne Children's Zoo, Newport Aquarium, St. Louis Zoo, and Nashville Zoo for their contribution of materials for inclusion in this publication. Research and publication costs were partially supported by Purdue University and Duke Energy.

COVER PHOTO CREDITS **Front:** main–Tom Campbell; top right–Purdue Extension; middle–Nick Burgmeier; lower right–Purdue Agricultural Communications; bottom: Nick Burgmeier. **Back:** top left–Purdue Agricultural Communications Hellbender exhibit; main–Tom Campbell.

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