Kellogg Biological Station

Long Term Ecological Research

A Comprehensive Program of Research, Education, and Outreach

The KBS K–12 Partnership for Science Literacy

For more than 10 years, KBS has hosted a long-term partnership among area science teachers, LTER scientists, and College of Education faculty to enhance the content and delivery of the Michigan K-12 science curriculum. The program promotes improved science teaching by providing teachers in-depth exposure to current topics in ecology together with training in inquiry-based science methods. Twelve rural school districts near KBS participate in school-year workshops, a summer science institute, and an NSF GK-12 graduate fellowship program.

Graduate and Undergraduate Education

The KBS LTER program is part of Michigan State University's W.K. Kellogg Biological Station. The Station is MSU's largest off-campus educational facility and is one of North America's oldest and most prominent inland field stations, with 11 faculty in year-round residence. Graduate and undergraduate education is a major part of the mission of KBS and an integral part of LTER activities. Both graduate students and undergraduate interns conduct research on site, and many students participate in a variety of field courses offered at the station each summer. For further information about educational opportunities at KBS see www.kbs.msu.edu.

Sampling greenhouse gas fluxes beneath a corn canopy.

K-12 Partnership teachers conduct an invasive plants experiment.

The U.S. National LTER Network

The KBS LTER Site is part of the national LTER Network established by the U.S. National Science Foundation (NSF) in 1980. The Network is made up of 26 sites at which long-term research in ecology and environmental biology provides a better understanding of ecological phenomena in both natural and managed ecosystems.

A broad variety of ecosystems are represented in the Network, including tundra, forest, grassland, desert, and wetland sites, among others. KBS joined the network in 1988 to represent the agricultural field-crop ecosystem.

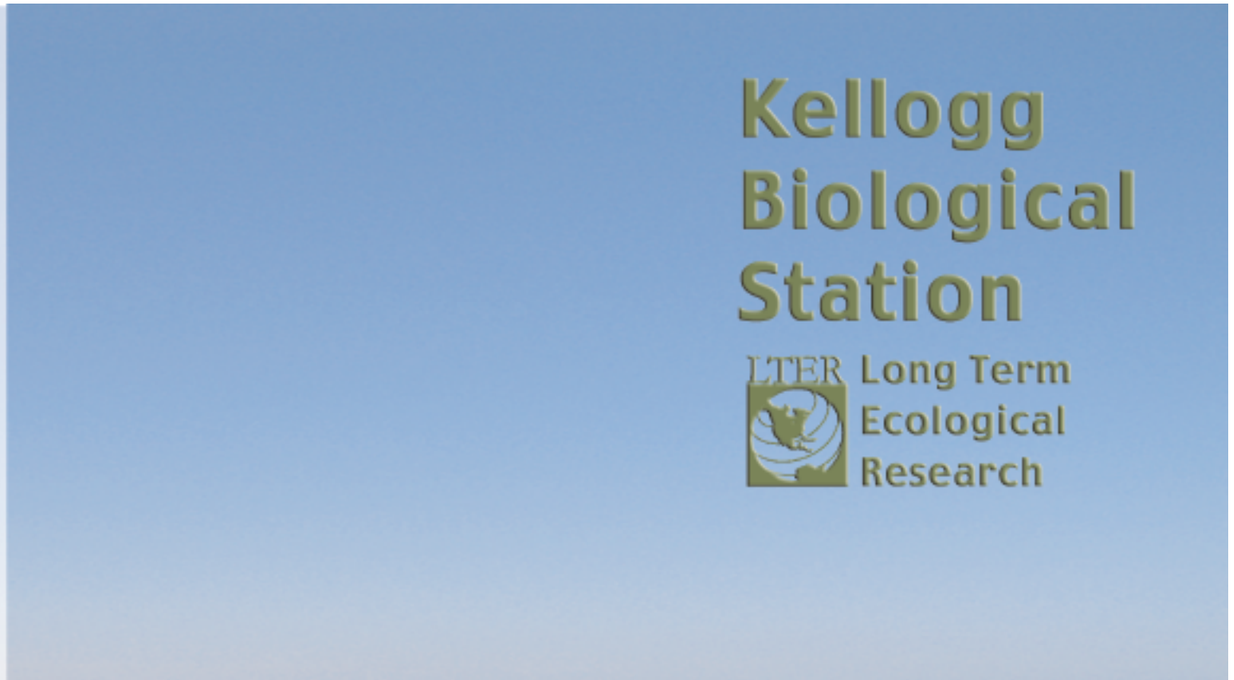
The KBS LTER site is funded by NSF with additional support from Michigan State University and the Michigan Agricultural Experiment Station. For further information, including a list of publications from the site, visit the KBS LTER web site: www.lter.kbs.msu.edu

Location

The KBS Academic Building houses laboratories and classrooms for teaching and research.

KBS is located in southwestern Michigan, just north of Kalamazoo and about 60 miles south of the main MSU campus in East Lansing. The station is in a mixed rural landscape that provides access to a wide variety of terrestrial and aquatic research habitats. Facilities at KBS include modern laboratories and classrooms plus a conference center that features locally produced food and provides overnight and longer term housing.

KBS and the LTER program welcome visiting scientists and graduate students interested in conducting research at the site. Tours for interested groups are available by contacting the LTER Coordinator via the web site.



For more information

www.lter.kbs.msu.edu

W.K. Kellogg Biological Station
Michigan State University
Hickory Corners, MI 49060

(269) 671-2354

For more information about the LTER Network, see:

www.lternet.edu

Kellogg Biological Station

Long Term Ecological Research in Row-Crop Agriculture

Research at the Kellogg Biological Station LTER site is directed towards understanding the ecology of intensive field crop production and its environmental consequences.

Why study the ecology of field-crop agriculture?

Contemporary cropping systems are extremely productive, but high productivity comes with economic and environmental costs that are being increasingly scrutinized. The economic cost of purchased inputs such as fuel, fertilizers, and pesticides is often the single greatest farm expense. The environmental cost of nitrogen, phosphorus, and pesticide losses to groundwater, surface waters, and the atmosphere are substantial.

One strategy for reducing these costs is to shift crop management from a chemical-based system to one that is biologically based, to intensively manage the system for organisms that can together provide the nutrients and pest protection required for high yields. But to do this effectively—while minimizing environmental damage—requires a basic ecological understanding of these systems. Research at KBS is devoted to acquiring this understanding.

More than 15 species of lady bird beetles (Coccinellidae) help to keep plant pests such as soybean aphids in check.

Ecosystem Services from Agriculture

Food and fiber are the two most important services provided to humans by cropping systems, but other services can also be important: clean water and air, biodiversity, carbon sequestration, wildlife habitat, and open space, to name a few. Managing for these services is often secondary if considered at all, yet all are valued by society.

An important goal of KBS research is to better understand the services provided by agricultural landscapes, which include unmanaged areas such as wetlands, grasslands and woodlots as well as crop fields. By better understanding the services that landscapes provide and their value to society, it will become more practical to design incentives for their provision, and thereby improve environmental stewardship and move agriculture to a more sustainable future.

The Agricultural Ecosystem

About fifty percent of the conterminous U.S. is under agricultural management, with about half of this in row crops. At KBS we are asking fundamental questions about how these ecosystems function: how do microbes and other soil organisms make nutrients available to plants; how are pest populations kept in check, how does plant biodiversity contribute to ecosystem productivity; what regulates the loss of nitrogen and other pollutants from these ecosystems; and how can the ecosystem services provided by agriculture be valued.

Our research is designed to answer the broader question of how agronomic management based on ecological concepts can more effectively substitute for agriculture's reliance on chemical subsidies.

At KBS, research is conducted in a variety of ecosystems along a management intensity gradient

Soybeans

Hybrid poplar trees

Early successional community

Late successional forest

Intensively managed → **Unmanaged**

Annual Crops (Corn - Soybean - Wheat)
- Conventional management
- No-till management
- Reduced input
- Certified organic

Perennial Crops
- Alfalfa (forage)
- Poplar trees (biofuel)

Successional Communities
- Early successional old field
- Mid-successional old field
- Late successional forest

Long-Term Experimentation

Short-term experiments are valuable for identifying many of the organisms and processes important for cropping system success, but to understand how all the pieces fit together requires a long term perspective. Droughts, for example, vary in intensity, happen only every few years, and can dramatically affect crop productivity and nutrient loss, as can unusually wet years. Pest and pathogen outbreaks can be equally infrequent but sudden in their effects. And some ecosystem properties, such as soil microbial communities and soil organic matter, change only very slowly—decades may be needed to document change. Long-term measurements of important properties of the ecosystem give KBS researchers the capacity to detect subtle change and provide a valuable backdrop against which to ask short-term questions.

Researchers collect deep soil cores to understand soil carbon dynamics.

An Ecosystem Approach

Cropping systems are complex communities of plants, insects, microbes, and other organisms that interact to create a harvestable product. Most management strategies seek to maximize yields by adding resources and removing pests, often very successfully but also with hidden costs: a solution for one problem can easily create a different problem elsewhere in a system this complex.

A way to avoid hidden costs is to understand how different parts of the system interact. So scientists at KBS are measuring not only the factors directly involved in crop productivity—nutrients, pests, and water—but also other key parts of these intensively managed ecosystems.

Changes in microbial and plant diversity, hydrologic flow, insect predator populations, greenhouse gas emissions, human behavior, and soil organic matter pools are a few of the measures that allow a systems approach to row-crop management.