Learning the living landscape
Ecological systems research | Geospatial technologies
University- and statewide educational resources

Kansas Biological Survey
East to west across Kansas, the landscape shifts dramatically—from forested bluffs to Flint Hills prairie to open plains—following a gradient of changing rainfall and temperature averages. Along the way, the evidence of human reliance on natural resources is clear: fertile fields, ponds and reservoirs, richly blooming prairies, wind farms, and sun-soaked grasslands dotted with grazers.

At the Kansas Biological Survey, we study ecological systems, both terrestrial and aquatic, in the Great Plains and beyond—including the impacts of human use. We gather data on the ground and from satellite information systems. In collaboration with partners across KU, throughout the region and around the world, we collect, interpret and present scientific research-based information to planners and policy makers whose decisions affect us all.

We are biologists, ecologists, geographers, geologists, mathematicians, engineers and geographic information systems specialists working within a diverse group of programs that complement and synergize one another. We also manage the 3,700-acre KU Field Station, where researchers and students explore the changing landscape through study not only in the natural sciences but also in the arts, humanities and social sciences.

Together, we learn the landscape.

The Kansas Biological Survey’s work is grounded in its historic studies of state flora and fauna dating back to 1866. The University of Kansas and the Board of Regents created the Survey formally in 1911. The State of Kansas recognized the Survey as a state research agency in 1959, defining its responsibility to “gather, interpret and distribute information on the state’s plants and animals.”

Today the Survey is a research center housing programs and labs focused on natural systems. Scientists study prairie plant communities, pollinator habitat, reservoir and watershed health, land use, ecosystems, global change biology and more. The Survey embraces an expanded mission that’s true to its roots and focused on the long term:

• to promote a scientific research-based understanding of natural systems and the effects of human interactions with them;
• to serve as an educational and information resource for the University, the KU and area communities, the state and the nation;
• to encourage and provide a setting for multidisciplinary research aimed at meeting human needs while ensuring the availability of natural resources.
Echinacea angustifolia (here at Tallgrass Prairie Preserve), perfectly suited to the climate and soil of North Central Kansas, is renowned worldwide for its medicinal properties. Kansas historically has produced more of this species than any other place on earth.

(Above) A KU doctoral student and undergraduate assistant visit a Shawnee County prairie to study pollinator communities.

We know the iconic prairie, one of Kansas’ signature landscapes, by its distinctive flowers and grasses. Yet the beauty we see depends on what we don’t see: the health of the microbial communities of bacteria and fungi in the soil. Soil health affects plant health in every landscape, from croplands and pastures to wetlands and forests, extending to streams, reservoirs and the intermittent water basins of western Kansas known as playas—the main sources for aquifer recharge.

For Kansas Biological Survey scientists, the research laboratory extends across the entire state and includes the soil beneath, which is teeming with many times more species than exist above ground. Studies of natural systems outside Kansas provide points of comparison and bring additional knowledge home.

Survey scientists focused on microbial systems come together with those studying plant and insect communities, water bodies and land use to frame a big-picture, long-range understanding of the complex overall systems people depend on. Keeping the balance assures air, soil and water quality, adequate wildlife habitat and sustainable agricultural production.

“To a great extent, the visible health of the landscape correlates directly with the health of our food and water and the air we breath. To take care of those things, we need to understand how they’re all related, from the soil right up into the atmosphere.”

—Jim Bever, KU Foundation Distinguished Professor of Ecology and Kansas Biological Survey Senior Scientist
A precious resource

When it comes to water, Kansas is pushing its limit. Many of the state’s reservoirs are filling with sediment; by the end of this century, 11 of 24 federal reservoirs are expected to be half-filled. Kansas is dotted with more than 200,000 other lakes and smaller ponds for flood control, drinking water, irrigation, livestock, recreation and other priorities.

KU has made water a research priority. As part of its Strategic Initiative, eight new faculty positions focus on water quality and resources. This decision was based on the strengths of several KU units, including the Kansas Biological Survey, whose scientists have monitored the region’s lakes, rivers and streams, as well as aquatic species, for decades.

Survey scientists continue to work with state agencies and officials and to educate planners and the public about water resources—publishing the first Atlas of Kansas Lakes, launching the online Kansas Lakes and Reservoirs Data Repository Portal, and advising the Kansas Legislature, at its request, on the State’s Water Plan.

“We have to make it a priority to understand the structure and functioning of all of our reservoirs. Guided by this, we can determine and implement the best management for each and then continually evaluate the effectiveness of our actions.”

—Jerry deNoyelles, KU professor of ecology and evolutionary biology, Kansas Biological Survey deputy director
Kansas Natural Heritage Inventory • Kansas Natural Resource Planner

The work of the Kansas Natural Heritage Inventory, among that of all the Kansas Biological Survey’s programs, most closely resembles the historic work of surveying the state’s plants and animals and making the information public. The importance of this work was recognized 150 years ago and still is today.

Heritage program biologists and ecologists routinely are called upon by private industry and government entities to assess specified sites for species and habitat data. This sets a baseline for decision-making about construction projects, land use and long-range planning. The program also is involved in restoration and remediation projects and in the development of site-specific management recommendations across the state.

For more than 25 years, the Heritage program has maintained an integrated database containing comprehensive biological data on the plants, animals and natural communities of Kansas. Most of these data are available through the Kansas Natural Resource Planner, an online map that enables users to view, separately or simultaneously, more than 20 categories of natural resource and infrastructure data.

“For more than a century, Survey scientists have studied the plants, animals, and natural communities of Kansas and the Great Plains. The collections and observations of earlier generations now can be applied in ways unimagined in the past. The legacy data accumulated from this work offers a window into our biological and ecological heritage, provides insights into today’s environmental challenges, and enables informed decisions that will shape our future.”

—Craig Freeman, Kansas Biological Survey Senior Scientist and Senior Curator, KU’s McGregor Herbarium

(Main photo) Survey scientists from the Kansas Natural Heritage Inventory monitor plants at the Smoky Hill Air National Guard Range (Saline and McPherson counties) as part of an overall study of plants, wildlife, prairie management and land use history on the site. (Above) Data from such studies are integrated into the Survey’s Natural Resource Planner, an interactive online map designed to help users make informed decisions in planning and development projects.
Twelve major river basins—from the Cimarron in the southwest to the Missouri in the northeast—extend into Kansas. These basins, or watersheds, are the basic unit for water management and planning by the state. Within these watersheds lie complex networks of streams, as well as wetlands. And every major reservoir in Kansas, whether managed by federal or local authorities, results from damming a river.

Clean and plentiful water is a primary concern in Kansas, from the state to the local level. Kansas Biological Survey aquatic ecologists study rivers, streams, lakes and wetlands to determine baseline conditions and monitor them for changes due to natural and human activity. Key concerns include water clarity, chlorophyll levels and the presence of nitrogen and phosphorus. In addition, researchers study plant, fish and macroinvertebrate communities.

Survey scientists often are contracted to do these studies for the state, counties, cities and public utilities, as well as federal agencies. The results of this monitoring lie at the core of decisions that must be made to assure the health of humans, livestock and wildlife across the state.

“Our aim is to avoid environmental impacts as we plan for infrastructure changes across Kansas. To do that we need current, accurate data on habitat and species distributions. For everything from the pallid sturgeon to the prairie chicken, we rely on the data and judgment of Kansas Biological Survey.”

—Brad Loveless, Executive Director, Environmental Services, Westar Energy
Since 2000, satellites have produced images of nearly all of Earth’s surface each day. This aerial imagery is a key source for mapping tools developed by the Survey’s Kansas Applied Remote Sensing (KARS) program—tools involved in monitoring land use, rangeland and forest characterization, soil conservation needs assessment, surface mined lands inventory, mapping of irrigated lands, urban area analysis and much more.

The KARS program has a much longer history, though. It was established by NASA and the State of Kansas in 1972. Since 2001, KARS has worked in cooperation with the Kansas Department of Wildlife, Parks and Tourism, providing resource managers with custom mapping and access to the most current geospatial technologies.

KARS applied research helps public agencies and private firms make best use of data from satellite and airborne remote sensing systems. A wide range of users, from farmers to policy makers, rely on the maps, databases and natural resource models developed by KARS to make key land use decisions.

“The products derived from the use of GIS technology as it relates to fish and wildlife management in Kansas have become our foundation for assessing landscape-level impacts on our resources. The expertise and guidance through our partnership with KARS—which has the ability to keep current with GIS technology—have been invaluable.”

—Keith Sexson, Director, Kansas Department of Wildlife, Parks and Tourism
On the KU Field Station’s Fitch Natural History Reservation stands a 120-foot monitoring tower. Along the forest floor runs a complex electrical array of sensors. This place, along with Harvard Forest, the Smithsonian Conservation Biology Institute and Konza Prairie Biological Station, is among 106 key sites in the National Ecological Observatory Network (NEON)—one of the largest initiatives in the history of the National Science Foundation. Over a 30-year period beginning in 2017, this continent-spanning project will gather data on the causes and consequences of climate change, land use change and invasive species.

The Fitch Reservation was included because it has transitioned from prairie to corn field to forest. Being part of NEON is an important step in the Kansas Biological Survey’s ongoing focus on ecosystems research. Survey scientists study changing ecosystems around the world—in prairies, grasslands and forests, and in underground microbial communities—and the effect changes can have on human activity and health. Continuing work with NEON and partners across the world will take these studies far into the future.

“NEON’s undertaking—ecological monitoring at this scale and duration—is unprecedented and likely will serve as a model for the rest of the world. The KU Field Station site will provide unique data on the transition from tallgrass prairie into eastern deciduous forest.”

—Jennifer Smith, field operations manager, NEON Domain 06, the Prairie Peninsula
**RESEARCH**

Number of active grants held by Survey scientists annually (average): **60**
From state and federal agencies: **34**

Average annual funding from state and federal grants: **$4.7 million**

Number of key sites, including the KU Field Station, in the National Science Foundation's continentwide National Ecological Observatory Network: **106**

New NSF grant funding 2010-2014: **$3.26 million**

Number of lakes presented through data and maps in the Survey's Atlas of Kansas Lakes: **76**

Number of streams in EPA Region 7 (Kansas, Missouri, Iowa, Nebraska) from which water chemistry data have been collected: **2,235** In Kansas: **595**

Macroinvertebrate species identified in EPA Region 7 streams: **1,340**
In Kansas streams: **408**

KU Field Station total acreage: **3,673**
Acres at the core research area: **1,800**
Distance of core area from Lawrence campus: **8 miles**

Long-term experimental terrestrial plots and aquatic basins at the Field Station: **350**

Research projects supported by KU Field Station facilities since 1985: **150+**

External funding drawn by these projects: **$27 million**

Publications produced by resident and visiting scholars from research conducted at the Field Station since 1949: **800+**

Bird species recorded at the KU Field Station: **258**

The Field Station’s Rockefeller Native Prairie supports more than 200 native species of flowering plants.

**SERVICE and OUTREACH**

Layers of data available for viewing in the Kansas Natural Resource Planner interactive online map: **42** (See kars.ku.edu/maps/naturalresourceplanner/)

Average annual requests to the Kansas Natural Heritage Inventory for rare species data, project review and other information, from private businesses, government agencies, conservation organizations and the public: **800+**

Number of states for which the Survey monitors lesser prairie chicken habitat: **5** (entire range)

Estimated number of citizen scientists participating annually in monarch butterfly tagging through Monarch Watch: **100,000**

Annual participants in meetings, tours and other KU Field Station events: **900**

**TEACHING**

Average number of students working directly with Kansas Biological Survey researchers and staff each year: **64**

Percentage who are undergraduates: **50**

Average number of graduate students with thesis/dissertation members holding at least half-time Survey appointments: **35**

Students who have completed graduate degrees based on research done at the Field Station: **160+**

Average number of KU courses relying on the KU Field Station each year: **16**

Average number of KU undergraduates conducting research at the Field Station each year outside regular classes: **13**

Monarch Watch, a Survey affiliate program, tracks the annual migration of the Monarch butterfly and provides extensive public outreach.

Researchers measure the width of a stream as part of data collection.
Kansas Biological Survey programs and laboratories

Core programs

The Aquatic Research Group conducts scientific studies on issues related to water quality and aquatic ecology using state-of-the-art technologies to collect and analyze critical information on the status and condition of Kansas reservoirs, streams and wetlands. The Central Plains Center for BioAssessment also conducts research on freshwater ecology and water quality issues. It is a Society for Freshwater Science Certification Center taxonomic certification center and also facilitates the exchange of scientific information among scientists, governmental officials and the public. The Invertebrate Zoology Laboratory conducts mosquito monitoring in support of West Nile surveillance and monitors macroinvertebrates in playas and other seasonal wetlands.

The KU Ecosystems Research Group is a consortium of researchers seeking to understand how terrestrial and aquatic ecosystems around the world function. The group comprises faculty, postdoctoral researchers and students who explore Earth’s vegetation, soil, water and climate using a diversity of approaches, particularly in the context of climate change and land use.

The Kansas Natural Heritage Inventory collects, manages and disseminates information about the biological diversity of the state, emphasizing the plants, animals and natural communities that are sensitive, threatened or endangered. Data are made available to a wide variety of users to provide early notice of potential natural resource conflicts, to guide public and private land use decisions, and to develop conservation priorities.

The Kansas Applied Remote Sensing (KARS) program, established by the National Aeronautics and Space Administration (NASA) in 1972, conducts research on applications of remote sensing technology to a broad array of environmental and agricultural issues. Its interactive online maps, such as the Natural Resource Planner and the Green Report, provide environmental and infrastructural information of great interest to the public and vital to land-use planners. The program works to facilitate technology transfer of a variety products and services derived from remote sensing technologies to commercial, governmental and other end users.

University of Kansas Field Station

The KU Field Station, established in 1947, provides nearly 3,700 acres of diverse native and managed habitats as well as laboratory support facilities for field-based environmental research and education.

Affiliated programs

Monarch Watch is a cooperative network of students, teachers, volunteers and researchers dedicated to the study of the monarch butterfly in nationwide efforts to promote the conservation of monarchs and their habitat; to further science education using monarchs; and to involve thousands of students and adults in a study of the monarch’s spectacular fall migration.

The Native Medicinal Plant Research Program provides scientific validation and promotes public understanding of medicinal uses of native Kansas plants.

The Crucial Habitat Assessment Tool (CHAT) GIS Center provides an online map viewer and spatial representation of the Lesser Prairie Chicken Range-Wide Conservation Plan for a five-state consortium of state fish and wildlife agencies.
Reservoir health and water quality are key research focus areas of the Kansas Biological Survey. Across the state, Survey researchers study lands and waters such as those around Chase County Lake, shown here.