



Left: Stacey Vanderwulp monitors rainout shelters used to test crop and plant response to reduced rainfall. Photo credit: K. Stepnitz, MSU. Right: Mark Hammond and MSU undergraduate researcher Gabe Stewart measure how warming affects invasive and native plants. Photo credit: E. Schultheis, MSU graduate student



NATURAL LANDSCAPES

KBS researchers study how plant, animal and microbial communities respond to global changes in climate, nitrogen deposition, and invasive species. Changes in temperature and precipitation will affect plant and animal communities. Some species will benefit from these changes, but many are threatened by rapidly changing environmental conditions. Current research at KBS related to these concerns includes:

- ⇒ How climate change and variability influence the growth and reproduction of invasive exotic and native species.
- ⇒ How plants and their associated soil microbes respond to drought stress.
- ⇒ How increased nitrogen deposition and warming affects the legume-rhizobium mutualism, an interaction responsible for naturally fixed nitrogen in terrestrial ecosystems.

For more information, contact Dr. Jennifer Lau, Dr. Katherine Gross or Dr. Sarah Evans

KBS research is advancing our understanding of how climate change influences the ecosystems we depend on and value. The results can contribute to understanding how changes in management can reduce greenhouse gas emissions that are contributing to climate change and help communities adapt to a changing climate. Climate change research at KBS fulfills our mission to understand natural and managed ecosystems, their interactions with people, and how we can sustain and enhance the ecosystem services they provide.

For faculty contact information, visit the W.K. Kellogg Biological Station website.

kbs.msu.edu



W.K. Kellogg Biological Station CLIMATE CHANGE RESEARCH

The majority of scientists agree that humans play an important role in the observed rise in global temperature. Scientists at the W.K. Kellogg Biological Station (KBS) are investigating how climate change affects natural and managed ecosystems in Southwest Michigan and around the world.

This research increases scientific understanding of these processes and shows how management can be used to mitigate, or lessen, the negative effects of climate change. Climate change research at KBS focuses on four main themes, described in this brochure.



WATER QUALITY AND AVAILABILITY

Climate change will alter the water cycle in many ways. We expect there will be increases in temperature, as well as changes in precipitation (rain and snow) amount and timing. These changes will impact both surface and ground waters that are vital to human and ecosystem health. More summer droughts, more intense summer, rainfalls less lake ice cover, and milder winters are likely in the American Midwest and will affect species composition and the function of aquatic ecosystems. KBS research examines several aspects of these changes, including:

- ⇒ How interactions between increasing temperature and nutrients are shaping phytoplankton (suspended algae) communities in lakes and oceans.
- ⇒ How increasing water temperature affects the invasive zebra mussel in Michigan lakes and the relationship to harmful algal blooms.
- ⇒ How changing climate affects water quantity and quality in the tropical river floodplains of Brazil and Australia.

For more information, contact Dr. Steve Hamilton, Dr. Chris Klausmeier, or Dr. Elena Litchman.



Lauren Kinsman-Costello collects water samples from a restored wetland as part of a study on nutrient release from flooded soils. Photo credit: S. Hamilton, MSU

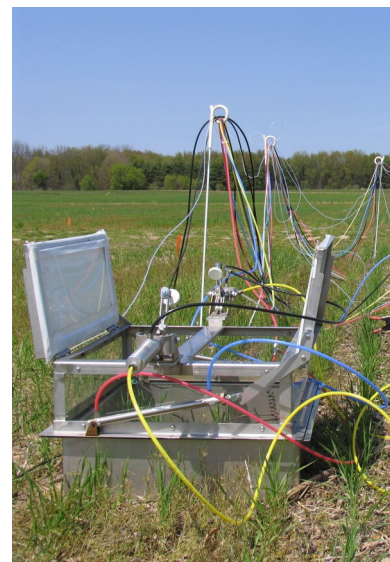


Jeffrey White (Fisheries & Wildlife) samples Gull Lake for a monitoring program supported by the Gull Lake Quality Organization and KBS. Photo credit: S. Hamilton, MSU





Field technician A.J. Ozanich collects greenhouse gas samples in a corn field, part of the KBS LTER biofuels research program. Photo credit: K. Stepnitz, MSU. Below: Automated greenhouse gas sampling chambers in a wheat field on the KBS LTER site. Photo credit: J.E. Doll, MSU



CROPPING SYSTEMS

Midwestern cropping systems will both affect and be affected by a changing climate. It may be possible to mitigate the agricultural contribution to climate change by understanding how management practices affect greenhouse gas emissions and carbon sequestration. Research can be used to inform agricultural management and policy at local to national levels. Studies at the KBS Long-Term Ecological Research program and Great Lakes Bioenergy Research Center are seeking to answer a number of questions related to climate change, including:

- ⇒ How changes in management affect the global warming impact of annual and perennial cropping systems;
- ⇒ How management can reduce the global warming impact of converting marginal lands to biofuel crops; and
- ⇒ How farmer attitudes and decision-making processes influence nitrogen fertilizer management and ultimately the climate change mitigation potential of annual cropping systems.

For more information, contact Dr. Phil Robertson, Dr. Bruno Basso, or Dr. Julie Doll.

ANIMAL AGRICULTURE

Impacts of climate change on livestock production are both direct and indirect. Major concerns for farmers are how extreme weather events will affect the quality and quantity of feed produced from pasture and other crops, and how animals will adapt to heat stress. One way cattle contribute to climate change is by producing greenhouse gases through enteric fermentation (digestion).

Reducing these emissions, particularly methane, is one way to reduce the contribution of livestock to climate change. Scientists at KBS are using the Pasture Dairy Center to study the relationships between greenhouse gas emissions, farming practices and milk production. Climate change research includes:

- ⇒ How methane and carbon dioxide production from dairy cows is affected by feed and forage quality.
- ⇒ How to decrease the carbon footprint of dairy farms through management practices that reduce carbon emissions and increase carbon storage in pastures.
- ⇒ How grazing affects plant biodiversity, productivity and other ecosystem processes in pastures.

For more information, contact Dr. Santiago Utsumi.

Cows on pasture at the KBS Pasture Dairy Center. Photo credit: M. Haan

