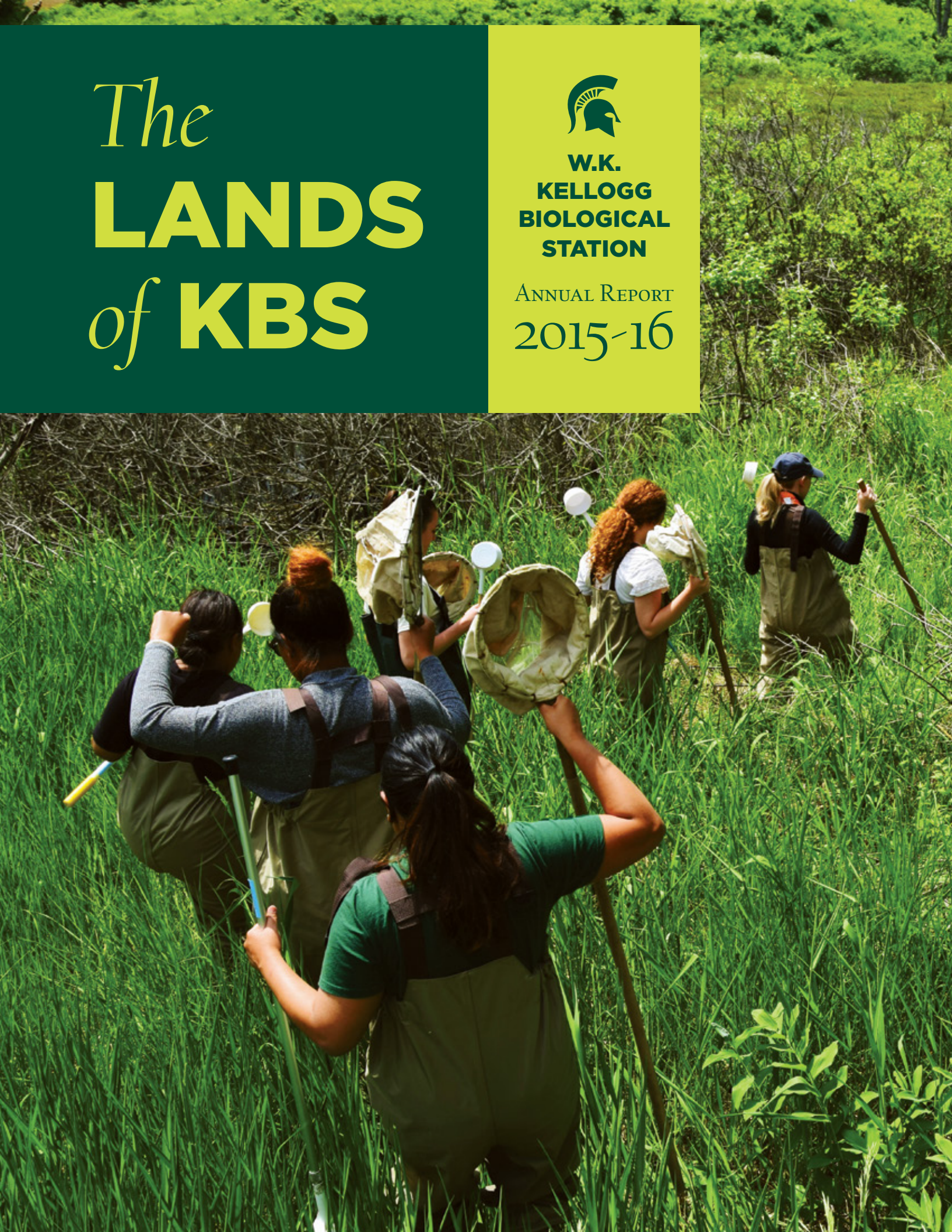
The LANDS *of* KBS

W.K. KELLOGG BIOLOGICAL STATION

Annual Report

2015-16



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THE **MISSION** OF THE W.K. KELLOGG BIOLOGICAL STATION IS TO

INCREASE OUR UNDERSTANDING OF NATURAL AND MANAGED ECOSYSTEMS AND THEIR LINKAGES TO SOCIETY.

Photo credit: Kurt Stepnitz, MSU

LETTER *from the* DIRECTOR

DEAR FRIENDS AND NEIGHBORS...

The lands of KBS have been home to extraordinary research, innovative education and accessible outreach for nearly 90 years, and we celebrate that in this year's annual report. Our unique location, landscapes and facilities have made it possible for us to tackle important challenges and answer important questions in conservation, ecology and evolution.

As Michigan State University's largest off-campus educational complex, we take great pride in fulfilling our land-grant mission – collaborating with one another and with you to understand and create solutions for problems in natural and managed landscapes. This year, we celebrate some of the lands of KBS that best illustrate our legacy of conservation and our commitment to sustainability.

The KBS Experimental Pond Lab has been used for cutting-edge research in aquatic ecology for over four decades. We also celebrate the past, present and future of Lux Arbor Reserve, which has been a key research site for multidisciplinary research at KBS for the past 25 years, and will continue to be. Finally, we share with you a prime example of our commitment to collaboration – the Prairie Restoration Project.

This report is full of stories that make our faculty, staff and students proud to be part of the KBS community, and we hope that you see many reasons to be proud of your commitment to our community as well. Because of your support, we continue to develop partnerships both locally and globally for the greater good.

We hope to see you soon here at KBS, and to hear from you how we can serve you best.

With thanks,

Dr. Katherine Gross

GOING GLOBAL

KBSERS TRAVELING

KBS researchers have been all over the world, from Brazil to Namibia to Russia.

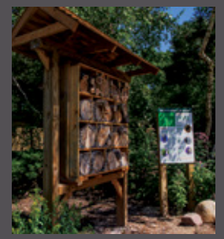
Pictured below is Dr. Sarah Evans, working with samples in the Namib Desert. (Photo courtesy of Sarah Evans)

A HOME FOR BEES

at the BIRD SANCTUARY

The Sanctuary's Native Pollinator Garden now includes a Bee Condo and signs to educate visitors about pollinators. After a 2-year planning and designing process, the signs and condo were installed in spring 2016, thanks to KBS staff and volunteers, with assistance from Dr. Jason Gibbs of MSU's Entomology Department.

The project was funded primarily by the Sanctuary, with supplemental funding from Bird Sanctuary memberships and a grant from the National Association of Interpreters (NAI).



POINTS OF PRIDE

HIGHLIGHTS FROM THE PAST YEAR

July 2015 - June 2016

Extraordinary things happen in labs, classrooms, offices, and the great outdoors. In this report, you'll get to learn about some of our proudest places and projects.

NEW WEBSITE

We launched our new and greatly improved website in January 2016, creating new individual sites for the Bird Sanctuary and Conference Center and Manor House.

KBS RESEARCHERS' NOTABLE WORK

This year, KBS faculty, postdoctoral research associates and graduate students published their research in leading journals like *Animal Behaviour, Bioscience, Ecology & Evolution, Evolutionary Applications, Global Change Biology Bioenergy, Global Ecology & Biogeography, Hydrobiologia, Nature, PLoS ONE, Proceedings of the Royal Society B,* and others.

Dr. Gary Mittelbach was named a 2015 Fellow of the Ecological Society of America (ESA), and was awarded at ESA's meeting in Baltimore, Maryland, in August 2015.

SUMMER UNDERGRADUATE PROGRAMS

93 undergraduate students came to KBS for our summer 2016 session to take courses, gain research experiences, and grow as young professionals and scientists. Many of those students were able to come to KBS because of scholarships.

Pictured below are the 15 students who came from other universities and colleges to participate in our full-time Research Experiences for Undergraduates (REU) program.

FY15-16 SOURCES OF SUPPORT

39% General Fund
27% Grants & Allocations
25% Business Accounts
5% Gifts & Trust
4% AgBio & Extension

TWO NEW SCHOLARSHIPS ESTABLISHED

The **Richard A. Brunt Family Scholarship** supports undergraduate student experiences at KBS. The Brunt family and friends created this scholarship in memory of Richard Brunt, who spent over 36 years of his career as a high school science teacher and later as an administrator as the science director of Toledo Public Schools. This scholarship will inspire more students to consider and excel in science careers.

Future graduate students conducting research that contributes to the sustainability and enhancement of natural and managed ecosystems may receive funding from a planned gift that created **The James Larson W.K. Kellogg Biological Station Endowment for Graduate Research in Climate Change and Environmental Sciences.** Dr. James Larson established this endowment to support research efforts studying the impact of climate change. Through this gift, the Kellogg Biological Station will continue actively working on saving the environment that supports life on earth.

Pictured below is Lindsey Alderink, one of four students who received summer 2016 funding from the Brunt Family Scholarship.

KBS AROUND THE WORLD

We believe that diversity in background and experience make a difference in how we conduct our best research for the greater good.

When our researchers study phenomena around the world, there are no limits to what we can learn and what we can offer back to people all over the globe.

KBS RESEARCH LOCATION

KBS RESEARCHER'S HOME

LUX ARBOR RESERVE 25 YEARS

TUCKED AWAY IN SOUTHWEST BARRY COUNTY, LUX ARBOR RESERVE HAS BEEN A PLACE OF LEARNING FOR STUDENTS AND FACULTY SINCE IT WAS GIVEN TO MSU BY THE LIGHT FAMILY IN 1991. THE LIGHT FAMILY'S TERMS STIPULATED THAT LUX ARBOR WOULD BE USED AS A "CENTER FOR THE STUDY OF CONSERVATION, ENVIRONMENTAL SCIENCE, WOODLANDS OR PRAIRIE RESTORATION" AND TO SUPPORT THESE PROGRAMS AT KBS.

For 25 years, KBS has been committed to Lux's original purpose, and the lands and waters around Crooked Lake have supported impactful aquatic and terrestrial research by KBS and other researchers.

Dr. Steve Hamilton, a KBS professor in MSU's Department of Integrative Biology, has maintained a water level monitoring program on Crooked Lake continuously since 1996, started just after he first came to KBS in 1995. Volunteers play an important role in this program, and the data they have collected shows that water levels have varied by over 6 feet since 1996.

Understanding long-term water level variation is important not only for scientists studying these systems, but also for local landowners. Hamilton has shared his data with Crooked Lake watershed residents, who are concerned with about the effects of changes in climate and withdrawal of water from Lower Crooked Lake for irrigation on water levels. Lux Arbor includes many ponds that have been used for both biogeochemical and ecological studies.

"There is a great diversity of water quality and aquatic life that makes the location interesting for comparative studies, and because it is secure we can set up experiments," said Hamilton. "The Lux Arbor sites have appeared in a number of our scientific papers and we have obtained federal grants to work on the overall Crooked Lake system."

The Lux Arbor landscape includes forests and fields. Some of the former agricultural lands are Great Lakes Bioenergy Research Center sites, as these large areas allow scientists to measure the biomass production potential and environmental effects of bioenergy crops. Abandoned fields at the reserve also provide sites for prairie restoration experiments by KBS and MSU faculty and students.

The former airstrip is now used for experiments by visiting KBS graduate student Anna Groves, who is conducting her Ph.D. research on prairie restoration. Groves is also working with her advisor, Dr. Lars Brudvig, as well as Doug Landis and Rufus Isaacs and other MSU faculty, on a Project GREEEN grant to learn how to improve habitats for pollinators. These are marginal lands and full of invasive species – quite a challenge for restoration, but Groves is up to it.

"It's extra hard to restore those places," said Groves. "We'd like to learn how to restore this type of soil and plant community. No two restored prairies turn out exactly the same, for better or for worse. I'm interested in learning why."

She is testing a number of factors that are known to affect prairie restorations, including the number of species added, timing of seed sowing and herbicide application, and variation in rainfall. Her research at Lux Arbor will benefit scientific knowledge about prairie restorations, as well as conservation efforts to create habitats that support local pollinators.

Lux Arbor is a unique place for prairie restoration work, and Groves cites the support of Lux Arbor manager Mark Manuszak as an important resource in her research. Manuszak, who replaced now-retired former manager Steve Norris in 2015, is responsible for assisting students and researchers in establishing their projects at the reserve.

"There are some things a graduate student just isn't equipped to do (like, till a field), so that's where KBS comes in. It's an awesome place to be," said Groves. "Mark looks out for all the researchers at Lux, which I appreciate very much."

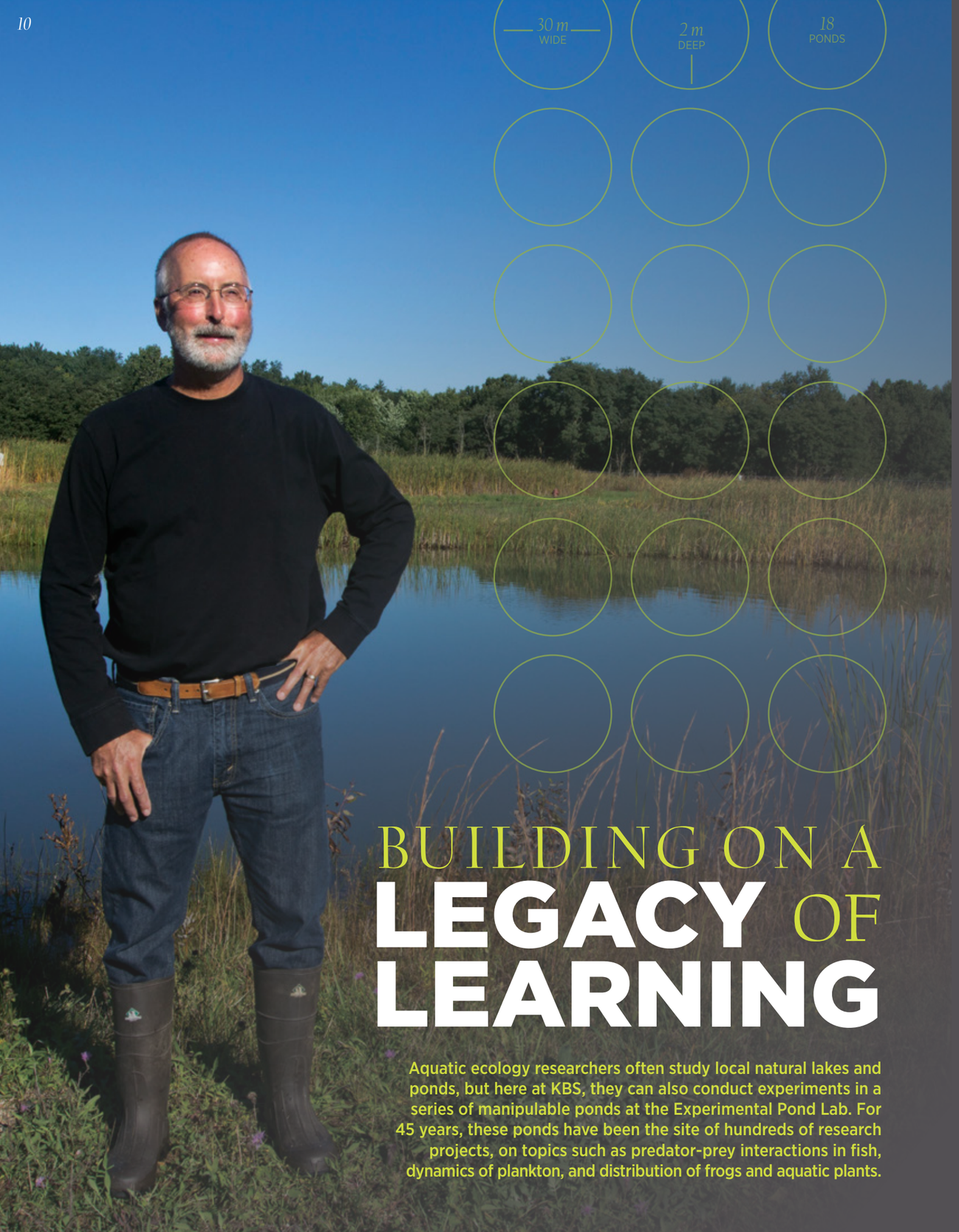
When asked to describe Lux Arbor, Manuszak said, "I would sum it up as being one of the most diverse pieces of property in southern Michigan, between the ag, between the forest, between our marginal lands, the wetlands, the riparian areas, there's probably not too many properties, especially in southern Michigan, this size, that can offer as much as far as our natural resources and diversity are concerned."

Manuszak hopes to continue to work with neighbors, researchers, the university, and conservation groups to fulfill the original mission of the reserve. He is excited to facilitate more researchers utilizing the property. Lux's future is clear and bright as a site for outstanding research that impacts the scientific community, the public and surrounding ecosystems.

HISTORIC OSPREY BANDING AT LUX ARBOR IN COLLABORATION WITH DNR

Michigan Department of Natural Resources (DNR) wildlife biologists banded two osprey chicks at their nest at Lux Arbor in June 2016. Banding these rare birds allows the DNR to monitor their location and activity, and gain information about the species' survivorship. The chicks at Lux Arbor were the first to be banded in southwest Michigan as part of the DNR's statewide osprey banding initiative. DNR wildlife biologists hope to establish a volunteer base in southwest Michigan to help monitor the birds in the next year.

Left: Biologists prepare to band the chicks on Crooked Lake while an adult osprey flies overhead; Photo credit: Sabrina Brown, 2016 KBS Intern. Right: DNR wildlife biologist Ken Kesson places one of the newly banded osprey chicks back into its nest; Photo courtesy of Roy Van Loo, Jr.)



BUILDING ON A LEGACY OF LEARNING

Aquatic ecology researchers often study local natural lakes and ponds, but here at KBS, they can also conduct experiments in a series of manipulable ponds at the Experimental Pond Lab. For 45 years, these ponds have been the site of hundreds of research projects, on topics such as predator-prey interactions in fish, dynamics of plankton, and distribution of frogs and aquatic plants.

The KBS Experimental Pond Lab was constructed in 1971 through a National Science Foundation (NSF) grant to Michigan State University, and was one of the first of its kind in the United States.

"When they were built, the idea was that they could be outdoor experimental units – think of them as big test tubes outdoors. Today, it's a great facility to do experimental work on aquatic communities and aquatic ecosystems," said Pond Lab Coordinator Dr. Gary Mittelbach (pictured at left).

The ponds are in high demand for use by KBS faculty and graduate students, as well as visiting researchers. The Pond Lab includes not only the 18 experimental ponds but also hundreds of cattle tanks for smaller experiments, and an indoor lab space. Graduate students like Sara Garnett use the Pond Lab for their dissertation research.

Garnett said, "It's a really good opportunity to replicate things in a more controlled way than you might be able to in natural ponds, which obviously have a lot of different things going on that you can't necessarily control."

"The ponds are unique because the NSF views them as a regional resource, and they're available for researchers not just from MSU, but from all over the country," said Mittelbach.

Dr. Stuart Jones, a former KBS postdoctoral researcher and current faculty member at Notre Dame, has a proposal in review at NSF to use 16 of the 18 ponds to study dissolved organic carbon effects on productivity and nutrient cycling.

"The KBS ponds are attractive because they are large enough that in many ways they behave like natural aquatic ecosystems, but small enough that we have access to a large number of them and can replicate our experiments," said Jones.

Dr. Chris Steiner, a KBS alumnus advised by Mittelbach, has been coming back to the Pond Lab to conduct research for the past 6 years with undergraduate and graduate students from his lab. Mitra Asgari, a graduate student in Steiner's lab at Wayne State University, has been at KBS every summer since 2014 to study the distribution of aquatic insects.

"Working at the Pond Lab was the best way I could get familiar with fishless pond systems," said Asgari. "The research facility and human support available at the Pond Lab definitely made this experience much easier and manageable, and I am really thankful for that."

"I am proud of the history of aquatic research that has been performed at KBS and the Pond Lab and my small part in it," said Steiner. "I hope by bringing students to KBS, they not only benefit from the practical aspects of doing research there, but they also get a sense of heritage and their place in this history."

Mittelbach, a KBS faculty member in MSU's Department of Integrative Biology, has been coordinating the Pond Lab's use since 1986, but his relationship with the ponds began much earlier.

Mittelbach was a graduate student in Earl Werner's lab in the 1970s, when the ponds were just a few years old. His dissertation research was about how body size and behavior determined the diets and habitat use of bluegill sunfish, which he was studying in local lakes.

Along with Werner and colleagues, Mittelbach conducted an experiment in the KBS ponds following the growth and habitat use of different-sized bluegills and their predator, the largemouth bass. They found that the fish were trading safety and better survival for less food and slower growth.

After graduating with his Ph.D. in 1980, Mittelbach worked at Ohio State University studying reservoirs around Columbus, Ohio. Every summer, he returned to KBS to study at the Pond Lab. In 1986, he returned to KBS for good as a faculty member and began managing the Pond Lab.

Mittelbach advised recent KBS graduate Dr. Melissa Kjelvik, who also studied bluegill sunfish at the ponds. When she presents her research on bluegills, she references a graph from Mittelbach's research.

"It's really beneficial to have all of his knowledge, because he not only did his dissertation there, but he's been working at the Pond Lab for most of his academic career," said Kjelvik. "Having that knowledge, it was so much easier to make the connections that I probably wouldn't have otherwise."

In addition to building on Mittelbach's research, Kjelvik also passed down his expertise as a mentor. She coached summer undergraduate students, who conducted their own experiments at the ponds. The Pond Lab was an ideal place for her to mentor undergraduates, in part because of its history of research.

"We have them read studies that were done at the ponds before they came, and they can see how what they're doing fits in," said Kjelvik. "I think what makes the Pond Lab so special is the community of researchers that have been out there, and knowing that you're part of that research family. Building on what was already learned from research done out at the Pond Lab is really neat and unique."

The Pond Lab has been a generational home for a scholarly community of aquatic researchers since 1971, and its future is sure to promote even more scholarly development as researchers continue to return year after year.

(L TO R) **JIM GILLIAM, DON HALL, EARL WERNER, AND MITTELBACH, C. 1980** (COURTESY OF GARY MITTELBACH)

GROWING TOGETHER

Restoring KBS lands to native prairies & making discoveries about the future of prairie species

IMAGE COURTESY OF NASH TURLEY

LEFT PAGE: Adrienne Wayne, Alex Walus, George Wheeler, Emily Grman, Chad Zirbel, Louis Jochem & Lars Brudvig at a field site
RIGHT PAGE (clockwise from top left): (1) the site of an experiment manipulating temperature; (2) Nash Turley, Brudvig, Grman, Zirbel, & Wheeler; (3) the site of an experiment manipulating mammal access; (4) Anna Groves & Logan Brissette; (5) Tyler Bassett & Jen Lau

HISTORICALLY IMPORTANT PRAIRIE SPECIES ARE NOW NEARLY ABSENT FROM LOCAL MICHIGAN LANDSCAPES, AND WITH THEM, MANY NATIVE BIRDS AND INSECTS THAT ADD VALUE TO AGRICULTURAL AND NATURAL LANDSCAPES HAVE ALSO DECLINED. TO COMBAT THAT LOSS, RESEARCHERS ARE RESTORING IDLE LANDS AT KBS TO THEIR FORMER PRAIRIE GLORY – AND ANSWERING FUNDAMENTALLY IMPORTANT QUESTIONS ABOUT ECOLOGY AND EVOLUTION.

The project began when KBS was approached by the Michigan Department of Natural Resources (DNR) and asked to participate in a project designed to restore prairie habitat on privately owned lands. DNR and KBS staff hatched a plan to restore multiple plots of land at KBS, which would create habitats for more native species.

"Restoration is bringing back biodiversity to areas that were somehow impacted negatively by human activities," said Dr. Nash Turley, a postdoctoral researcher at MSU interested in restoration ecology.

A team led by principal investigators (PIs) MSU faculty Dr. Jen Lau, Dr. Lars Brudvig, and Eastern Michigan University faculty Dr. Emily Grman capitalized on the opportunity to both implement prairie restorations and establish a long-term research project.

"They [DNR] were working with the facilities team here at KBS to identify lands that could be restored," said Lau, a KBS associate professor in MSU's Department of Plant Biology. "When we approached them about using these restorations to answer questions, they were super excited about it."

"This partnership really helps build a bridge across these two interest groups, where the researchers are working with the managers," said Brudvig, an MSU Plant Biology professor. "There's an opportunity for translation of our findings that might not otherwise be there."

The team secured a grant from the National Science Foundation to supplement initial DNR funding, which supported the restoration and additional experiments. The team members built off each other's ideas and set up a variety of experiments, replicated in 12 plots of land around KBS.

"This project is a perfect opportunity to meld a basic ecological understanding of how these communities work with larger scale implications for what that means for a restoration," said Grman, a KBS alumna who is now an assistant professor in EMU's Department of Biology and specializes in plant community ecology.

The experiments focus on biodiversity, questioning what the ideal number of native species is for restorations and where those species' seeds should come from, as well as how prairie species respond to climate change.

"Our project has exploded in all sorts of interesting directions to consider restoration practices under global warming, how herbivores influence restorations, and how soil microbes influence restoration outcomes both now and in the warmer environments predicted in the future," said Lau.

The experimental plots are in spaces with different land use histories, and the variety of landscapes will likely contribute to the variation in outcomes – variation that the researchers are especially excited to investigate.

"The variation between our southern and northern seed sources is amazing. Northern and southern partridge pea plants, for example, look totally different," said Lau. "There's a lot of variation across our 12 sites in terms of which plants are establishing."

In addition to the faculty and Turley, the research team for the project includes graduate and undergraduate students and a local K-12 teacher. Jen Boyle, a middle school teacher from Gull Lake Community Schools, is on the team as a part of the KBS Research Experiences for Teachers (RET) program, which provides K-12 teachers summertime hands-on research experience and opportunities to develop ways to implement and share research in their classrooms.

Boyle helped develop interpretive signs for the project's plots at the Bird Sanctuary, which are highly visible to visitors walking the Lake Loop trail. The signs will make connections to species noticeable in the Bird Sanctuary's native pollinator garden.

Through constant collaboration, the prairie restoration project evolved beyond its original goals to be a shining example of the innovation and impact only possible through successful teamwork.

> *"I'm proud to be a part of this project because of the unique collaborative nature. I would say the team has had some of the most exciting science discussions I've had in all my years of science."*
>
> DR. JEN LAU

Next year, the team will initiate a citizen science project that will get the public involved in collecting data. The project is intended to continue for decades, resulting in unique long-term contributions to scientific understandings of biodiversity and evolution, not to mention 12 beautifully restored prairies for all of us to see and learn from at KBS.

WE THANK YOU FOR YOUR SUPPORT.

July 1, 2015 – June 30, 2016

$5000 and up

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David G. Dvorak, M.D.
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Russell G. and Lou Ann S. Mawby
Thomas C. and Sharin E. Noall

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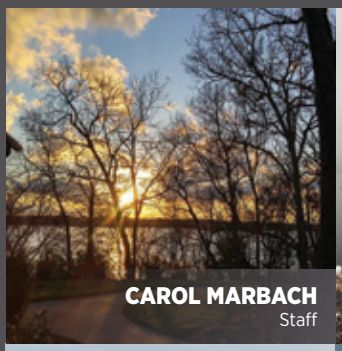

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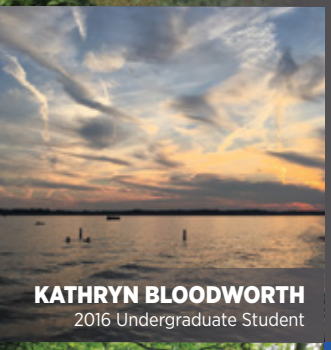

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