The University of Kansas
Field Station and Ecological Reserves

A HALF CENTURY OF RESEARCH AND EDUCATION
THE MISSION OF THE UNIVERSITY OF KANSAS FIELD STATION AND ECOLOGICAL RESERVES IS TO FOSTER SCHOLARLY RESEARCH, ENVIRONMENTAL EDUCATION, AND SCIENCE-BASED STEWARDSHIP OF NATURAL RESOURCES.

CONTENTS

From the Director 1
Overview 2
Research Management Plan 7
Summaries of Tracts 9
Research 13
Land Management and Stewardship 21
Teaching and Outreach 22
Research Support 24
Administration 24
Global Perspective 25
Tracts and Facilities 26
   Nelson Environmental Study Area 26
   Frank B. Cross Reservoir 29
   Kansas Aquatic Mesocosm Program 30
   Biotic Succession/Habitat Fragmentation Facility 32
   Rockefeller Experimental Tract 34

Robinson Tract 36
   Geohydrologic Experimental and Monitoring Site 37
   Hall Nature Reserve 38
   Breidenthal Biological Reserve 39
   Rice Woodland 41
   Wall Woods 41
   Fitch Natural History Reservation 42

University of Kansas Support, Affiliate Programs, and Other Resources 45
Organizational Chart 47
Resident Faculty and Staff Investigators 48
Externally Funded Research: 1985–2000 52
Theses and Dissertations: 1949–2000 54
Publications: 1949–2000 58
Credits 68
The University of Kansas Field Station and Ecological Reserves (KSR) recently celebrated its 50th anniversary. It seems fitting at this time to summarize the growth and development of the field station during its first half century, and to recognize the contributions of the many dedicated people whose efforts have produced a rich tradition of research, education, and stewardship. This publication chronicles the achievements at KSR that now serve as the foundation for even greater work in the future.

KSR began formally in 1947 when a 239-hectare (590-acre) parcel of land, which was the former farm of the first governor of Kansas, was dedicated as a nature preserve and field station. KSR now consists of 726 hectares (nearly 1800 acres) of native and reseeded tallgrass prairie, forests of different ages, natural and reconstructed wetlands, a small reservoir, a variety of habitats used for experimental manipulation, including managed grasslands and 100 experimental ponds, two research laboratories, and other support facilities. KSR is strategically located for ecological research and teaching in a natural transition zone between the eastern deciduous forest and the tallgrass prairie of North America. The principal goal of KSR is to support scholarly research, environmental education, and science-based stewardship of natural resources at the University of Kansas (KU).

The scientific and teaching contributions from KSR during the past 50 years, as reviewed in this document, are a major source of pride for all of us. To date, faculty, staff, and students working at KSR have produced more than 700 publications with 154 students completing advanced degree requirements based on research at KSR. Since 1985 more than 75 externally funded projects totaling $11 million have been completed utilizing KSR facilities. Currently, more than 40 faculty and staff from KU and other institutions are involved in a variety of aquatic and terrestrial research programs conducted at KSR. More than 1000 students from KU, area colleges, and public schools visit KSR annually as part of educational and outreach programs. KSR has become an important resource for supporting field-based ecological research and teaching at the University of Kansas.

Many individuals and organizations have contributed to the growth and success of KSR. With the initial contribution from Dr. Charles Robinson, first governor of Kansas, and his wife Sara, the 239-hectare Fitch Natural History Reservation (FNHR) has been the site of numerous studies, including the changes of plant and animal communities as they have undergone succession from the former agricultural landscape.

Professor Henry S. Fitch, for whom the area is named, began his work at the site in 1948 and has conducted research and teaching on the area for more than 50 years. A natural history trail through many of the different habitats at FNHR is supported by on-site educational materials and is open to the public. In 1956, a 65-hectare (160-acre) farm adjacent to the FNHR consisting of native tallgrass prairie and agricultural land was added through a grant from John D. Rockefeller, Jr. A portion of the site was reseeded to tallgrass prairie in a long-term study evaluating land management practices on grassland.

From 1965-1974, with generous donations from the Rice Foundation, the Breidenthal Family, and Roy and Eleanor Wall, KSR acquired 81 hectares (200 acres) of remnant eastern deciduous forest 16 kilometers (10 miles) south of FNHR. This forest is within an area known as the Baldwin Woods, which was designated in 1980 as a National Natural Landmark, and provides opportunities to study native plants and animals within a minimally disturbed setting.

The 44-hectare (108-acre) Robinson Tract, another portion of the original farm of Governor Robinson, was added in 1970 and in addition to providing woodlands and grasslands for teaching and research, also provides natural wetlands and wetlands restored from previous disturbances. The 250-hectare (618-acre) John H. Nelson Environmental Study Area (NESA) was secured in 1970, largely through a gift from the former dean of the graduate school, John H. Nelson and his wife Kathryn, to provide a diverse number of habitat types for short- and long-term ecological studies where habitats are purposely manipulated. This area supports major ecological research, including a long-term National Science Foundation project evaluating the impact of habitat fragmentation on plant and animal communities. An experimental pond array at NESA is used to study the effects of various disturbances on aquatic ecosystems and a 4.5-hectare (11-acre) reservoir (with protected watershed) serves as a model aquatic system for studying natural processes in regional habitats.

In 1999, the 47-hectare (116-acre) Hall Nature Reserve composed of several habitat types was added through the generosity of Hubert “Hub” Hall and Kathleen McBride Hall on behalf of the Hall Family. Hub Hall’s father, E. Raymond Hall, former director of the Kansas University Natural History Museum, led the successful efforts to establish the FNHR in 1947. The Hall Nature Reserve will be used for studies of the natural recovery processes associated with new approaches to land restoration. Future additions to KSR in the surrounding area or across the State of Kansas will continue to expand the available research and teaching opportunities.

KSR is administered by the Kansas Biological Survey, a research unit of the University of Kansas. KSR benefits from the many resources available at the University of Kansas, and from efforts of the Kansas University Endowment Association. Work is in progress to include KSR in the development of an Institute for Earth and Ecosystem Science at KU. The principal role for the Institute will be to conduct research on the complex issues associated with natural resources, water and air quality, land use, and the impacts of global climate change by facilitating interdisciplinary interactions among investigators. In the future KSR will continue to play a key role in scholarly research, environmental education, and science-based stewardship of natural resources at the University of Kansas.

For the University of Kansas Field Station and Ecological Reserves,

Edward A. Martinko, Director
Kansas Biological Survey
Overview
University of Kansas Field Station and Ecological Reserves (KSR)

Established in 1947, KSR is the biological field station of the University of Kansas (KU).

During the last half century the University of Kansas Field Station and Ecological Reserves (KSR) has grown and evolved in scope of research, breadth of educational offerings, and diversity of ecosystems preserved. However, the mission of KSR – ecological research, environmental education, and stewardship of natural resources – has remained a constant guiding principle.

The KSR field station is composed broadly of three elements: land, people, and information. The land – 726 hectares (about 1800 acres) in eight tracts – includes diverse habitats and specialized research facilities. The prairies, forests, wetlands, ponds, laboratories, gardens, and large-scale field studies on KSR lands provide the platform for research and education programs.
Scientists, students, teachers, managers, administrators, and friends are the human element of KSR. The time, talent, and creative energy of this diverse group provide the intellectual foci for extraordinary programs of research and environmental education.

Information is the third component of KSR. Information is the foundation upon which we advance science – confirming past findings and exploring new ideas. Results from previous research, data from ongoing studies, and archives such as biological specimens, samples, and photographs provide the baseline for research.

There is a synergy within this triumvirate – land, people, and information – that propels the research and education mission at KSR. Scientists at KSR conduct research of fundamental importance to Kansas, the Great Plains, and our nation. Because environmental education is a key to our future, the educational opportunities KSR affords to hundreds of students each year is increasingly important.

Habits
Northeast Kansas is situated in the transition zone (ecotone) between eastern deciduous forest to the east and the tallgrass prairie to the west. Two hundred years ago, before Euro-American settlement, the area was a mosaic of habitats dominated by tallgrass prairie. Today the landscape is highly fragmented and much altered as a result of human activity.

At KSR, terrestrial habitats include oak-hickory forest, tallgrass prairie, restored prairie, land in stages of ecological succession (old field, shrubland, and woodland), and land in agricultural management. Intermittent streams, wetlands, ponds, and a small reservoir and protected watershed represent aquatic habitats. Collectively these habitats support a variety of research projects and permit a broad array of teaching opportunities.

Research Management Plan
Some KSR tracts are used exclusively as nature reserves and are protected from disturbance and manipulation. Research and teaching activities on native prairies, forests, and aquatic habitats are carefully monitored to limit direct human impact. Other areas within KSR are available for experimental manipulations and for development of research facilities.

This balanced approach – nature reserves and experimental areas – ensures the long-term viability of KSR as a research station. It provides for the conservation and study of imperiled natural communities and yet accommodates the development of facilities and field experiments that address contemporary environmental issues.

Students in a KU Environmental Studies field course examine invertebrates captured in sweep nets at John H. Nelson Environmental Study Area.
Research and Teaching Facilities

Facilities to support research and teaching are available for resident and visiting scientists, teachers, and students. Most facilities are located in a central area, including laboratory buildings, experimental ponds and a reservoir, a geohydrology research site, fenced enclosures for small mammal research, a lath house and irrigated areas for plant studies, a meteorological station, a caretaker’s residence, and maintenance buildings.

A special feature of KSR is the availability of sites for experimental manipulations. Long-term, large-scale projects are underway that examine issues of habitat fragmentation and ecosystem restoration. In addition, areas are reserved to accommodate research requiring smaller-scale manipulations.

Nature trails through forest, prairie, wetlands, and managed areas facilitate teaching and public outreach at KSR. The new wetland restoration site provides opportunities to experience the wetland ecosystem. For persons desiring a field trip experience but unable to navigate trails, a series of signs along a roadway describe an interesting prairie restoration and management study.

People

The scientific community at KSR is composed of faculty, staff, and students from KU and other academic institutions. These scientists represent many different fields of study. In a typical year, about 35 faculty and staff conduct research or teaching activities, 25 graduate students use KSR for some aspect of Master’s or doctoral research, and numerous undergraduates participate in studies.

A number of other people support KSR. Staff and administrators affiliated with KU and the Kansas University Endowment Association, benefactors, and people from surrounding communities, in various capacities, all play a role in KSR operation and development.

The Kansas Biological Survey, a research and service agency at KU, administers KSR. KBS staff manage KSR and coordinate activities. Faculty and staff from academic departments and programs at KU provide guidance and direction.
Information Base

Since 1947, about 700 publications (theses, dissertations, monographs, and scientific articles) have reported on research done, fully or in part, at KSR. This baseline information, combined with long-term studies spanning 40–50 years in some cases, and other data sets provide an unusually rich information archive for KSR.

Physical archives make up the remainder of the information base at KSR. Biological specimens, environmental samples, maps, and photographs are examples of archives that form a base of knowledge. Collectively, this base of information establishes KSR as a site where complex environmental questions may be addressed.

Research

KSR researchers conduct an impressive range of research in ecological and environmental science. Plants, animals, and microbes have been studied at KSR over the last 50 years. Research has included studies of behavior, physiology, morphology, reproductive biology, pollination, genetics, predator-prey interactions, host-pathogen relationships, habitat requirements, and community and landscape ecology. Likewise, research is ongoing on the physical environment — soil, air, and water — including its relationships with organisms and ecosystems.

Funds for research and development at KSR come from KU and multiple other sources. KSR scientists are highly successful in obtaining grants from such groups such as the National Science Foundation, Environmental Protection Agency, United States Department of Agriculture, National Aeronautics and Space Administration, United States Geological Survey, several Kansas agencies, and the private sector.

History and Future

Since its founding in 1947, KSR has grown and developed through the efforts of concerned citizens, faculty, students, administrators, and others dedicated to establishing a field station to promote research in the natural sciences and to provide expanded educational opportunities for people of all ages. The faces change through time but the commitment to research, teaching, and environmental stewardship is strong now and will continue to be in the future.
Research Management Plan

KSR tracts are managed in one of two broad categories: Natural Areas or Experimental Areas. In general terms, Natural Areas are places with minimal disturbance, and Experimental Areas are sites where manipulations are allowed.

Natural Areas

Experimental manipulations and modifications are not allowed on Natural Areas. They are managed with minimal disturbance, although in some cases fire may be used to preserve native communities. These areas provide an opportunity to study native organisms, communities, and ecosystems, and serve as baselines against which environmental change can be measured.

...preservation
...biodiversity
...baselines for comparisons

Experimental Areas

Experimental manipulation, habitat modifications, and development of research facilities are permitted. Note, however, that some of these sites may contain native communities that are preserved. These sites provide the research facilities and experimental studies that allow scientists to address complex issues.

...experimental ecology
...manipulations
...laboratories, gardens, ponds...
Summaries of Tracts

The University of Kansas Field Station and Ecological Reserves (KSR) is composed of eight different tracts.

KSR is an integrated system of sites for research, teaching, and conservation. The names of individual tracts that comprise KSR are retained as a tribute to a lifetime of scholarly endeavor, to retain historic connections, or to honor the wishes of donors who have provided funds to establish a “living memorial.”

Each unit of the KSR system contains unique elements and, collectively, these units permit the diversity of research and teaching activities for which the field station is renowned. The following narratives highlight individual units – more detailed accountings are provided in later sections of this report.

Breidenthal Biological Reserve, Rice Woodland, and Wall Woods

Located in an area known as Baldwin Woods, these three tracts comprise an 81-hectare (200-acre) block of oak-hickory forest. Baldwin Woods was historically, in the 1850s and earlier, a grove of forest lying north of a high ridge traversed by the Santa Fe Trail; this woodland consisted of about 1500 hectares (3700 acres). Baldwin Woods supports an unusually rich diversity of plants and animals – many of forest affinity and on the western edge of their ranges.

In 1980, the entire Baldwin Woods area was designated as a National Natural Landmark because it is recognized as a “…significant example of the natural heritage of the Nation.”

Scientific studies within the Breidenthal Biological Reserve, Rice Woodland, and Wall Woods are done with as little disturbance as possible so as not to damage the sensitive ecosystem. KSR will preserve a portion of the Baldwin Woods ecosystem in perpetuity; however, disturbance and fragmentation by continued development in the greater Baldwin Woods area are major concerns.

Fitch Natural History Reservation

The Fitch Natural History Reservation (FNHR), established in 1947, is the oldest unit of KSR. A former farm of the first Governor of Kansas, fields on FNHR had a history of grazing, haying, and cultivation until 1948. At that time the area was protected from disturbance, and dedicated to teaching and research. Ecological succession has greatly changed the aspect of FNHR over the decades and most formerly open areas are now wooded.

Researchers led by Professor Emeritus Henry S. Fitch, resident naturalist since 1948, have documented successional changes in plants and animals on the site, providing an unusually detailed historical record. Thousands of people of all ages have learned about natural history and ecology during field trips to the area. A 2.1-kilometer (1.3-mile) self-guided nature trail through FNHR is open to the public.
Aquatic communities enclosed in a series of fiberglass tanks (mesocosms) can be experimentally manipulated to address research questions.

John H. Nelson Environmental Study Area

The John H. Nelson Environmental Study Area (NESA) is devoted primarily to experimental ecological studies. A variety of habitats are available for manipulation and numerous research facilities are located there.

The Kansas Aquatic Mesocosm Program (KAMP) facilities include more than 100 experimental ponds and aquatic enclosures, as well as Frank B. Cross Reservoir – a small research lake with a protected watershed. At NESA there are also plant research facilities (including a lath house and irrigated gardens), fenced enclosures for small mammal studies, and a 12-hectare (30-acre) biotic succession/habitat fragmentation research facility. KSR field headquarters, a caretaker residence, a meteorological station, laboratories, maintenance and storage buildings, and equipment are also located at NESA.
Rockefeller Experimental Tract

The Rockefeller Experimental Tract (RET) was acquired in 1956 for two purposes: to conserve a small native prairie, and to determine what land management practices were best for restoring and managing prairies. The native prairie, which is maintained by periodic burning, contains more than 165 native plant species.

Since 1962, tracts of reseeded prairie have been burned, grazed, mowed, or left untreated to determine effects on prairie ecosystems. This site is now one of the longest-running studies of prairie restoration in the region.

Robinson Tract

Located on the Kansas River floodplain and adjacent rolling hillsides, the Robinson Tract (RT) contains diverse biological habitats and geological features. A primary use of RT is for undergraduate teaching, especially students in introductory biology and ecology courses. Hundreds of students each year traverse the prairie, forest, and wetland habitats at RT and learn about these ecosystems. A new wetland restoration project enhances teaching opportunities at the site.

Because a part of RT overlies the Kansas River aquifer there is an abundant source of ground water near the surface. A water well and large-capacity pump at RT supplies water to the aquatic facility at NESA. The Kansas Geological Survey operates a major research facility at RT that examines geological and hydrological features of the aquifer.

Hall Nature Reserve

The Hall Nature Reserve (HNR), located on uplands just south of the Kansas River, is the newest unit of the KSR system. Habitats at HNR include high-quality and degraded native prairie, reseeded prairie, and successional woodland. Research and teaching at HNR focuses on conservation and restoration of native habitats. HNR is of historic interest because of its location near Lecompton, a former territorial capital of Kansas.
Scientists at KSR conduct an array of basic and applied research in both terrestrial and aquatic habitats. They study diverse organisms, physical environments, and ecosystem processes. Research programs range from single investigator to multidisciplinary teams.

The following sections summarize research at KSR in a sequence roughly following the levels of biological organization—from organisms and populations to communities, landscapes, and ecosystems. Although this is a convenient framework for conceptualizing research, it is somewhat oversimplified as much of the KSR research deals with interactions of multiple levels. A section on conservation biology (a field of science concerned with maintenance of biological diversity) has been included because much of the research at KSR has applications in this area. Please refer to later sections of this report for details on investigators, projects, funding, and publications.

Organismal Biology

Historically, a major focus of research has been the study of individual organisms under natural and semi-natural conditions, and this continues to be a productive area of research at KSR. Research topics have included aspects of physiology, behavior, morphology, taxonomy, and ecology—spanning truly diverse groups of organisms.

Flowering plants, ferns, mosses, liverworts, algae, and fungi have been the subject of scientific investigations. Zoological studies of physiology, diet, home range movement, reproduction, and morphology have been completed for mammals, birds, amphibians, and reptiles. Likewise, entomologists and invertebrate zoologists have made significant research progress with diverse species ranging from wasps and butterflies to spiders, mites, and snails. KSR serves the scientific community as an outdoor laboratory where plants and animals are available for scientific study.

Population Biology

Population biology is the integration of two disciplines: population ecology and population genetics. Population biology is a particularly active research area at KSR and focuses on understanding the factors affecting the numbers of individuals in and genetic composition of populations.

Researchers measuring the photosynthetic rate of native plants in the field. Many native plants are adapted to the high temperature and sunlight of midwestern summers. Information on physiological adaptations of native plants is important for understanding how plants cope with their environment during normal conditions and in extremes such as drought.

The copperhead (Ankistrodon contortrix, a pit viper) is one of scores of species studied at KSR. The early studies of Henry S. Fitch are recognized as classics within vertebrate biology, and his later work spanning 50 years has provided unparalleled insight into the ecology and natural history of snakes. Because KSR is maintained as a permanent research station these kinds of long-term studies are possible.

Behavioral ecology of the paper wasp (Polistes metricus) has been studied using an array of nest boxes at NASA. Colonies of these wasps are usually established by a single female that lays all the eggs and attends the nest until the first group of sterile workers—her daughters—mature. However, a significant proportion of colonies are founded by two or more females, who share the work, though only one produces most of the offspring. The research was focused on factors that would lead a female wasp to accept a subordinate role in these cases. These studies contributed significantly to scientific understanding of origins of social behavior in insects.
Grassland ecosystems are of great economic importance in the Great Plains and are ideal model systems for addressing questions of biodiversity. Researchers at KSR utilize a variety of approaches to examine how local and regional mechanisms interact to modulate plant species diversity and temporal community dynamics in grasslands. Experimental manipulations of soil resources and seed availability investigate the relative importance of habitat productivity and local species pools in governing successional dynamics and diversity. Additional studies evaluate: landscape patterns in plant diversity; the role of resource competition in grasslands; and the interactions of resource supply, disturbance, and small mammal impacts in regulating grassland community structure.

The annual sunflower (Helianthus annuus) readily colonizes disturbed sites and is abundant throughout the Midwest. Researchers at KSR are examining sunflower population dynamics at both local and regional spatial scales. One focus of the research is exploring whether there are likely to be ecological effects of gene exchange between cultivated varieties and wild populations. Such data are needed to evaluate the potential impact of bioengineered crop plants.

Researchers at KSR use a variety of approaches (population censuses, studies of survival and reproduction of organisms of different ages or stages, surveys of genetic variation, experimental manipulations, and modeling) to study everything from temporal dynamics of common small mammal populations to the factors affecting the persistence of rare plant populations. Because KSR has both protected high-quality native habitats and other areas available for manipulation, it is an ideal location for this research.

Community and Ecosystem Ecology

Community ecology focuses on the patterns of plant and animal distributions in nature, and on processes that regulate the species composition of biotic communities. Scientists study how communities of organisms are influenced by species interactions (e.g., predator-prey relationships, herbivory, and competition), by resource availability (e.g., inputs of water, nutrients); by habitat characteristics; and by inputs of pollutants. KSR provides a site where scientists investigate the influences of biotic and abiotic factors on both plant and animal communities – often using intensive, large-scale experimental manipulations.
The process of woody plant colonization is studied at the Biotic Succession/Habitat Fragmentation (BSHF) facility at the Nelson Environmental Study Area. Thousands of individual tree seedlings have been tagged, and their growth and survival is monitored as part of a long-term study. Data indicate that trees and shrubs invade faster in larger patches, and in patches closer to intact habitats. In addition, records obtained from thousands of rough-leaved dogwood saplings (Cornus drummondii) reveal that growth rates are greatly decreased where stem densities are highest - this pattern has been predicted by theory, but has been difficult to test under natural conditions. Habitat fragmentation has a major influence on ecosystems. Researchers use the BSHF facility to investigate the effects of patch size and spatial dynamics on plants, animals, and their physical environment.

Studies of terrestrial ecosystems, focusing on habitat fragmentation, ecological succession, and land use effects are also underway. Studies of aquatic ecosystems are similarly in progress; these experiments consider the effects of agricultural runoff (which may contain pesticides, fertilizers, and suspended soils) on fish, insects, plants, algae, and bacteria. Both sets of ecosystem-level studies provide an understanding of how ecosystems function and how they may respond in the future to environmental change.

The interaction of agriculture and aquatic ecosystems is an area of intense interest in the Great Plains and throughout the world. A multidisciplinary group of scientists at KU (from the Departments of Ecology and Evolutionary Biology, Chemistry, Civil and Environmental Engineering, and Economics) have begun a collaborative study of the effects of multiple stressors on aquatic ecosystems. The experimental portion of this research project seeks to clarify the interacting effects of nutrient loading (eutrophication) and a toxic stressor (an agricultural herbicide) on aquatic ecosystems. The ecological portion of this research will be conducted using the experimental pond array at the Nelson Environmental Study Area. In addition, the social science component of this study seeks to evaluate public attitudes towards possible pollution-related changes in surface water quality and drinking water quality. This project embraces a holistic approach to determine ecological and societal relationships within agro-ecosystems.

Musk thistle (Carduus nutans), an aggressive invader of overgrazed pastures and disturbed sites, is considered a noxious weed in most parts of the United States. KSR investigators examined the population biology and ecology of musk thistle in naturally occurring populations as well as in a variety of experimental plots. This research resulted in a series of recommendations for musk thistle control based on its biology and competitive interactions in different land management settings.
16 University of Kansas Field Station and Ecological Reserves
KSR has assembled a geographic information systems (GIS) database containing a variety of national, state, local, and KSR geographic data. GIS is a computer-based tool for mapping and analysis that stores information about the world as a collection of thematic layers that can be linked together by geography. Shown in the background is an orthophoto of KSR's northern tracts, with a tract boundary overlay. Insets highlight the variety of digital data available through the database including (top to bottom): tract-level historic aerial photos (1937-1994), digital soil maps, digital elevation models (DEMs), and a variety of vegetation monitoring data. GIS has proven invaluable for solving many real-world problems, from recording details of planning applications to modeling global atmospheric circulation. At KSR, GIS data are combined in various ways for mapping, analysis, environmental assessment, and natural resource planning.

Landscape Ecology

Across the United States, and worldwide, landscapes are being altered more rapidly and more extensively than at any period in human history. Landscape ecology examines spatial variation within landscapes across multiple scales. It considers the biological, physiological, and societal causes of patterns within the landscape—ranging from cities to wilderness.

Scientists use KSR to examine the relationships between patterns and processes observed in landscapes and various aspects of the environment—such as soils, moisture, vegetation, and land use. New technologies, such as remote sensing and geographic information systems, are employed in this research. Because KSR contains a variety of natural and managed habitats, and because large-scale manipulations are possible, KSR accommodates the range of multidisciplinary research that is necessary to build theory and develop integrative tools necessary to address complex and pressing environmental concerns.

This Landsat TM image over KSR, taken on July 2, 1997 from a satellite orbiting about 705 kilometers (438 miles) above the earth's surface, has a resolution of about 30 meters. The red-blue-near infrared image composite shows vegetation in bright red, dormant vegetation in pink, and water, pavement, or bare soil in shades of blue. Major features highlighted are roads, urban development, forest corridors, regional waterways, and agricultural lands. Remote sensing research at KSR has used images like this one to understand the effects of land use, land management, and landscape fragmentation on ecological and environmental processes. The insights gained from this research can be applied across regional, national, and global scales and can be used to enhance urban and watershed planning and natural resource management.

Arrows indicate the three major groupings of KSR tracts: top arrow identifies northeast corner of Fitch Natural History Reservation (refer to map on page 6 for relative locations of Nelson Environmental Study Area, Rockefeller Experimental Tract, and Robinson Tract); bottom arrow identifies northeast corner of Breidenthal Biological Reserve (refer to map on page 6 for location of Rice Woodland and Wall Woods), and left arrow shows northeast corner of Hall Nature Reserve.
Remote sensing is a technique used for analyzing landscape patterns and trends using low altitude aerial photography or satellite imagery. This series of aerial photographs was taken in November 2000 over a portion of KSR using an aircraft-mounted multispectral camera. These images were taken from an altitude of 3048 meters (10,000 feet), with a ground resolution of approximately one meter. The camera acquires images in the red, blue, and near-infrared wavelengths. In the resulting image composites, healthy vegetation appears red, dormant vegetation is blue-green, and bare ground is white. The images are being used to study the interrelationships between land use and land management and ecological processes such as changes in vegetation and water quality.
Biogeochemical Cycles

All organisms – plants, animals and microbes – interact with the abiotic (nonliving) portion of the environment to obtain the essential resources that are necessary for life, such as water and nutrients. Complex relationships between biotic and abiotic components regulate the structure of biotic communities and also define how materials are acquired and move within and between ecosystems.

KSR scientists are studying the concentration, movement, fate, and transformation of chemicals present in diverse ecosystem components: biota, air, soil, and water. These multi-investigator studies have provided new knowledge of ecosystem-level processes and biogeochemical cycles that are critical to the regulation of natural systems. These studies also are helping us to better understand how aquatic and terrestrial ecosystems may respond to future environmental change.
For centuries people have relied on plants for health and healing. Even within the U.S. today, over 40% of prescription drugs contain at least one ingredient derived from nature and fully 25% of drugs contain an ingredient derived from flowering plants. Natural compounds from our native plant species may be superior, or less expensive, than synthetic compounds in certain situations. Modern laboratory techniques now permit examination of the natural chemical compounds found in plants. Combined with clinical trials, many plants are now being shown to have positive benefits for human health. Scientists use the plant growth facilities at KSR for propagating species used in medicinal plant research. For example, at KSR scientists can experimentally control factors such as water and nutrient levels to determine effects on the quantity and concentration of natural plant compounds. Plants preserved in native communities at KSR, such as purple coneflower (Echinacea pallida, pictured here), represent a storehouse of diversity of natural compounds – some of which may hold the key for disease and illness.

**Conservation Biology**

Biological diversity (biodiversity) is a term used to describe the variety of living organisms, biotic communities, habitats, and accompanying ecosystem processes in nature. Maintaining biodiversity is critical for our society – consider medicines, food, pollination, nutrient cycling, oxygen production, genetic materials, aesthetics – and may be intrinsically valuable for the well-being of humans. Biodiversity on earth is declining as species become extinct and habitats are destroyed at an alarming rate.

Conservation biology is concerned with the protection and management of biodiversity. It blends traditional disciplines of natural sciences, such as genetics and ecology, with natural resource management and, ultimately, the social sciences.

Scientists study rare species and imperiled native communities at KSR to garner direct data on their ecological properties. This information is used directly in conservation planning. Researchers also use KSR for experimental studies of ecological phenomena – habitat fragmentation, exotic species, and pollution – that are known to have serious consequences on biodiversity.

Restoration ecology, a subdiscipline of conservation biology, uses ecological principles and resource management to restore degraded systems to their former states. Historically, KSR scientists have been active in this area, especially in the restoration studies of prairie and wetland systems. Because KSR has high quality areas (which serve as reservoirs for native biodiversity), degraded areas (which can be restored), and areas for manipulation (experiments), it is an ideal platform for studies of ecosystem restoration.

Mead's milkweed (Asclepias meadii) is a rare, long-lived prairie plant. One of the largest and most genetically diverse populations of this species is found at KSR's Rockefeller Prairie. Researchers have studied this population for over a decade to better understand its biology and factors critical to its conservation at the site.

Garlic mustard (Alliaria petiolata) is an aggressive, non-native plant that invades forests and replaces native wildflowers. Researchers assess the response of garlic mustard to different control methods. Results are used to develop strategies for controlling invasions in native woodlands.

Earthwork for a 1.6-hectare (4-acre) wetland complex at the Robinson Tract, encompassing nine separate wetlands of various sizes and depths, was recently completed. This project was made possible through a cooperative agreement with partners including the Kansas University Endowment Association, U.S. Fish and Wildlife Service, Natural Resources Conservation Service, and the Kansas Biological Survey. Historically, the site contained shallow, ephemeral wetlands that provided habitat for plants and animals, natural filtering of surface waters, and buffers to flooding. However, years ago the site was drained for agriculture. Restoration efforts to date have involved returning original drainage characteristics to the field and enhancing wetland conditions.

The Topeka shiner (Notropis topeka) is a small native fish whose distribution is now restricted to a few stream drainages in the Great Plains, including the Kansas and Cottonwood river basins in Kansas. Loss of suitable habitat over the last century – through degraded water quality and introduction of non-native fish species – has drastically reduced the distribution of this minnow such that the U.S. Fish and Wildlife Service has designated it as an endangered species. Research facilities at KSR provide scientists the opportunity to study the ecological and biological characteristics of the Topeka shiner, and other aquatic species. Information from these studies contributes to development of conservation plans for rare species.
Land Management and Stewardship

KSR staff and scientists manage the nearly 726 hectares (1800 acres) of land, facilities, and projects comprising the field station. They balance the current and anticipated needs of researchers with the long-term care and stewardship of KSR— including preserving the integrity of its native communities. Management decisions are science-based, with input from a scientific advisory board, and adapted to meet pragmatic concerns.

Field staff are experienced with techniques required to maintain habitats, control exotic or invading species, and provide manipulations for field experiments. Mowing, burning, grazing, herbicide and fertilizer applications, watering, and tillage operations are all part of regular management activities at KSR. Staff routinely adapt equipment and techniques to serve the special needs of field researchers and to properly manage sensitive ecosystems. They exercise special care and creativity to minimize unwanted disturbance in natural areas.

Stewardship is a serious commitment at KSR. Faculty, students, administrators, donors, and volunteers have worked diligently over the last 50 years, and continue to work, to provide a setting for exemplary research and teaching opportunities. Management of natural resources that accommodates research and teaching—yet conserves the resources for future generations of students, scientists, and the public—is a fundamental goal at KSR.

Managers monitor habitats and keep detailed records of land use to aid research and future management decisions.

Land managers burn a native prairie that is invaded by trees and shrubs.
Teaching and Outreach

Since 1948, thousands of people of all ages have benefited from environmental education and outreach programs at KSR.

KSR fosters an active program of teaching and outreach that serves university students, K–12 students, and the general public. Undergraduate classes from KU and elsewhere make extensive use of established teaching trails, in addition to visiting the diverse native and managed habitats at KSR. Advanced courses offered in biology, engineering, environmental studies, geography, and geology provide students with opportunities to explore ideas, learn methods and techniques, and conduct research at KSR.

Students gain experience as field assistants on faculty research projects or by conducting independent research at KSR. In a typical year, there are about 25 graduate students using KSR for their thesis or dissertation research. Between 1949 and 2000, research at KSR has been incorporated into 150 Master’s theses and Ph.D. dissertations. Many students, both graduate and undergraduate, have undertaken independent field research projects at KSR sites.

“...I cannot hope to describe all I observed...the trip was quite surprising in every way again.” — from a KU student.
For younger students and the general public, the KU Natural History Museum and Biodiversity Research Center sponsors classes that often visit KSR, and special tours of KSR facilities for school and other groups are provided. In addition, a self-guided nature trail is open to the public.

Because native habitats at KSR are managed for long-term preservation, they serve various outreach efforts: training exercises for natural resource professionals; demonstration areas; and carefully-managed seed collection in support of conservation efforts at other sites.

Planning is underway for facilities and resources that will increase the reach and impact of education and outreach capabilities at KSR. A 1.6-hectare (4-acre) wetland restoration project was completed in 2000, adding yet another exciting dimension to the kinds of natural communities found at KSR, while concurrently helping to preserve diminishing wetland habitats in the Kansas River Valley.

“Environmental education is a learning process that increases people’s awareness about the environment and associated challenges, develops the necessary skills and expertise to address these challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action.” — from National Environmental Education Advisory Council Report to Congress, 1996
Research Support

KSR data and facilities are made available to the scientific community in support of research and teaching.

Various databases are maintained in support of research and teaching at KSR. Climate data are recorded and available in electronic format from a meteorological station at the Nelson Environmental Study Area (NESA). Lists of birds, mammals, amphibians, reptiles, plants, and other taxa can easily be accessed. Small representative collections are held at field headquarters at NESA; these are supplemental to more extensive collections of Great Plains taxa that are readily available in the KU Natural History Museum and Biodiversity Research Center. Archives of aerial photography, maps, publications, land use, and various ecological datasets are maintained and made available to researchers.

A geographic information system has been used to capture spatial data about KSR. Core database coverages for property boundaries, historic vegetation, soils, topography, cultural features, and research facilities are available to researchers. Spatial referencing is facilitated by a surveyed grid system throughout several of the tracts that allows researchers and managers to record precisely the location of research sites. In combination with GIS, this grid permits efficient and accurate capture of spatial data for management and archival purposes and creates opportunities for using spatial analysis in the design and interpretation of field studies.

On-site staff maintain KSR and help implement and manage field projects. They also maintain facilities and can customize arrangements for the use of KSR resources (laboratories, workshops, equipment, and research installations).

Information about KSR, as well as databases and GIS coverages, are available on the KSR website, which can be accessed through the Kansas Biological Survey’s main page (www.kbs.ku.edu).

Administration

From 1948 until about 1970 the administration of the field station was the responsibility of Henry S. Fitch, in collaboration with colleagues from KU. With acquisition of additional lands a more formal administrative structure was adopted and a Field Facilities Committee was formed. Quickly this evolved into the Experimental and Applied Ecology Program, and the station and land was named the Kansas Ecological Reserves. Both the Committee and the Program, each consisting of a director and a scientific advisory board, operated as units in Research and Graduate Studies at KU.

In 1999, the field station was formally merged into the Kansas Biological Survey. The administrative structure now consists of a director, an executive committee, an operations committee, and a general membership. The station name was changed from Kansas Ecological Reserves to University of Kansas Field Station and Ecological Reserves (KSR). This reorganization has afforded new opportunities to enhance the research and teaching mission of KSR.

Kenneth B. Armitage, Professor Emeritus in the Department of Ecology and Evolutionary Biology, served as Director of the field station from 1974–1994. The station developed in a sound and steady fashion under his leadership. Dr. Armitage, who served on the KU faculty from 1956 until retirement in 1996, continues his research in behavioral ecology and remains active in support of KSR.
Global Perspective

The impact of research and teaching at KSR extends far beyond the physical boundaries of the biological station. Scientists develop and refine methods at KSR that are applied to field research questions at sites elsewhere in Kansas, the United States, and internationally. Because KSR is conveniently located near the KU main campus where many researchers are based throughout much of the year, it is readily available to train personnel and plan research programs.

Field experiences gained at KSR provide a foundation that can be valuable for work in diverse environments. For example, several of the scientists associated with KSR conduct research and teaching in Costa Rica and other tropical areas, and various students are actively engaged in research at these sites.

To fully understand the nature of complex environmental issues it is necessary to integrate and synthesize information across multiple sites. Biological field stations such as KSR are particularly important in this research because they provide secure sites where background data and facilities are available. KSR continues to play an active role in globally-significant, long-term ecological research.

Students on a field trip in the Costa Rican tropics. KU participates in several programs that provide education and research opportunities in tropical environments. In fact, the exchange program between KU and the University of Costa Rica in San José is the oldest exchange of its kind in the Western Hemisphere. In 1946, a year before he led efforts to establish the Fitch Natural History Reservation, E. Raymond Hall, then Director of KU’s Museum of Natural History, arranged for a collaborative agreement with his counterpart at the University of Costa Rica to share faculty expertise.

For more than two decades researchers at the Kansas Aquatic Mesocosm Program (KAMP) facility have participated in cooperative experimental field studies at other research stations – including the Experimental Lakes Area (ELA) research station in northwest Ontario, Canada. ELA is the largest site in the world for experimental manipulations of natural lakes. As at KSR aquatic facilities, researchers at ELA investigate ecosystem response to various manipulations in order to understand and predict the response to environmental change. Experimental acidification of a portion of a lake (shown here), followed by whole-lake manipulations simulating exposure to acid precipitation, provide the framework for assessing the consequences of pollution.

Millions of sheep and goats are bred and raised on the steppes of Inner Mongolia, China. Researchers from the Kansas Applied Remote Sensing program use satellite remotely-sensed data to study climatic influences on the phenology of these grasslands. Theoretical research conducted at KSR has contributed greatly to the development of multitemporal remote sensing analysis techniques that are now being used in Inner Mongolia where changing climatic conditions are influencing the socio-economics of the region.
The John H. Nelson Environmental Study Area (NESA) is devoted to experimental ecology: manipulation of habitats and development of research facilities.

In 1970, Irvin Youngberg, President of the Kansas University Endowment Association, located and arranged purchase of property adjacent to the Fitch Natural History Reservation and Rockefeller Experimental Tract. Development of NESA was enabled by a gift from John H. Nelson, former Dean of the Graduate School, and his wife Kathryn, a longtime friend of the University and early champion of the campus’ landscaping program.
NESA now consists of 250 hectares (618 acres) – the original 166-hectare (410-acre) tract, expanded by 84 hectares (208 acres) purchased in 1984, 1987, and 1990. Together with the Fitch Reservation and Rockefeller Tract, a contiguous area of over 5 square kilometers (2 square miles) is now incorporated into the KSR system. NESA serves as the base for field operations and facility development for KSR.

Habitats

NESA includes a diverse array of habitats that are used for a variety of short- and long-term ecological studies. Although most of NESA was prairie prior to Euro-American settlement in the mid-1800s, the largest remaining area of original habitat is an oak-hickory stand that represents a portion of what was recorded historically as a 135-hectare (330-acre) grove of upland forest. As a result of fire suppression over many decades, the original area of woodland has increased by the development of successional forest along its margins, and by the gradual “filling-in” of formerly open savanna areas. The other significant remnant of original habitat at NESA is a small native prairie, which has a rich prairie flora and is maintained by periodic burning.

Even though NESA is an experimental area where habitats are available for manipulation, areas that contain high-quality native communities are afforded some degree of protection from disturbance so that they may be preserved.

The vast majority of NESA was altered by agriculture during the century before it was acquired by KSR. These lands are representative of agro-ecosystems in the region and, because they can be manipulated, provide a range of research opportunity. Management of lands at NESA is determined by the needs of current and planned research projects and facilities.

A variety of experimental manipulations – burning, mowing, grazing, soil disturbance, and fertilizer additions – are conducted at NESA to assess responses of plant and animal communities. Several areas are used for long-term experimental studies of vegetation dynamics, including the role of resources (nutrients and water), seed availability, and competition in establishment of plant communities. Other habitats are manipulated for studies of animal populations.

Facilities

NESA serves as field headquarters for the biological station. Laboratories, a workshop, storage buildings, and specialized research facilities are clustered at a central location at NESA. An on-site residence, located at the entrance to complex, provides security for projects and equipment at NESA. A weather station is also located near the complex. Field staff and many researchers base their field operations from this site.
A general purpose laboratory, constructed in 1993 with funding from the National Science Foundation and the University of Kansas, supports a range of research and teaching activity. The 2400-sq. ft. building contains wet and dry laboratory rooms, an animal behavior observation room, an animal holding room, a small conference room, and the station field office. This laboratory contains scientific equipment for general use (e.g., ovens, balances, microscopes) and researchers may bring specialized equipment.

A lath house, constructed in 1997 with funding from the National Science Foundation, is a multi-use structure designed to provide a protected open-air environment for experiments. The 470-sq. ft. lath house, a wood frame building covered by hardware cloth, has a concrete floor and is supplied with water and electricity. This structure is used to protect germinating seedlings needed for field experiments, for plant competition studies, and for some aquatic research in small pools. The lath house is adjacent to an irrigated “garden” that is used for shorter-term studies and as a nursery for plants used in other research.

A 1800-sq. ft. workshop, equipped with an array of tools and equipment, serves the primary maintenance needs for KSR. The workshop is also available for scientists who construct and repair field equipment.

In addition to the workshop, there is another 2520-sq. ft. building that provides “rough” laboratory space, storage for field equipment, and storage areas for supplies, vehicles, boats, tractors, implements, mowers, tillers, and power equipment. Design of buildings and policy encourage maximum flexibility in use of buildings such that a range of research and teaching activities can be supported.

Shorter-term experimental studies of small mammal populations and communities can be conducted in an array of eight large (0.8–1.0 ha) and 12 small (0.1 ha) fenced enclosures located in another area of the tract. The enclosures permit experimental manipulation of population densities, resources, and competitors. In addition there are numerous other enclosures of various sizes, some portable, that are used in research.

Other major research facilities – the Biotic Succession/Habitat Fragmentation facility, the Kansas Aquatic Mesocosm Program (KAMP), and Frank B. Cross Reservoir – are located at NESA and are described in the following sections.
Frank B. Cross Reservoir

Frank B. Cross Reservoir is a 4.5-hectare research impoundment constructed at NESA in 1991. The reservoir and nearly all of its 50-hectare watershed lie within KSR, allowing control over access and direct human activity. An on-going monitoring program has tracked changes in the physical, chemical, and biotic environment of the reservoir since its construction. Physical improvements to the reservoir area were made possible in 1998-9 by funding from the National Science Foundation.

Cross Reservoir was designed to have characteristics typical of small lakes and reservoirs that exhibit strong thermal stratification during the summer. Maximum depth of the reservoir is 13 m, and its water level has changed by less than 0.5 m since it reached maximum capacity in January 1993. The reservoir’s depth, combined with its protected location, results in strong thermal stratification. The reservoir is thermally stratified from late April to November, with an anaerobic hypolimnion for much of this time. In a typical winter, it is ice-covered for up to two months from mid-December to late February (a second stratified period). The reservoir is oligotrophic to mesotrophic.

A major focus of current research concerns the responses of deep-water photosynthetic organisms to variation in light and other environmental factors. Studies of the deep-water community in Cross Reservoir have contributed to research by KAMP personnel on other reservoirs and lakes in the US and Canada.

Cross Reservoir has been studied intensively since 1993. It is intended to serve as a relatively undisturbed reference system for other Midwestern lakes and reservoirs. The only whole-basin manipulation is stocking with native fish species. Any other experimental manipulations are conducted in temporary enclosures.

The facility is named in honor of Frank B. Cross, Director Emeritus of the Kansas Biological Survey and Professor Emeritus in the Department of Ecology and Evolutionary Biology. His career at KU began when he was hired as a Fisheries Biologist by the Kansas Biological Survey in 1951, and he subsequently served as Director of the Survey from 1967 to 1973. His academic tenure at the University spanned a career of 40 years, during which time he established the Division of Ichthyology at the Museum of Natural History. Following his retirement in 1991, Dr. Cross has continued to be actively involved with aquatic research at KU.
Kansas Aquatic Mesocosm Program

The Kansas Aquatic Mesocosm Program facility (KAMP) is located at the John H. Nelson Environmental Study Area. Research at KAMP is focused on experimental studies of aquatic ecosystems, including their relationship with terrestrial ecosystems. Experimental ecosystems are used as surrogates for natural ecosystems. In one such study following the effects of a common agricultural herbicide over a period of three years, immediate changes in the pond plant community later led to changes in insects and fish due to alterations of their food sources and habitat. The conclusion was that more widespread effects of this herbicide would likely occur in the natural environment than was previously expected.

When any type of natural environment is exposed to a stress, either of natural origin like a drought, or from human actions like a pesticide application, a complex “chain reaction” of effects can result. Such effects can be studied in experimental ponds, which serve as surrogates for natural ecosystems. In one such study following the effects of a common agricultural herbicide over a period of three years, immediate changes in the pond plant community later led to changes in insects and fish due to alterations of their food sources and habitat. The conclusion was that more widespread effects of this herbicide would likely occur in the natural environment than was previously expected.

Investigators working at KAMP have produced more than 100 publications using these experimental aquatic ecosystems. Research at the KAMP facility continues to develop a better understanding of how environmental stress involves both direct and secondary effects on aquatic habitats. It has also contributed significantly to the development of the standard methods for impact assessment of pesticides used by the U.S. Environmental Protection Agency.

Aquatic Mesocosms:
The Experimental Pond Facility

For experimental studies in aquatic habitats, KAMP offers a wide range of research possibilities. The core facility includes 100 experimental ponds ranging in size from 0.01 to 0.8 hectares. Seventy-seven ponds are 0.045 hectares and 16 are 0.01 ha. In addition, KAMP has 80 large, 11-
Aquatic Laboratory Building

An aquatic research laboratory for KAMP was constructed in 1990 with funding from private industry. The 1200-sq ft. laboratory is an attractive and comfortable earth-berm and wood building that overlooks the experimental ponds. The laboratory is supplied with a flow-through water supply from the pond facility. The building also provides a residence for up to six visiting researchers in two rooms, along with bathroom, shower, and kitchenette facilities.
Biotic Succession/Habitat Fragmentation Facility

Habitat fragmentation is the most common, and least understood, consequence of human alteration of the natural environment. It occurs whenever a large habitat or an interconnected series of habitats is broken into small, isolated patches. Habitat fragmentation alters a wide range of ecological processes, including individual behavior, population persistence, interspecific interactions, and ecosystem fluxes—even when the total area of habitat is not greatly reduced. Experimental studies of habitat fragmentation provide unique insight into ecological issues of spatial dynamics, scaling, and regional processes as determinants of local community structure.

The Biotic Succession/Habitat Fragmentation (BSHF) facility at the Nelson Environmental Study Area is one of the few long-term experimental studies in the world based around a deliberately constructed, fragmented landscape. Research at the facility has been funded by the National Science Foundation since 1988. The central goal of the BSHF facility is to examine effects of fragmentation (in particular, patch size and landscape position) on the rate and pattern of a key ecological process, biological succession. Biological succession is a progressive change in the plant and animal community occupying a location in the absence of disturbance. For example, if an open field in eastern Kansas is left undisturbed over a period of years it will gradually be replaced by forest. The obvious changes in appearance and species are accompanied by more subtle changes in ecological processes, including the dynamics of plant and herbivore interactions.

The BSHF facility consists of an archipelago of small, medium, and large patches arrayed in a nested, randomized design within a 12-hectare (30-acre) field. The choice of patch sizes and their spatial arrangement were guided by knowledge of the biology and abundances of the dominant plants.
and small mammals in early to mid-successional systems, and by consideration of local landscape patterns. The patch archipelago was created in the fall of 1984 within a uniform agricultural field that was then left fallow. It has been maintained since then by regular mowing of the interstitial areas, leaving the patches undisturbed. As a result the area surrounding each patch has remained a low, open turf while the patches have developed more complex habitats through biological succession.

Results

During the first nine years of the study (1984–93) effects of patch size on plant succession were subtle and small in magnitude, whereas effects on small mammal populations were dramatic. Some mammal species were restricted to the large patches and others were more common on small patches. Since 1994, strong spatial effects on plant community dynamics have produced a mosaic of successional stages.

The variation has been driven by direct landscape factors of patch size and location relative to seed sources, and by the indirect effects of fragmentation via herbivory. The rate of succession towards woody vegetation increases with patch size: large patches have much higher woody plant densities than do small patches. The rate of succession is also higher for patches closer to the forest edge. Changes in the herbaceous community appear to follow woody plant colonization.

Another goal of the facility is to study the reciprocal effects of animal and plant population dynamics. Small mammals can have strong effects on biological succession by feeding on tree seedlings. Because spatial patterns of mammal abundance have shifted during succession on the BSHF facility, researchers are also examining correlations between mammal distributions and the rates and patterns of woody plant recruitment.

Studies by other investigators have focused on effects of feeding by other herbivores, which are also affected by patch size and distance from forest edge. In addition, the BSHF facility has been used to examine effects of habitat fragmentation on a variety of predators (large mammals, snakes, spiders, and ground beetles), and on plant pathogens.

Future

The BSHF facility is maintained by KSR as a core long-term research site, available for use by qualified students, faculty, or staff investigators from any institution. The successional mosaic of the BSHF facility will continue to change in succeeding years. Development of a complete woody canopy over the next decade is expected to alter patch microclimate significantly, adding a new source of among-patch variation (for example, in soil moisture levels).

The innovative experimental design of the facility, combined with the long-term databases, creates a unique resource for ecological research that becomes more valuable with time.

Representative Research Publications


Rockefeller Experimental Tract

The Rockefeller Experimental Tract (RET) was established to preserve a small native prairie and to study methods for maintaining and restoring tallgrass prairie.

Today less than 1% of the original tallgrass prairie that formerly dominated the Midwestern landscape now remains. Awareness of the value of native prairie prompted serious efforts to conserve and restore the prairie patches that remain. However, there are many questions important to the long-term success of conservation and restoration projects that are unanswered.

In 1956, Professors E. Raymond Hall and Henry S. Fitch obtained funding from John D. Rockefeller, Jr. to acquire the 65-hectare (160-acre) farm that became the RET. In contrast to the policy of strict protection on the adjoining Fitch Natural History Reservation, established in 1947, RET was intended to be available for experimental habitat manipulations, as well as any management necessary to maintain native habitats.

Rockefeller Native Prairie

The small native prairie preserved, known as the Rockefeller Native Prairie, is remarkably rich in native plants with more than 165 species. Several rare plants occur on this 4-hectare (10-acre) prairie, including two federally protected species. Long-term studies on populations of rare plant species, and carefully managed off-site
propagation of seeds produced from the site, are pivotal in the conservation of prairie species. The Rockefeller Native Prairie also serves as a baseline for comparison with experimental and restored areas.

The prairie was used as a hay meadow from the 1870s until 1956. Springtime burns, at 1–3 year intervals, have been used to maintain the native community since 1957. Only non-disruptive research and teaching activities are allowed on the prairie.

Experimental Prairie Treatments

The long-term restoration study on the RET began in 1957 when former pastures and crop fields were sown with a mixture of four prairie grasses. Five years later, the resceded areas were assigned to one of four treatments: 1, burning (springtime burns at 1–4 year intervals); 2, grazing (cattle pastured annually during the growing season); 3, mowing (mowed or hayed annually); and 4, untreated (no management). The treatment regimes have been maintained for 40 years, providing a unique opportunity to examine the interaction of historic (pre-1956) land use, long-term (post-1956) management practices, and landscape position on the progress of restoration.

Research and Teaching

As a general finding, management has had a profound effect on prairie maintenance. Burning or mowing precludes invasion of prairie by woody species, whereas portions of prairie that were grazed or left untreated have been colonized heavily by forest.

Because of its long-term nature, the RET study has also highlighted the importance of evaluating experimental treatments, and restoration, in relation to landscape features and historic land use. For instance, forest colonization is influenced by management practices (post-1957), landscape position (e.g., ridge or slope, and distance to existing forest), and historic land use (pre-1957). The interaction of these factors produces considerable heterogeneity within the landscape and influences the outcome of restoration efforts.

After more than 40 years, none of the restored areas has yet attained a diversity of plants species comparable to the adjacent native prairie. Likewise the soils differ greatly, with restored prairies having lower soil nitrogen and organic matter than native areas. Researchers are using RET and other facilities at KSR to investigate the interaction of soil condition (nutrients, texture, water availability) and seed dispersal on seedling establishment, and to study the interactions among plant competition, herbivory, and disease in grassland communities. This research is providing important data on the mechanisms regulating plant populations and building theory upon which to base ecosystem restoration and conservation science.

The land included in the Rockefeller Experimental tract was granted from the United States government to the Union Pacific Railroad in 1868. The railroad quickly sold the land to an individual and a farmstead was established (house, barns, rock fences, orchard...). By 1915, the farm consisted of 40 hectares (100 acres) of cropland or planted pasture, 4 hectares (10 acres) of native (unplowed) prairie, and about 20 hectares (50 acres) of thin rocky soils that were mostly forested or open woods. During the next 50 years, under a succession of owners, the land continued to be used for cropland, grazing, and harvesting of native prairie hay.

Students learn about native biodiversity, ecosystem restoration, and conservation.

Summer mowing (either side of road) prevents trees and shrubs from invading the area sown in prairie grasses, whereas woody species colonize areas that are grazed (far right) or untreated (far left).
Robinson Tract

Diverse habitats provide extensive opportunities for environmental education.

The Robinson Tract comprises most of the site where Charles Robinson, first governor of Kansas, and his wife Sara built their country estate known as Oak Ridge. The Robinsons constructed a wooden, two-story home at the site in the 1860s and lived there until their deaths — his in 1894 and hers in 1911. The farm was bequeathed to KU and held by the Kansas University Endowment Association (KUEA) until 1970 when, failing to find funds to restore the historic home, KUEA sold the buildings and about 3 hectares (8 acres) to a private party so that the home could be preserved (tragically a fire destroyed the farmhouse in 1991). KUEA then made the 44 hectares (108 acres) of land surrounding the buildings available to KSR in the early 1970s.

The site is on the rolling hills and floodplain on the north side of the Kansas River. Diverse habitats exist on the site: tallgrass prairie, savanna, wetlands, floodplain forest, successional woods, and former agricultural lands. Geological features include diverse soils, springs, and shallow groundwater contact. Abundant water in the aquifer underlying the Robinson Tract supports a water well that supplies the aquatic research facility two miles north at the Nelson Environmental Study Area, and provides the focus for a major research site operated by the Kansas Geological Survey.

The Robinson Tract is treated as an experimental area and is open to manipulations and to development of experimental facilities used for teaching and research. In the early 1990s an ecology teaching trail was developed on the site that is used extensively by undergraduates in the biological sciences at KU. Hundreds of university students use the trail each year in class field trips, and many students conduct “hands-on” projects. A wetland restoration project has just been completed and will be used for teaching about wetland ecosystems, and a prairie restoration is planned. The diversity of natural habitats in a compact setting, and ongoing and planned restoration projects, make the Robinson Tract ideal for university teaching, outdoor education, and outreach activities.
Geohydrologic Experimental and Monitoring Site

Hydrogeologists are frequently asked to evaluate the threat posed by waste sites to waters of underlying aquifers. Predicting how a contaminant might move in the subsurface is a major challenge for such evaluations because of complex interactions among physical, chemical, and biological processes that control movement rates. Current methods are often of limited utility because they rely upon the assumption that alluvial aquifers are homogeneous. In reality, alluvial deposits are typically comprised of complex layers of differently sized materials, ranging from gravels to fine clays. Such heterogeneity can wreak havoc with efforts to characterize aquifer properties because contaminant movement may occur preferentially in layers that may be missed in routine studies.

Development and testing of improved methods for alluvial aquifer characterization is the goal of a multi-year project of the Geohydrology Section of the Kansas Geological Survey (KGS). The field site for this project is the Geohydrologic Experimental and Monitoring Site (GEMS) located on the Robinson Tract of KSR. Since 1988, work at GEMS has been funded by a variety of state and federal agencies including the National Science Foundation, U.S. Geological Survey, Department of Defense, and private industry. Results from GEMS research have recently been applied to studies of groundwater contamination in eastern Europe.

Research at GEMS has focused on three areas. The first was intended to provide detailed knowledge of the structure of the alluvial deposits underlying the site. Initially, several groups of wells were established, each consisting of an array of wells drilled to different depths in the underlying alluvium. In order to characterize subsurface deposits, KGS researchers developed a device for taking relatively undisturbed cores of saturated sands and gravels while drilling these wells. In more recent work, researchers have tested new techniques for aquifer characterization based on direct-push technology, as an alternative to conventional drilling methods. This technology gives researchers unprecedented access to the subsurface, allowing them to describe the subsurface in much greater detail than has previously been possible.

The second major research effort being carried out at GEMS is focused on well tests. Well tests are a class of techniques based on introducing a pressure disturbance into a well (e.g., turning on a pump), then measuring how this disturbance changes over time at the source and neighboring observation wells. Estimates of the transmissive and storage properties of an aquifer can be obtained from these data.

The third research area concerns low-temperature geochemistry of the alluvial aquifer. The object of this work is to develop a better understanding of spatial and temporal variations in groundwater chemistry in an alluvial aquifer setting.

GEMS is also used for training students and professionals in hydrogeological field methods. GEMS serves as the primary site for short courses for state-agency personnel, field methods courses taught through the Department of Geology, and for graduate student field research. GEMS also serves as a long-term monitoring site to study hydrologic processes in the Kansas River floodplain.

Representative Research Publications
Hall Nature Reserve

Donation of the Hall Nature Reserve (HNR), the newest addition of land to the KSR system, exemplifies the generosity of concerned citizens.

In the fall of 1999, Hubert “Hub” Hall and his wife Kathleen McBride Hall donated a 47-hectare (116-acre) parcel of land to the KU Endowment Association that would expand KSR. The Halls wanted to conserve native habitat and further environmental research and teaching at KU. The Hall family has a long-held interest in conservation. In fact, it was Hub’s father, E. Raymond Hall, who led successful efforts to establish a natural history reservation for KU in 1947. The gift of HNR ensures preservation of its native habitats for future generations of students and researchers. As for KSR lands acquired with previous gifts (by Briedenthal, Nelson, Rice, Rockefeller, and Wall), HNR provides a welcome addition.

Located southeast of the small city of Lecompton, which was a territorial capital of Kansas, HNR is important in local and regional history. Wilson Shannon, territorial governor of Kansas from 1855–56, lived in a home located on HNR, and the site was then known as Fort Shannon. Little remains of the home site as the structures were dilapidated and demolished years ago. Nevertheless, the site affords ample opportunity to discuss the interplay of cultural features and natural history.

HNR is situated on uplands, about a mile south of the Kansas River, northwest of Lawrence. The soils are generally thin on the site and there are outcrops of the Orcad and Lecompton Limestone. Small acreages of high-quality tallgrass prairie are found on the HNR, as well as prairie that has had a history of grazing, and prairie that has been seeded in former cultivated fields. Much of the woodland is represented by early successional tree species, but some ravines contain trees characteristic of mature forests. Research and teaching activities at HNR will focus on conservation and restoration of native habitats.
Baldwin Woods

Baldwin Woods was designated a National Natural Landmark by the United States Secretary of the Interior in 1980, in recognition of its contribution to the natural heritage of the Nation.

Baldwin Woods is an exemplary remnant stand of oak-hickory forest in the eastern Great Plains. The area is home to numerous plant and animal species at their western limits of distribution. The combination of shale, limestone, and sandstone outcrops, diverse topography, and a small stream provide varied substrates that support a rich biotic community.

Local naturalists and university researchers have long recognized the significance of the Baldwin Woods. Prior to Euro-American settlement, the area encompassed about 1500 hectares (3700 acres) of closed forest and open savanna. However, development of rural areas for agriculture and, in recent years, for suburban housing has greatly reduced the extent of native woodland.

Beginning in 1965, three areas within Baldwin Woods were added to the KSR: Breidenthal Biological Reserve, Rice Woodland, and the Roy and Eleanor Wall Woods. These KSR tracts are protected as natural areas where only non-disruptive research and educational activities are permitted. Their value for teaching and research increases with time as, unfortunately, similar natural communities become more and more rare. Experimental manipulations are generally not permitted; however, certain small-scale manipulations may be considered, and fire may be used to maintain areas that were historically more open.

In addition to the KSR tracts within the Baldwin Woods, Ivan Boyd Woods, a 14-hectare (35-acre) preserve, is maintained by Baker University. A large area of state-owned land surrounding Douglas County State Lake, managed by the Kansas Department of Wildlife and Parks, is also afforded some protection. With the cooperation of private landowners in the area, efforts are underway to develop coordinated strategies for conservation and management that will help secure the future of this unique natural treasure.

Breidenthal Biological Reserve

The 36-hectare (90-acre) Breidenthal Biological Reserve consists of 28 hectares (70 acres) purchased in 1965 by the Kansas University Endowment Association, and subsequent purchases of 4 hectares (10 acres) each in 1973 and 1974. The majority is relatively undisturbed eastern deciduous forest, although there are remnants of savanna habitats in more xeric sites. A small headwater stream, a tributary of Coal Creek (Wakarusa River drainage), flows through the forest. The stream valley has very steep slopes with surface seeps representing ground water contact. The underlying bedrock of the lower slopes is primarily sandstone whereas that of the upper slopes is shale and limestone. The lower sandstone slopes support a mesophytic flora containing many species of mosses and liverworts that are rare in the Great Plains.

“...not having a car in the 1930s, we would ride the train from Lawrence to Baldwin Woods where the conductor would slow the train so we could jump off...after an afternoon of botanizing we would flag down the train to return home.” [Renowned botanist Ronald L. McGregor, recalling early trips to Baldwin Woods on a now-abandoned railway that ran through the Vinland Valley.]
Aerial photograph (1994) of Baldwin Woods showing KSR tracts and approximate extent of forest mapped in the late 1850s. Other important features apparent in the photograph are Baldwin City, Douglas County State Lake, Ivan Boyd Woods (just east of KSR tracts), and the abandoned railroad right-of-way running generally southwest to northeast through the area. Several locations along the old railroad are indicated on the photograph (crosses), as are locations of monuments marking the Santa Fe Trail (star), and Signal Oak (dot).
Rice Woodland
In 1972, the 32-hectare (80-acre) Rice Woodland was purchased and deeded to The Nature Conservancy, which later transferred the title through restrictive deed to KU Endowment Association. Raymond F. Rice and the Ethel and Raymond F. Rice Foundation provided funds to secure this high-quality natural area. The majority of the Rice Woodland is relatively undisturbed eastern deciduous forest. Thirty-one species of trees and 21 species of shrubs and vines were recorded on the tract in a 1963 study – remarkably high species richness for native forests in the central United States.

Wall Woods
The 13-hectare (32-acre) Roy and Eleanor Wall Woods was acquired in 1974 by Roy and Eleanor Wall on behalf of The Nature Conservancy; a restrictive deed for the property was subsequently acquired by the KU Endowment Association. The tract is high quality woodland.
The Fitch Natural History Reservation (FNHR), a former farm of the first governor of Kansas, was established in 1947 and is the oldest unit of the KSR system.

In the late 1940s Professor E. Raymond Hall, director of the KU Natural History Museum, recognized the need for a protected area to be used for ecological research and teaching. Dr. Hall led an effort that persuaded the Kansas State Board of Regents to dedicate a site for this purpose in 1947. The 239-hectare (590-acre) site chosen was already under university control, having been donated to KU by Dr. Charles Robinson, first governor of Kansas, and his wife Sara. Robinson had acquired the land in the 1860s and the tract had long been known as the “Robinson Pasture.”

On July 1, 1948, Dr. Henry S. Fitch was hired as superintendent and resident naturalist for the newly created KU Natural History Reservation. From the time of its establishment, the goal of the reservation has been to serve as a permanent research station for studying native animals and plants, along with their physical and biotic environments. It was expected that collaborative efforts by investigators working on the site would provide unique insights into these interrelationships. A second goal was to provide students an opportunity to learn ecological principles through hands-on experiences.

Management and Succession

The original management plan for the reservation emphasized protection of all habitats and species (even those plants and animals that were regarded elsewhere as undesirable). In the late 1940s, this goal represented a new concept of land management in the region. During the five decades since FNHR was created, it has been protected from activities such as burning, logging, and grazing by livestock – a hands-off policy of “letting nature take its course.”

At the time this policy was established, few realized the essential role of periodic fire and grazing in maintenance of grassland habitats. A consequence of protecting the reservation from disturbance has been the gradual replacement of grassland and open areas by woody vegetation, a process known as biological succession. As succession has progressed, a large number of native species have disappeared from the reservation, particularly those associated with grassland and prairie.

Henry S. Fitch and student examining a Hudsonian jumping mouse in 1951 (above), and Dr. Fitch showing students a snake in 2000 (below). Since 1948, thousands of students have learned about ecology and natural history at FNHR.
When FNHR was created in 1947 it looked very different from its present, heavily-wooded condition. In 1947, woodland habitat was generally confined to the slopes between hilltops and valleys, though some trees also grew along streams and in a few scattered groves. Tree species composition varied according to slope exposure and land use history. South-facing slopes, which were most likely prairie prior to Euro-American settlement, had scrubby woodland dominated by early-successional trees. By contrast, north-facing slopes had a more diverse forest community that included oaks, hickories, American elm, and other tree species. American elm was the dominant tree species and was represented by the largest individual trees. These wooded areas have changed relatively little. The most obvious change has been the death of the large American elms from Dutch elm disease (phloem necrosis) beginning in the early 1950s.

In 1947, most of the FNHR consisted of open heavily-grazed pastures and cultivated fields. These have followed different successional trajectories over the past 50 years. After removal of livestock, former pastures developed a dense ground cover of mixed grass and broad-leaved herbs. The dense ground cover provided shelter and food for small mammals that thrived for a short time. In subsequent years, shrubs and young trees encroached onto former pastures, gradually shading out the grasses and eliminating habitat for animals dependent on relatively open grassland. By 2000, the area consisted of open woodland.

Succession to woody vegetation proceeded more rapidly on formerly cultivated fields, many of which had been planted in corn for the 1948 season. These fields produced an abundant weed crop in the first year after cultivation ceased, mainly of giant ragweed and sunflower. Over a series of years sunflower and giant ragweed were replaced by perennial plants, especially goldenrod and aster. After about a decade, saplings (mainly of elm) formed dense thickets, and poison ivy became abundant. At this stage the bottomlands provided shelter and an abundance of edible foliage for white-tailed deer, which concentrated their activities in these sites. Over successive decades, as the saplings grew larger, natural thinning occurred. A closed-canopy woodland developed, with little understory vegetation.

**Achievements and Future**

Since 1948, Dr. Fitch, other faculty, and students have produced scores of scientific publications about the flora and fauna of the area. Thousands of students of all ages have received an introduction to ecology through group visits and classes. In 1986, the reservation was formally renamed the Fitch Natural History Reservation in recognition of the contributions to ecological research and environmental education made by Dr. Fitch and his family.

Dr. Henry Fitch and colleagues have monitored changes in plant and animal populations on FNHR for more than 50 years. Because of this rich database, and the fact that the history of land use on FNHR is well known, the site affords great opportunity for a range of ecological studies – especially research dealing with biological succession.

FNHR provided the foundation to build KSR – the KU biological field station – and remains a vital component of its environmental research and science education mission.

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“A Kansas Snake Community summarizes findings from a field study of 50 consecutive years ... It is the longest running single-site, ecological research study of vertebrates ever done.” – comments from Kreiger Publishing announcing the 1999 book by H. S. Fitch detailing the ecology of 18 species of snakes on the Fitch Natural History Reservation.

These two photographs, taken from near the same location, show succession on former bottomland pasture. In 1948, the pasture was relatively open, with a few scattered trees along a stream (right side) – densely wooded hillsides are visible in the background. By the year 2000, trees colonized the area and the open grassland was eliminated.
The University of Kansas (KU) is a major public university, supported by the state of Kansas. KU is a member of the American Association of Universities, and ranks among the top 20% of U.S. colleges and universities in research funding. The university community in Lawrence, Kansas, includes 1,400 faculty and staff, 6,500 graduate students, and 19,000 undergraduate students. All units of KSR are within a 20-minute commute from the KU campus in Lawrence. Housing and services are readily available in Lawrence, a vibrant city of 80,000 people. Major metropolitan areas of Topeka and Kansas City are within 60 kilometers (37 miles) of Lawrence, and Kansas City International Airport is located 100 kilometers (62 miles) northeast via interstate highway.

Activities at KSR are coordinated with several KU research centers and academic units. The advisory group and executive committee that oversee KSR include members drawn from all of these KU branches. Brief overviews of selected research centers, programs, and academic units affiliated with KSR are provided below.

KSR is a program of the Kansas Biological Survey (KBS). KBS is a non-regulatory, non-degree granting research and service unit of KU, chartered by the state of Kansas. Programs within KBS address environmental and biological issues at state, regional, national, and global levels. KBS employs 35 research and professional staff who conduct research on a range of topics and regularly provide a wide range of environmental information to state and federal agencies, local government, private industry, and conservation groups. Program within KBS, in addition to KSR, include the Aquatic Research Program, Central Plains Center for Bioassessment, Kansas Natural Areas Program, the Kansas Applied Remote Sensing Program (KARS), and the NASA Great Plains Regional Earth Science Applications Center (RESAC).

The KARS Program of KBS is internationally recognized for its research on environmental and agricultural applications of remote sensing technology. KARS research has a global focus, with major collaborative projects conducted in China and Central America, along with regional projects in the Great Plains and Rocky Mountains states. KARS scientists conduct exploratory research at KSR sites and have developed archives of various imagery for KSR. In cooperation with its commercial partner TerraMetrics, Inc., KARS facilitates technology transfer of products and services derived from remote sensing technologies to commercial, governmental, and other end users. NASA has designated the KARS Program as the Great Plains RESAC, one of seven such regional remote sensing application centers in the U.S.

The Natural History Museum and Biodiversity Research Center at KU (KUNHM) is internationally recognized as a center for research and training in systematics and evolution. Its mission has long included a strong emphasis on individual groups of organisms, particularly vertebrates, insects, and plants. Recognition that human activities increasingly threaten biodiversity on local, regional, and global scales has led KUNHM to expand interdisciplinary programs in bioinformatics and conservation biology. KUNHM has been a leader in developing the database systems that are essential to biological monitoring. KUNHM has been closely associated with KSR.

The Flint Hills Tallgrass Prairie Preserve, which is an outstanding example of Flint hills upland prairie, is one of a variety of diverse ecosystems in Kansas that is preserved by The Nature Conservancy.
since the reserves were established. During its early history, KSR was administered by faculty with close ties to KUNHM. Since then, KUNHM staff and students have continued to use KSR sites and facilities in their research and public education programs. Cooperation between KSR, other KBS programs, and KUNHM will expand over the coming decades as programs to monitor ecosystem condition become increasingly important national priorities.

The Kansas Geological Survey (KGS) is administered by KU under a Kansas state charter similar to that of KBS. The mission of KGS is to collect, correlate, preserve, and disseminate information leading to a better understanding of the geology of Kansas, with special emphasis on natural resources of economic value, water quality and quantity, and geologic hazards. KGS maintains extensive databases on natural resources within the state. The hydrology division of KGS, which focuses on surface and below-ground water resources, maintains the GEMS facility at KSR. Scientists at KBS, the hydrology division of KGS, and units of Kansas State University are also collaborating to establish a comprehensive statewide program for water resource information, the Virtual Kansas Water Resources Institute.

The KU Libraries are a member of the Association of Research Libraries, and belong to the regional Big XII university library consortium. The KU Libraries have been a leader in national efforts to develop electronic publishing systems for dissemination of scholarly work and to develop digital archives for research. The Anschutz Science Library and Spahr Engineering Library, both located on the Lawrence campus of KU, have extensive holdings in environmental research and allied subjects.

The mission of KSR is enhanced by participation in various associations and consortia throughout North America and Central America. For example, KSR is a member of the Organization of Biological Field Stations – an association of about 180 field stations and professionals concerned with field facilities for biological research and education. KSR is also a member of the Association of Ecosystem Research Centers – a group of 39 U.S. research programs in universities and private, state, and federal laboratories that conduct research, provide training, and analyze policy at the ecosystem level of environmental science and natural resources management.

In addition to KSR sites, other lands are potentially available to KSR researchers with prior approval of research plans. A major resource is The Kansas University Endowment Association, which owns 17,400 hectares (43,000 acres) of land throughout Kansas. Other areas include those owned by The Nature Conservancy, Baker University, and other entities. The Kansas Natural Heritage Inventory Program at KBS maintains a database of species and community-level occurrences and can assist researchers in identifying research sites of a state-wide basis.
ORGANIZATIONAL CHART

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Norman A. Slade
Val H. Smith
Orley R. Taylor, Jr.
Valery J. Terwilliger
Li Zheng
Resident Faculty and Staff Investigators

A diverse community of scientists uses the University of Kansas Field Station and Ecological Reserves (KSR) for research and teaching. The portraits and brief descriptions below are intended as a rough “field guide” to the current set of KSR personnel and their work. “Resident” here refers to faculty or staff based at the University of Kansas, Baker University, Haskell Indian Nations University, and Johnson County Community College who currently work, or have recently worked, on KSR projects. In addition to those listed below, many current and former faculty and staff, as well as students—from these and other institutions—have used KSR facilities as part of their research or teaching activities. The compilations of external research funding and publications, included as appendices to this report, provide a more complete record of their names and research.

Helen M. Alexander
Associate Professor
Department of Ecology and Evolutionary Biology (Ph.D., Duke University)

Plant population biology: Ecological and genetic interactions between plants and fungal pathogens; potential ecological consequences of crop-wild hybridization, using wild sunflowers as a model system; and population dynamics of long-lived prairie plants.

Roger L. Boyd
Professor and Chair, Biology Department, Baker University. Adjunct Curator, Natural History Museum and Biodiversity Research Center (Ph.D., Colorado State University)

Ecology: Avian ecology; wetland restoration, and conservation biology.

Scott W. Campbell
Staff Researcher, Kansas Biological Survey (M.S., University of Kansas)

Applied aquatic ecology: Field management of aquatic studies at the Kansas Aquatic Mesocosm Program facility; reservoir water quality studies; development of new technologies for control and management of aquatic plants.

Frank deNoyelles, Jr.
Associate Director, Kansas Biological Survey; Professor, Department of Ecology and Evolutionary Biology and Environmental Studies Program (Ph.D., Cornell University)

Aquatic ecology: Effects of pesticides on aquatic communities; variation in rates of contaminant biotransformation using experimental ecosystems; and ecology of subepilimnetic phytoplankton in thermally stratified water bodies.

Director of the Kansas Aquatic Mesocosm Program (KAMP).

Kenneth B. Armitage
Emeritus Professor
Department of Ecology and Evolutionary Biology (Ph.D., University of Wisconsin)

Behavioral ecology: Life history strategies of ground-dwelling scurids, including marmots and woodchucks.

Calvin L. Cink
Professor, Biology Department, Baker University (Ph.D., University of Kansas)


Henry S. Fitch
Emeritus Professor, Department of Ecology and Evolutionary Biology (Ph.D., University of California at Berkeley)

Vertebrate ecology: Ecology and behavior of reptiles, especially snakes, and long-term studies of successional change. Resident naturalist on the Fitch Natural History Reservation since 1948.

James J. Butler, Jr.
Senior Scientist, Kansas Geological Survey (Ph.D., Stanford University)

Hydrogeology: Experimental analysis of groundwater flow patterns and development of field methods for aquifer characterization. Director of the Geohydrologic Experimental and Monitoring Site (GEMS) facility.

Tatsuji Ebihara
Assistant Professor, Department of Civil and Environmental Engineering (Ph.D., University of Cincinnati)

Environmental toxicology: Pathogen transport in soil systems and hydrocarbon biotransformation processes in “biofilms” (microbial communities occurring as thin layers coating solid surfaces).

Calvin L. Cink
Professor, Biology Department, Baker University (Ph.D., University of Kansas)


Bryan L. Foster
Assistant Professor, Department of Ecology and Evolutionary Biology (Ph.D., Michigan State University)

Plant community ecology: Processes that regulate plant species distribution and biodiversity in tallgrass prairies and successional grasslands: spatial processes in communities; habitat restoration; and linkages between biodiversity and ecosystem function.
Johanna Foster
Associate Professor, Johnson County Community College; Adjunct Professor, Department of Ecology and Evolutionary Biology (Ph.D., University of Kansas)

Ecology and conservation biology: Effects of mound-building ants on tallgrass prairie plant communities, including comparisons of soil characteristics and plant species on and off ant mounds; influence of management practices on ant species distribution in native and restored prairies.

David W. Graham
Associate Professor, Department of Civil and Environmental Engineering (Ph.D., University of Arizona)

Environmental toxicology: Use of molecular biology for studies of contaminant biotransformation in natural systems; correlations between biological indicators of environmental stress and physical and chemical conditions; and impact of endocrine-disrupting compounds on aquatic organisms and communities.

Christopher A. Haufler
Professor, Department of Ecology and Evolutionary Biology (Ph.D., Indiana University)

Plant systematics: Evolution and systematics of the fern family Polypodiaceae, including patterns and processes of speciation in ferns.

Robert D. Holt
Professor, Department of Ecology and Evolutionary Biology; Senior Scientist, Division of Community Ecology, Natural History Museum and Biodiversity Research Center. (Ph.D., Harvard University)

Theoretical and community ecology: Predator-prey interactions, patch dynamics, and the interface between ecology and evolutionary biology.

John Healey
Research Assistant, Kansas Geological Survey (M.S., Iowa State University)

Hydrogeology: Development and improvement of field methodologies used in hydrogeology and aquifer characterization.

Robert H. Hagen
Program Associate, University of Kansas Field Station and Ecological Reserves, Kansas Biological Survey; Courtesy Associate Professor, Department of Ecology and Evolutionary Biology (Ph.D., Kansas State University)

Plant systematics: Floristics of the grassland biome of central North America; prairie conservation; collection-based informatics; and systematics and evolution of Asteraceae.

Donald G. Huggins
Senior Scientist, Kansas Biological Survey; Courtesy Professor, Department of Ecology and Evolutionary Biology (Ph.D., University of Kansas)

Aquatic ecology and entomology: Quantification of human disturbances on aquatic ecosystems.

Bruce A. Johanning
Operations Manager, University of Kansas Field Station and Ecological Reserves, Kansas Biological Survey

Management of experimental facilities: Design, construction, and maintenance of field facilities and equipment at KSR.

W. Dean Kettle
Associate Director, University of Kansas Field Station and Ecological Reserves, Kansas Biological Survey (Ph.D., University of Kansas)

Ecology and conservation biology: Natural resource management and planning; long-term biological monitoring; and historical analysis of vegetation change and land use. Coordinator of research, teaching, and management at KSR.
Kelly Kindscher
Associate Scientist, Kansas Biological Survey; Courtesy Associate Professor, Department of Ecology and Evolutionary Biology and Environmental Studies Program (Ph.D., University of Kansas)

Conservation biology: Studies of prairie plant communities, including plant species richness and diversity; wetland and prairie restoration; and ethnobotany, including uses and conservation of native medicinal plants.

Cynthia K. Larive
Associate Professor, Department of Chemistry (Ph.D., University of California at Riverside)

Environmental analytical chemistry: Application of GC/MS, LC/MS/MS and LC/NMR to study the fate of organic contaminants in aquatic systems and to determine the structure of their breakdown products as a means for elucidating transformation pathways.

Gwen L. Macpherson
Associate Professor, Department of Geology (Ph.D., University of Texas at Austin)

Geochemistry and hydrogeology: Low-temperature aqueous geochemistry, including time series analysis of the hydrochemistry of shallow carbonate and alluvial aquifers.

Craig E. Martin
Professor, Department of Ecology and Evolutionary Biology (Ph.D., Duke University)

Plant physiological ecology: C3 and C4 photosynthesis in rock outcrop succulents, and adaptations to irradiance in C4 grasses, mosses, and epiphytes.

Carl D. McElwee
Professor, Department of Geology; Senior Scientist, Kansas Geological Survey (Ph.D., University of Kansas)

Hydrogeology: Theoretical description of flow systems; model studies of availability of groundwater in Kansas; modeling of chemical quality; and evaluation of groundwater resources.

Dennis D. Lane
N.T. Yeatch Distinguished Professor, Department of Civil and Environmental Engineering (Ph.D., University of Illinois-Urbana)

Air quality research: Studies on airborne particulates; acid rain; and atmospheric deposition.

Stanford L. Loeb
Acting Director, Environmental Studies Program (Ph.D., University of California at Davis)

Applied aquatic ecology: Environmental monitoring of lakes and reservoirs; land use changes and their impact on water quality; and algal primary production.

Glen A. Marotz
Professor, Department of Civil and Environmental Engineering (Ph.D., University of Illinois-Urbana)

Air quality research: Air quality modeling; statistical analysis; and experimental design.

Raymond J. Pierotti
Associate Professor, Department of Ecology and Evolutionary Biology (Ph.D., University of California at Berkeley)

Vertebrate ecology: Evolutionary biology of vertebrates in relation to breeding system and parental care; field ecology of coyotes and deer mice; development of programs for training Native American students in environmental research.

Edward A. Martinko
Director, Kansas Biological Survey; Professor, Department of Ecology and Evolutionary Biology and Environmental Studies Program (Ph.D., University of Kansas)

Community ecology: Remote sensing of natural resources; insect community ecology; and landscape analysis and characterization.
Galen L. Pittman
Station Manager/Biologist, University of Kansas Field Station and Ecological Reserves, Kansas Biological Survey (M.A., University of Kansas)

Field biology: Monitoring bird populations and field ornithology, on-site facilities management, weather station operation, and assistance in long-term monitoring studies at KSR.

Kevin P. Price
Professor, Department of Geography; Associate Director, Kansas Applied Remote Sensing Program, Kansas Biological Survey (Ph.D., University of Utah)

Biogeography and landscape ecology: Monitoring and modeling of ecosystems using remotely sensed measurements and geographic information systems (GIS).

Stephen J. Randike
Professor, Department of Civil & Environmental Engineering (Ph.D., Stanford University)

Water quality and treatment: Strategies for control of naturally occurring and synthetic chemical contaminants in public water supplies; and sources and transformations of chemical contaminants in water supplies.

Stanley D. Roth
Adjunct Naturalist, Kansas Biological Survey (M.S., Emporia State University)

Ecology: Field research and environmental education.

Norman A. Slade
Professor, Department of Ecology and Evolutionary Biology, Senior Curator, Division of Mammals, Natural History Museum and Biodiversity Research Center (Ph.D., Utah State University)

Mammalian population ecology: Impact of environmental stochasticity on population growth and projection matrices; applications of capture-recapture techniques to nontraditional types of data; and long-term studies of small mammal populations.

Val H. Smith
Associate Professor, Department of Ecology and Evolutionary Biology and Environmental Studies Program (Ph.D., University of Minnesota)

Ecosystem and community ecology: Relationships between resource supplies and the structure and function of biological systems: including studies of the mechanisms that generate and maintain biodiversity in lakes and in old fields; the ecology of invasions by non-indigenous organisms; the mechanisms that regulate biogeochemical cycles of carbon, nitrogen, and phosphorus; and the effects of multiple stressors on aquatic systems.

Valery J. Terwilliger
Associate Professor, Department of Geography (Ph.D., University of California at Los Angeles)

Biogeochemistry and plant ecology: Application of stable isotope methods to study carbon and water use patterns of trees in tropical and temperate forests.

Orley R. Taylor, Jr.
Professor, Department of Entomology and Department of Ecology and Evolutionary Biology (Ph.D., University of Connecticut)

Insect ecology and behavior: Studies of reproductive and life history patterns in butterflies and plants; comparative biology of European and Neotropical African honey bees; and migratory behavior of monarch butterflies. Director of Monarch Watch, an educational outreach program based at the University of Kansas.

Li Zheng
Assistant Scientist, Kansas Geological Survey (Ph.D., University of Notre Dame)

Hydrogeology: Characterization of aquifer heterogeneity; studies of flow and transport in heterogeneous porous media; adaptive modeling of reactive transport in aquifers; and water supply and water resources management.
Externally Funded Research: 1985–2000

Much of the research activity at the University of Kansas Field Station and Ecological Reserves (KSR) has been supported by funding from sources outside the University of Kansas (KU). These external grants and contracts have made a vital contribution to the development of KSR facilities and databases and have created numerous opportunities for student participation in research. Between 1985 and 2000, more than 75 externally funded projects were conducted in part or entirely at KSR. Funding for these projects has totaled more than $11,000,000 and has come from a wide variety of public and private sources. These grants and contracts are listed below, arranged by starting year (and alphabetically by title for those awarded within the same year). For each grant or contract, the starting and ending years, the names of the principal and co-principal investigators (from KU, unless otherwise indicated), and the funding agency or organization are listed.

A regional assessment of the influence of rural non-point source pollution on the ecological integrity of stream ecosystems and evaluation of associated pollution control management. 1993-1994. (E. A. Martinko, D. G. Huggins, M. L. Johnson,


Effects of transgenic resistance to insects on wild sunflower populations. 1999-2002. (A. A. Snow [Ohio State University], H. M. Alexander, and D. J. Pilson [University of Nebraska]). United States Department of Agriculture.


Theses and Dissertations: 1949–2000

Between 1949 and 2000, 154 graduate theses and dissertations were completed, based entirely or in part on research conducted at the University of Kansas Field Station and Ecological Reserves (KSR). In addition to these published works, hundreds of other graduate students have completed independent research projects as part of their degree programs. The publications are listed below, presented chronologically, and alphabetically by author for those within the same year.

1949
Goble, C. R. 1949. The ecology of the Mollusca of the University of Kansas Natural History Reservation. M.A. Thesis. University of Kansas, Lawrence, Kansas. 70 p.

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1985


Trebatsoki, R. J. 1985. The impacts of bluegill (Lepomis macrochirus) and largemouth bass (Micropterus salmoides) on phytoplankton community structure. M.S. Thesis. Texas Christian University, Fort Worth, Texas. 32 p.

1986


1987


1988


55


2000


Publications: 1949–2000

More than 520 papers, reports, and monographs (other than theses and dissertations), based on research conducted entirely or in part at the University of Kansas Field Station and Ecological Reserves (KSR), were published from 1949 through 2000. These publications cover a diverse array of topics and form a key part of the KSR information base. KSR publications are listed below, arranged alphabetically by author surname.


Many people contributed to production of this report. W. Dean Kettle developed the report format and served as the primary author. Robert H. Hagen assisted with writing, collected biographical information, assembled compilations (grants, publications, and theses), and arranged photography by Wally Emerson. Edward A. Martininko and Frank “Jerry” deNoyelles gave advice throughout the project. Carleen A. Roberts provided professional graphics and design services, and undertook numerous smaller tasks that were critical to completion of the report.

Others who contributed text and helped edit included Bryan L. Foster, Helen M. Alexander, Norman A. Slade, Val H. Smith, Kevin P. Price, Theresa Crooks, James J. Butler, Jr., Valery J. Terwilliger, Dennis D. Lane, Kelly Kindscher, Scott W. Campbell, Frank deNoyelles, Jr., Robert D. Holt, and Roger L. Boyd. Drafts of the report were reviewed by Helen M. Alexander, Kenneth B. Armitage, Scott W. Campbell, Frank B. Cross, Frank deNoyelles, Jr., Henry S. Fitch, Bryan L. Foster, Robert D. Holt, Edward A. Martininko, Galen L. Pittman, Kevin P. Price, and Val H. Smith. Special thanks are extended to Craig C. Freeman for copy editing the final draft.

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The University of Kansas Field Station and Ecological Reserves

1. Nelson Environmental Study Area
2. Rockefeller Experimental Tract
3. Fitch Natural History Reservation
4. Robinson Tract
5. Hall Nature Reserve
6. Wall Woods
7. Breidenthal Biological Reserve
8. Rice Woodland

- Interstate 70 Interchange
- Paved Road
- Graveled Road

0 1 2 Mile
0 1 2 Kilometer