research landscape

Ohio's strengths in basic and applied research are broad and deep, spanning a multitude of academic, business and industrial organizations. The spectrum of clients served by the Ohio Supercomputer Center likewise encompasses many fields of study. This diversity attracts to Ohio eminent scholars and innovative entrepreneurs, as well as a breadth of regional, national and global research funding. A review of several of these projects yields a team of chemists and naturalists constructing computer simulations of forest fires that predict the dangers of controlled burns to wildlife. Researchers are measuring the water elevations of Amazon River tributaries to better understand the complexity of seasonal flooding. And, others are conducting vital studies in fields as diverse as psychology, linguistics, economics, engineering and political science. The Center strives to assist customers with basic needs, while simultaneously meeting the requirements of its most advanced customers, as evidenced by the significant projects described on the following pages. ■

above: Prescribed fires encourage new growth and reduce the risk of wildfires by intentionally burning underbrush and old wood. Foresters would like to extend the timeframe that they safely can implement prescribed fires in habitats of the endangered Indiana bat.

Healthy forests, healthy fires, healthy bats

Do no harm. In the effort to manage the forest habitats of the endangered Indiana bat, naturalists must always, always, first consider the impact on this nocturnal mammal. Bats perform a vital ecological role, feeding entirely on flying insects; a single bat can consume thousands of mosquitoes each night.

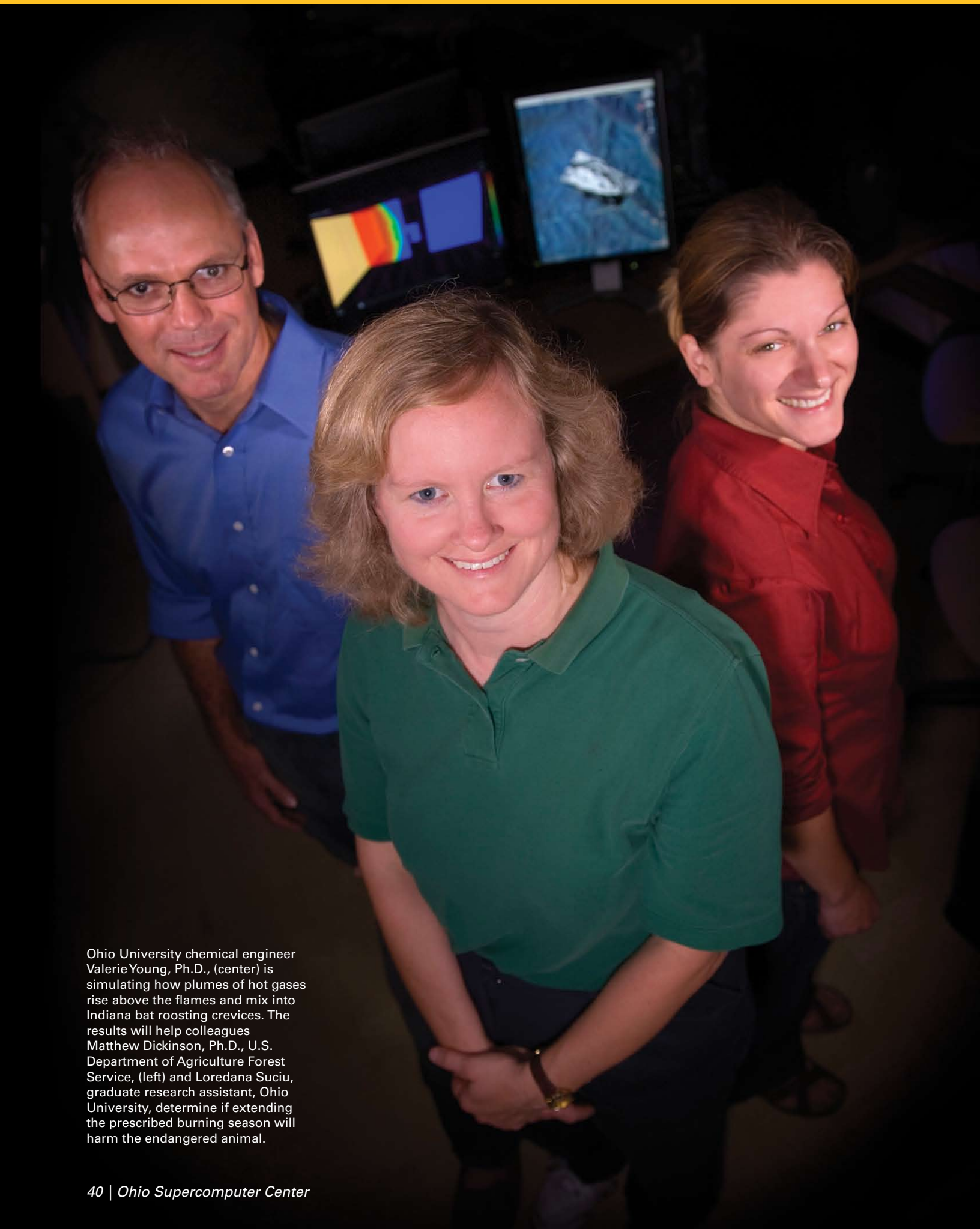
Summering in forests throughout the Eastern United States, female Indiana bats raise their young in maternity colonies. While their first choice for nurseries are dead trees with exfoliating bark, they also live in large, healthy trees such as shag hickory and oaks. Their male bats are singular creatures that choose colder microclimates; they commonly enter torpor, a hibernation-esque state, during cool or rainy days.

Ironically, one of the most effective ways to keep their ecosystem healthy could be lethal. If conducted improperly, prescribed fires — the technique of burning underbrush and old wood to encourage new growth and reduce the risk of wildfires and insect outbreak — could kill or injure both male bats in torpor and flightless young too heavy for their mothers to move. Consequently, naturalists err on the side of caution; they implement prescribed fires in known habitats of the Indiana bat only during winter months, when the bats are hibernating safely deep inside caves.

A multidisciplinary research project involving the U.S. Department of Agriculture's Joint Fire Science Program, Ohio University, University of Kentucky, Rochester Institute of Technology and several independent consultants is focusing on the potential effects of extending the burning season. The impetus for their efforts comes from Kentucky's Daniel Boone National Forest, where foresters would like to implement an aggressive prescribed burning program to restore and

below: Listed as endangered since 1967, Indiana bats play a major role in insect control. The small bats can consume up to half their body weight in insects each night.

photo courtesy of U.S. Fish and Wildlife Service



Ohio University chemical engineer Valerie Young, Ph.D., (center) is simulating how plumes of hot gases rise above the flames and mix into Indiana bat roosting crevices. The results will help colleagues Matthew Dickinson, Ph.D., U.S. Department of Agriculture Forest Service, (left) and Loredana Suciu, graduate research assistant, Ohio University, determine if extending the prescribed burning season will harm the endangered animal.

maintain oak and hickory groves and prepare for an expected invasion of gypsy moths.

Using Fire Dynamics Simulator, a version of computational fluid dynamics software, Valerie Young, Ph.D., a chemical engineer at Ohio University, is simulating how plumes of hot gases rise above the flames and mix into the roosting crevices of tree bark. She's running the data-intensive programs on the Ohio Supercomputer Center's IBM Cluster 1350.

"We suspect that the bark crevices may actually shelter bats from the fire's deadly carbon monoxide, smoke and heat," Young said. "Computational models of this kind have been used to study wildfires out West, over thousands of acres and days or weeks. As far as we can find, this is the first work that looks at the impact of fires on mammals on a microscale."

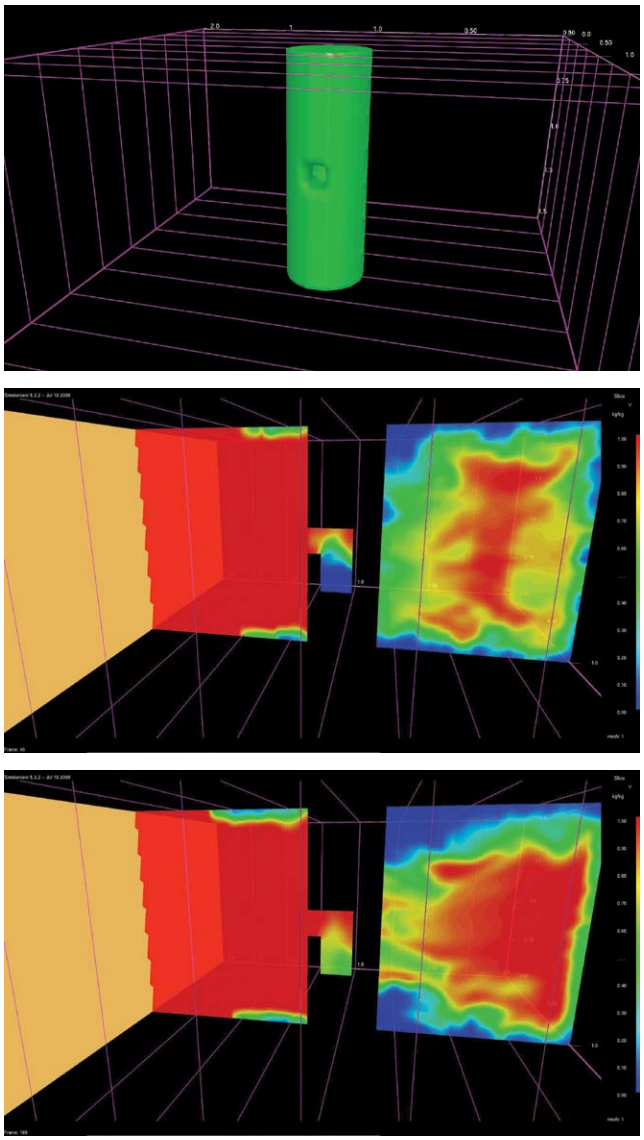
The models will help the team understand the mix of gas concentrations and temperatures for two scenarios. The first looks at the environment immediately above an active fire, when the intensity is brief, but the concentrations of smoke and heat are high. The second scenario models the low concentration of lingering smoke after the fires have subsided or been extinguished during nighttime inversions, which is when temperatures increase at higher elevations. This information will then be used to determine rates of gas and heat mixing into these crevices.

Research being conducted on OSC systems could help determine if foresters can implement an aggressive prescribed burning program that won't harm the endangered Indiana bat.

"With a better understanding of the effect of heat and smoke exposure on roosting Indiana bats, we can make better recommendations on what time of day and time of year to implement prescribed burns," said Anthony Bova, a physical scientist with the U.S. Department of Agriculture's Forest Service working on the project. "Fire obviously creates an immediate impact on the environment. We want to minimize the short term negative effects, and maximize the long term benefits."

"Our goal is to determine if the foresters can expand the range of time for implementing prescribed burns, without harming the endangered Indiana bat," Young added.

Or, in essence, do no harm. ■



above: NIST's Fire Dynamics Simulator, a computational fluid dynamics model of fire-driven fluid flow, was used to model how tracer gas mixes into a tree cavity that might be made by woodpeckers. In the top image, the green vertical bar represents the tree; the depression in the tree represents the cavity. The subsequent images, rotated ninety degrees to the left, show the fire's gases and how they move around the tree and into this potential bat roosting area.

Project leads: Matthew Dickinson, Ph.D., U.S. Department of Agriculture Forest Service; James Norris, Ph.D., Norris Consulting Services; Michael Lacki, Ph.D., University of Kentucky; & Valerie Young, Ph.D., Ohio University
Research title: Injury & mortality risks from wildland fire smoke & heat exposures for endangered Indiana bats (Myotis sodalis) in maternity roosts
Funding source: U.S. Department of Agriculture, Joint Fire Science Program