

W.K. Kellogg Biological Station Overview and Background External Review 27-28 March 2017

I. Introduction

The W.K. Kellogg Biological Station (KBS) has long been known for world-class research in ecology and evolutionary biology. The current faculty members are recognized as leaders in their fields, with research interests that span different levels of organization from genes to ecosystems and across a diversity of systems. Although the research of KBS faculty is primarily focused on fundamental questions, our work has important implications to address the environmental challenges of the 21st Century. Many faculty tackle these challenges directly through their research and outreach.

Over the past 30 years, KBS has established world leadership in agricultural ecology, the fundamental science that informs sustainable agriculture, and is home to several large agricultural ecology projects. There is also a long tradition of research at KBS on the ecological underpinnings for conservation and restoration. More recently this work has expanded to include research on evolutionary processes, particularly of microbes, that are important to these applications, particularly in light of climate change. The diverse landscape at KBS includes “working lands” that produce crops and timber and other important ecosystem services, and unmanaged lands that offer opportunities for research on restoration and conservation of native species and communities, particularly for aquatic ecology as our land base encompasses a wide range of aquatic habitats (see **About KBS**- maps).

What sets KBS apart from other field stations is the *core of resident faculty whose research programs* take advantage of the diverse natural and managed, aquatic and terrestrial habitats and first-class research facilities at KBS. A strong resident faculty maintains KBS excellence in research, graduate and postdoctoral training, undergraduate education, and outreach. These faculty continue the tradition of outstanding graduate and postdoctoral training that has defined KBS over the past 50 years, have a unique capacity to teach field intensive courses that include authentic research experiences to undergraduate students because they teach where they research, and provide the expertise and research opportunities that allow other MSU and external researchers to establish extensive research projects at KBS.

KBS also has taken a leadership role in many areas of research for which a field station setting is not crucial, but complementary, and that provides added value. For example, workshops held at KBS in bioinformatics and next generation tools for analyzing molecular and genomics data at KBS have allowed students to see the research sites at KBS where such data are generated. Similarly, teaching short courses in mathematical and statistical tools used in ecology and evolution (ELME), shows how these tools and mathematical theory can be – and are being – applied to address complex environmental problems that are part of research at KBS.

We have and are continuing to develop strong partnerships with campus departments and programs that offer opportunities for their faculty, graduate and undergraduate students to take advantage of the unique research and learning opportunities at KBS. KBS also has a tradition of outreach to teachers, other professionals and the public and we see exciting opportunities to expand this as well – sharing research from KBS and other MSU faculty. In this report we outline and review the aspects of KBS that make it unique among biological field stations – and research/education centers of MSU - and briefly outline a vision for the future. Our review focuses on the last five years (2012-2016) and builds on what we summarized and proposed as areas for growth in the Academic Program Review (APR) completed in 2012 (see **Academic Program Review**).

II. Our Mission

KBS faculty and staff contribute to the full spectrum of MSU's land grant mission by integrating research, graduate and undergraduate education, and outreach. This is epitomized in the KBS Mission:

The mission of the W.K. Kellogg Biological Station (KBS) is to increase our understanding of natural and managed ecosystems and their linkages to society. This entails three main integrative activities:

- *Promote and support multi-disciplinary research in ecology, evolutionary biology, agriculture, and conservation biology across the continuum of basic to applied research.*
- *Provide MSU students with inquiry-based educational opportunities in ecology, evolutionary biology, agriculture, and conservation biology.*
- *Provide outreach programs that bring KBS expertise to bear on environmental issues of public importance.*

Our success in fulfilling this mission stems directly from the unique combination of having an outstanding resident faculty and staff who are committed to the land-grant mission of MSU, world-class laboratory facilities situated in a large and diverse land base, and an array of field experimental facilities including the pond lab and plant ecology lab/greenhouse/field complex. There are also large scale experimental sites focusing on various aspects of agricultural ecology (the LTER and GLBRC) and a new large-scale restoration project that support the research of KBS and other MSU faculty, as well as national and international researchers (see **About KBS**).

Having faculty in residence year round at KBS allows us to provide a stimulating environment for research and graduate/postdoctoral training and to support the research of others. The multiple disciplines represented by KBS faculty (as evidenced in their different department affiliations), leads to collaborations and integration difficult to achieve in traditional departments. While university programs attempt to achieve interdisciplinary synergies, they do not have the geographic advantage of being located in the same building with access to the same field sites/ laboratories and shared postdocs and graduate students. All of this leads to a very special potential for integrative

collaborations found only in a small number of similar institutes nationally – e.g. Woods Hole, Cary Institute of Ecosystem Studies, Bodega Bay – which like KBS have a resident faculty, shared facilities and a geographic focus to their research. Unlike most campus units there are frequent interactions between Outreach, Development and Physical plant staff at KBS that promotes an atmosphere of shared purpose that is critical to fulfilling our mission.

III. Land base, Facilities and Administrative structure

Land base and Facilities: KBS is recognized as a premier site for field work in successional plant communities, freshwater habitats, and agricultural landscapes—research that takes advantage of the area’s diverse habitats and resident faculty expertise. The land base for KBS includes about 1,500 ha of diverse habitats, including forests, old fields, streams, wetlands, lakes, and agricultural lands. A total of 668 ha are contained within the contiguous station holdings at Gull Lake, with an additional 530 ha of successional, agricultural, and aquatic habitats in the Lux Arbor Reserve a few km to the north. In addition, over 200 natural water bodies, as well as a number of streams and rivers, occur within a 30 km radius of KBS. The combination of natural and managed habitats, many suitable for experimentation, together with nearby laboratory facilities with modern instrumentation, provides unparalleled opportunities for environmental research and education.

Major Buildings and Laboratories: The Academic-Stack building, located at the Academic Center next to Gull Lake, has the research labs and offices for KBS resident and visiting faculty, graduate students and postdocs. There is also a branch of the University library, computer workroom, dedicated rooms for radioisotope counting and CN analysis, a microscope/image analysis room, several shared wet labs (including one for molecular work), temperature controlled rooms for environmental chambers, and common-use labs dedicated to gas analysis and GIS. An adjacent 7-room, 3600 ft² greenhouse has high-intensity lighting and microprocessor temperature controls. The Academic Center site includes facilities of the Conference Center including the historical Kellogg Manor House, lodging and food services for summer students, conference groups and special events (McCrary Dining Hall, Sheriff and VanderPloeg apartments, Orchard Dorms, and cabins), and two historical cottages. Also located on this campus are offices for Outreach and Communications (Carriage House) and a boat house laboratory building.

In addition, KBS has six outlying field laboratories that allow for easy access to field sites by resident and visiting faculty and graduate students. These include the Experimental Pond Laboratory, Terrestrial Ecology Field Laboratory, and the LTER Field Lab. These facilities have been enhanced by recent NSF grants for facilities (FSML), allowing us to host a growing number of non-resident faculty research projects (see Grants and Research Activities). The field experimental sites for the NSF-funded Long Term Ecological Research (LTER) project in agricultural ecology and the DOE-funded Great Lakes Bioenergy Center (GLBRC) have attracted researchers from around the world to KBS.

People and Administrative Structure: KBS is managed jointly by the College of Agriculture and Natural Resources (51%) and the College of Natural Science (49%); the Director (Gross) reports to both Deans and oversees all research, teaching, and outreach/extension programs. The KBS Director has shared responsibility with department chairs in which the faculty are jointly appointed for annual reviews, teaching and related assignments and preparation of materials for reappointment, promotion and tenure. Summer teaching is the sole responsibility of the KBS Director (and funded separately by the Provost's office.) Total KBS full-time personnel (~100 individuals) includes faculty, specialists, research associates, technical and support staff. The KBS Director is supported by an Assistant Director for Finance and Operations, an Executive Assistant and Coordinators for: Development and Community Relations;, Science Education and Outreach, and Academic Program. The Executive Assistant (Smith) oversees hiring of academic personnel, travel and reimbursement, and provides administrative support for Development (communications with donors), Academic programs (enrolls students and is liason to campus departments). The Assistant Director for Finance and Operations (Widner) oversees finance, budgeting and human resources and IT for all of KBS and Facilities and Operations of the Academic programs. In addition managers of the Bird Sanctuary, Farm, and Conference Center/Manor House) report to this position. (see **About KBS** and **Support Units**)

Financials: The overall budget of KBS is approximately \$9M per year and includes ~\$2M/yr from MSU (CNS, CANR, MABR and a modest amount from MSUE) for personnel and operations, income from gifts and endowments (\$3-3.5M), and grant expenditures (\$2-3M/yr); an additional \$1.5M is provided by the MSU Office of Land Management for the KBS Physical Plant which includes maintenance of all building, grounds and utilities (see **About KBS**). In addition KBS receives an annual allocation for summer session instruction (faculty and graduate students) of ~\$250,000 and as well \$165,000 in fellowship funds from the MSU Graduate School. The Grad School funds are tied to grants (matching) and support students involved in LTER (\$65K); K-12 partnership (\$65K); and REU (\$15K) programs. In addition, KBS receives about \$180,000 annually from the Provost's Office, requested through the Colleges, to pay faculty and graduate students who teach summer courses.

IV. The Faculty.

There are 12 faculty (including the Director) in year-round residence at KBS; each has a joint appointment in one or more campus departments (Integrative Biology, Plant Biology, Plant Soil & Microbial Sciences, and Animal Science). Two faculty have joint (minority) appointments at KBS and are based on the MSU campus, but maintain research programs at KBS. There are also [10 adjunct faculty](#) – mostly non-MSU – affiliated with KBS who maintain active research programs here and/or contribute to teaching and outreach programs. [KBS faculty](#) are affiliated with several interdepartmental graduate programs at MSU: Ecology, Evolutionary Biology, and Behavior (EEBB); Environmental Science and Policy (ESPP); as well as the NSF-funded

BEACON STC for ‘evolution in action’. Faculty teach both on campus and in the summer at KBS (see Faculty Contributions). All do federally-funded research that supports graduate students, postdoctoral researchers and visiting scholars (see **Grants & Research Activities; Graduate Students and Postdocs**).

Research and Scholarship: The research portfolio of the [KBS faculty](#) encompasses the breadth of ecology and evolution from basic to applied research, includes expertise in empirical, quantitative and theoretical approaches (see **Faculty CVs**). As a research and educational facility we have a national and international reputation for excellence that is due to: 1) strong interactions among the faculty, the firm grounding of applied research in basic ecology and evolution, and the collaborations with or faculty from MSU and elsewhere; 2) the integration of field and laboratory observations and experiments enabled by the unique and often shared facilities that KBS provides, and 3) the focus on place-based research, with researchers overlapping on projects because they are in residence and working in the same field sites.

The productivity of KBS faculty and impact of their research is outstanding. The faculty publish in leading journals – ecological, disciplinary and multidisciplinary. In the past 10 years, KBS faculty have published papers in *Science* (8), *Nature* (4), *PNAS* (8) and several Annual Reviews (3). An Academic Analytics (2016) comparison of the 85 Ecology and Evolutionary Biology departments nationwide lists KBS 1st for percent faculty with grants, 5th for citations per publication, 11th for number of grants per faculty, 14th for grant dollars per faculty and 20th for citations per faculty. Since 1959 we have tracked publications based on research performed at KBS and there are nearly 2000; of these over 225 have been cited 100 times and 50 more than 300 times. The 10 most highly cited publications done at KBS (all cited over 800 times), include research by both KBS and visiting researchers (see **Grants & Research**)

Professional Contributions, Awards and Service: The professional contributions and scholarship of KBS faculty have been recognized by MSU and professional societies: two are University Distinguished Professors, one is a Hannah Distinguished Professor, three have been named MSU Foundation Professors and several have received Outstanding Faculty awards from the University. Several have been named Fellows of professional societies (AAAS; Ecological Society of America; American Academy of Arts & Science; Soil Science) and two were recognized as outstanding young investigators by the American Society of Naturalists. The KBS faculty also are active in professional service, serving as journal editors and officers, on review panels and involved in national and international advisory boards (details in **Faculty Accomplishments & Service**). KBS faculty are well integrated into their campus departments and programs, including sharing PI status with campus-based faculty on grants, serving on elected advisory committees, and as members and chairs of important committees (graduate affairs, seminar, curriculum). They also have served on (and chaired) search committees for new faculty hired into their ‘home departments’. They play a key role in the interdepartmental Ecology, Evolution and Behavioral Biology (EEBB) interdepartmental graduate program, by teaching in many of the core courses in this program and serving on the Executive Committee and other important committees (see **Faculty Accomplishments & Service**).

V. Grants and Research

KBS provides outstanding research facilities for both resident and visiting researchers and almost all of this work is funded by external grants. KBS faculty are very successful in obtaining funding for their research; nearly all have external grants (NSF, USDA, EPA, DOE) and most have had continuous funding from these agencies. Several have multiple awards and collaborations with both MSU and non-MSU research groups, including large multi-disciplinary collaborations at MSU (GLBRC and BEACON). In addition, KBS faculty have been PI and co-PIs on grants to support education and outreach activities here; most notably the K-12 partnership that has had consistent NSF funding for almost two decades. In total the external grant funding to KBS faculty has exceeded \$53M; of which over \$33M is managed at KBS (see **Grants and Research Activities**)

KBS also supports the research of campus based and other researchers. Over the past five years, almost 200 research projects have been conducted at KBS by individuals or groups from MSU and other institutions (see **Grants & Research Activities**). Of these, the majority were from MSU (67%) and approximately 50% were faculty in CANR departments with another 20% from MSU Extension. The agricultural lands of KBS, particularly the large experiments affiliated with the LTER and GLBRC are a major focus of the research activities at KBS by MSU and other faculty. A number of campus researchers have projects in the successional fields at KBS and Lux Arbor (LAR) focusing on restoration of native grasslands, including new faculty in ENT, IBIO, FOR, and PLB, one of whom (Brudvig (PLB) has established research here as part of a new CAREER grant. The unique facilities at the KBS Experimental Pond Lab attracts faculty from outside of MSU, several of whom have multi-year projects here. The non-MSU faculty doing research at KBS come from a broad range of institutions, including research intensive universities, small colleges and private industry (few – mainly at the Farm). We also host educational projects here in collaboration with staff at nearby nature centers. The growing number of visiting scientists, students, and teachers utilizing KBS facilities increases our competitiveness for funding from the NSF FSML program and illustrates our visibility as a hub for research and leadership in ecology and evolutionary biology.

VI. Instruction and Training

Courses: All KBS faculty (except the Director) contribute to campus teaching during the academic year through the department through which they have a tenure (or tenure-stream) appointment and admit graduate students (see **Faculty Contributions**). Most teach at the graduate level and are important contributors to the EEBB program by teaching in core courses required of students in this program. KBS faculty also teach upper-level undergraduate courses in their home departments. Graduate seminars focusing on emerging areas of research led by KBS faculty often attract campus-based students. We use video technology to connect from KBS to campus-facilities so these students can attend. For the past five years KBS has organized a “[Career Pathways](#)”

seminar for graduate students (and research associates) that focuses on professional skills needed and opportunities in careers within and outside the academy.

Graduate and Postdoctoral Training: Graduate and Postdoctoral are important components of the educational mission of KBS and promote a vibrant learning community of diverse, multidisciplinary interests.. We recruit exceptional students who are competitive at MSU and nationally for recruitment and research fellowships; over the past 5 years over 70% of the 34 students entering PhD programs have received a recruitment fellowship, including 8 with NSF pre-doctoral fellowships. KBS graduate students are also successful in obtaining funding for their research from NSF or USDA (8 DDIG or equivalent) as well as continuing and research fellowship support from MSU (over 80%). Fellowship funds from the NSF GK-12 grant (ended in Dec 2016) and the MSU Graduate Schools have been very important in providing funding for KBS students. A unique partnership with K-12 teachers in 12 surrounding school districts has fueled the GK-12 grant and also provided our graduate students with unique teaching opportunities. The training and experience that KBS graduate students get and their involvement in interdisciplinary research has made them very competitive for postdoctoral and research positions in industry as well (see **Grad Students & Postdocs**)

Postdocs come to KBS to work with specific faculty and we attract a large number of international postdocs (and visiting scholars). The interactive environment, strong mentoring (including participation the ‘Career Pathways’ seminar) and ability to collaborate with faculty outside of their primary research lab prepares postdocs well for academic positions; over 90% have moved onto academic positions (16) or another postdoc (4) after their appointments at KBS. (see **Grad Students & Postdocs**).

Summer Academic Programs: During the summer, the size of the KBS academic community more than doubles. This includes a growing number of undergraduate students taking summer classes and involved in research or professional internships (including REUs; see **Academic Programs**). There are also a growing number of visiting graduate students in residence in the summer – some for several months to conduct research, others for a few weeks to take a short course (e.g. ELME or EDAMAME); others come for 2-3 days over the summer to conduct research or to participate in the [‘Eminent Ecologist’](#) seminar.

Over the past five years we have modified our [course offerings](#) and schedule to better meet the needs and interests of MSU students. This includes increasing course offerings from Fisheries and Wildlife and a writing course. While many of the KBS courses are also offered on campus, the KBS offerings appeal to students because they include field trips, hands on learning and introduction to research. The small size of KBS courses and opportunity to live in residence also provides a unique learning experience that is particularly beneficial to students from under-represented groups or first generation undergraduates. It also allows transfer students – or those who switch majors - to catch up on the courses required for their major. For example, the “Launch Your Major” program, combines courses in introductory biology and statistics and provides students the opportunity to learn and use quantitative tools in their biology courses. Field Ecology and

Evolution (IBIO 440) offers students a structured research experience that includes reading literature, designing and conducting a field study, presenting the results and writing a grant proposal.

Research and Professional Experiences: We offer two types of research internships for undergraduates at KBS: REU (Research Experiences for Undergraduates) and URA (Undergraduate Research Apprenticeship). The [KBS REU program](#) is supported by a NSF site grant and supports 10 students (non-MSU) looking for an independent research experience. An additional 2-7 REUs (supported on faculty grants) also participate in this program. The [URA program](#) provides MSU students with an introductory research experience where they assist a graduate student or postdoc mentor with a project and take field courses at KBS. URAs are encouraged – but not required – to develop an independent project. A high proportion of URAs go on to REU or other research experiences, and we encourage them to present their research at the KBS summer symposium and campus research forums (see **Academic Programs**) Both URA and REUs are paid, provided free room and board (11 wks), funds for research. REUs also receive a travel award and both are eligible for travel funds to attend a regional or national meeting to present their research.

Both the URA and REU programs provide important opportunities for KBS to broaden participation and increase retention in STEM. Our goal is to have at least 50% of the students in these programs be from under-represented groups, or first generation students. Working with MSU diversity programs and colleagues at HBCUs and other minority serving institutions we have been reasonably successful in meeting these goals: of the 2016 REUs 70% self-identified as women, 70% as from underrepresented racial or ethnic group in STEM; 61% were from Historically Black Colleges and Universities (HBCU) or Hispanic Serving Institutions (HSI). While only about 30% of the MSU students in our programs are from under-represented groups, many of these are first generation and an additional 20% are transfers from community colleges (see **Academic Programs**) We continue to work with MSU programs that recruit and retain students from under-represented groups in STEM, particularly the DOW and DREW STEM scholars programs in CNS, to attract students to KBS.

We also provide mentorship training for graduate students and postdocs, working with resources at MSU that are also aligned with national programs in mentoring. This is important because the KBS field and living experiences can be quite foreign to many of our mentees; also even highly motivated mentors may not have the skills needed to be successful in mentoring students from diverse backgrounds and experiences. Mentors also meet informally with the Academic Program Coordinator throughout the year to discuss challenges and opportunities. To encourage graduate students to work with students we provide a stipend (\$1000) for each student they mentor and travel funds to attend a national meeting with their student.

We also offer 8-10 professional [internships](#) each summer in areas ranging from animal care, to landscaping, to environmental education, to community relations/marketing. These positions are typically mentored by KBS staff, and the units contribute to stipend

and room and board; some funding for internships also comes from campus departments. The internship program allows us to attract to KBS students who are not science majors, but by including them in the KBS science community, they gain an understanding of research and science that they would not likely get at MSU. These students also present at the Undergraduate Symposium and along with REUs and URAs participate in a weekly professional development seminar.

VII. Science Education and Outreach

KBS has a strong focus on public outreach, community engagement and extension that began with programming at the Kellogg Bird Sanctuary (established in 1926) and Farm (1928). Today, outreach programming at KBS is focused on environmental literacy and science education and is led by a Specialist who works closely with KBS to coordinate existing programs and to develop new science education programs in partnerships with campus departments and centers. While only one KBS faculty member has an Extension appointments, we work closely with MSUE Institutes to communicate and translate research by KBS faculty on environmental sciences, natural resource conservation and sustainable agriculture to regional and state-wide audiences.

[Science Education and Outreach](#) activities at KBS are led by a full-time specialist (Haas) who works with an Outreach Team that includes representatives of all KBS units to identify themes and partners and set priorities for KBS outreach programs. Outreach programs at KBS focus on research done at MSU, particularly KBS, in three areas:

- *enhance public/community understanding of science;*
- *increase the capacity of K-12 teachers to teach science; and*
- *translate KBS research to professionals*

The Kellogg Bird Sanctuary is the destination for 70% of outreach participants and as the original cornerstone KBS is the ideal place to expand programming focused on KBS research (see **Science Education & Outreach**). We have also developed in collaboration with faculty in the College of Education, grant support (NSF and EPA) to support programming in K-12 science education that builds on the commitment of W.K. Kellogg to education. Research conducted at the KBS LTER and dairy has provided opportunities for outreach on how to manage the environmental impacts of agriculture and introduced innovations in agricultural technology (pasture grazing, robotics for milking etc.) [The Dessert with Discussion](#) program, which started almost 10 years ago with funding from the Kellogg Foundation, further enhances our ties to the community and is important in making connections that are important for development..

VIII. Development and Community Relations

Important to the success of KBS is having an effective means for communicating what we do and why to our constituents and supporters. In 2016 we launched a newly designed website, with increased ways to share our story. In the last five years subscriptions rates

of our electronic newsletter has increase 156% and social media has increased our presence both locally and globally. Beyond web-based communication we have focused on communication at a personal level, concentrating on engagement with the KBS Director's Advisory Board and the formalization of the KBS Alumni Relations Program (see **Development and Communications**). KBS has an ambitious Empower Extraordinary campaign goal (\$8.2M) designed to align with CNS, CANR, and MSU priorities. As of March 2017, we had reached 44% of our fundraising goal for the campaign, including the establishment of a graduate fellowship, a graduate research endowment, an expendable scholarship, and a leadership gift towards the Kellogg Bird Sanctuary facility project. As our communication efforts have been more focused, succinct, and MSU branded, donor engagement has increased by the number of individual donors and the donation amounts to KBS.

IX. Vision and Future Investments

Over the next 20 years we envision KBS as a research and education Station that builds on current strengths in basic research in ecology and evolutionary biology and will deepen and expand the applications of these disciplines to conservation, restoration and agricultural ecology. More than ever society will need novel approaches to recalcitrant environmental problems, and KBS is uniquely positioned to contribute to the fundamental knowledge that will underlie solutions to those challenges, especially those that relate to the intersection of activities and ecosystem services that can be delivered from managed and unmanaged landscapes. Having a resident faculty at a biological field station will allow the exploration of these areas of research and expand educational experiences for students in ways that are not possible in a campus-based program.

To realize this vision will require new investments from MSU, donors, and foundations so that KBS can continue and expand its roles as a hub for research, education and outreach activities focusing on both basic and applied questions in ecology and evolutionary biology important to addressing the environmental challenges outlined in a number of recent NRC reports. In the near term, there are exciting opportunities to expand our collaborations with faculty, departments and programs in the Colleges of Agriculture and Natural Resources (CANR; lead) and the Natural Science (CNS). There are also potentials to foster (or renew) collaborations with faculty in the Colleges of Education (particularly for K-12 and K-16 educational research) Social Science (coupled human-natural systems) that will increase our impact nationally and internationally. Hiring faculty based at KBS who can lead and foster research in these areas is critical to our continued success and to further advancing the reputation of MSU for leadership in fundamental science of ecology and evolution and the applications of this to growing environmental challenges, locally, regionally, nationally and internationally.

Maintaining a vibrant research community at KBS: Over the next three years we anticipate three KBS faculty retirements: Doug Schemske (Hannah Chair, joint in PLB) has retired (Feb 2017); Gary Mittelbach (Professor, joint in IBIO) will retire in May 2018; Kay Gross (Director and University Distinguished Professor) will be retiring as

Director in August 2018. Also, recent changes in assignments of current KBS faculty will impact our capacity to maintain a vibrant research community here. Phil Robertson has recently taken on a 50% assignment as one of two Science Directors for the GLBRC (1 Jan 2017), which will impact some of his involvement in KBS academic programs. Pending the identification of space, two KBS-based faculty (Klausmeier and Litchman) plan to relocate their labs to campus as early as next year, and Getty (currently chair of IBIO) is also likely to discontinue his KBS appointment in the next year.

This loss of senior KBS faculty will have a significant impact on the research and intellectual environment but also could provide opportunities to expand faculty expertise. To begin to address this we are searching for a senior hire in Terrestrial Ecology (interviews in Feb-March 2017). This is a Global Impact Initiative (GII) funded hire, and is expected to both strengthen the research in terrestrial ecology at KBS and provide leadership in the KBS LTER. We expect that this person will be at KBS by August 2018 (perhaps earlier). Discussion regarding the search for a new KBS Director (Professor) is underway, and we are optimistic that this position will be posted in late spring, allowing for interviews in Summer 2017. We expect the search for the Hannah Chair can begin soon after the new Director is hired; this position has an affiliation with KBS, but the person hired is not necessarily KBS based.

Several emerging fields and opportunities for future funding in ecology and evolutionary biology guide our vision for future faculty hires at KBS. The land base, long term experiments and facilities at make us uniquely suited to support the research of faculty with the experimental, statistical and understanding of natural systems to address important environmental challenges and contribute to the expansion basic knowledge in these fields. Also having faculty here who are pursuing research that links data from different levels of biological organization - genes to ecosystems - and able to extrapolating ecological knowledge to regional and global scale processes will open new arenas for research at capacity and foster stronger relationships with campus programs in water science and food systems. There are new initiatives for federal funding (USDA LTAR, DOE; NSF INFEWS and Macrosystems) to support research in these areas that will build on the capacity of KBS to lead and foster interdisciplinary research related to bioenergy, food and water quality.

Faculty at KBS have identified five emerging areas of research in ecology and evolutionary biology that should be targeted for future faculty hires here. These are listed and briefly described below (not in priority order). All would strengthen the core faculty research excellence at KBS in ecology and evolutionary biology, provide opportunities for collaborations with campus faculty and strengthen interdepartmental EEBB and ESPP graduate programs. While opportunities have been identified for new senior hires (GII, new Director, Hannah Chair) at KBS, it is important to have young faculty in residence at KBS. So we propose that searches for these positions be at the assistant professor level. We are open to working with other units to attract established scientists in these areas.

Field evolutionary biology: Exciting advances that synergistically combine classic field studies and experiments with genomic technologies provide unprecedented opportunities

for understanding evolutionary processes that can play out over surprisingly rapid time scales. The facilities and land base at KBS would provide unique opportunities for a faculty hired in this area and would broaden the expertise in evolutionary and ecological processes that would enhance graduate training at KBS.

Community Ecology: Hiring a community ecologist at KBS who can capitalize on the extraordinary opportunities here to test ecological theories by studying biodiversity in natural and managed landscapes would maintain a strong tradition of research in this area at KBS and MSU. There are exciting opportunities to address questions that link theoretical and empirical work regarding the causes of diversity patterns at regional and global scales and the consequences of climate change to these patterns.

Population dynamics: Research in population dynamics relies on large, ideally long-term, biological datasets and sophisticated mathematical models to develop a mechanistic understanding of how populations respond both ecologically and evolutionarily to their environment. A new KBS hire in this area would have considerable opportunities for collaborative research that take advantage of data from long-term experimental and monitoring studies here on a variety of species and systems.

Spatial ecology: The extension of experimental results and observations from local to broader spatial scales is essential for understanding large-scale ecological processes, landscape and regional changes, and addressing global environmental challenges. A faculty hire in this area would bring to KBS someone who will advance ecological theory through analysis of multi-scale spatial data and promote further collaboration with GLBRC and LTER research teams focused on sustainability, regional analyses, and macroscale processes that link food-energy-water.

Social-ecological systems: KBS is in an ideal location for studying coupled natural-human systems, with a rich diversity of research on both managed and unmanaged habitats. This faculty position would add new dimensions to existing KBS research, especially in agricultural ecology, global environmental change, and conservation, and would also provide new linkages to campus departments not now affiliated with KBS.

Support Personnel: It is important to recognize the significant impact KBS has on the surrounding community and to invest in outreach and educational programs that assures that we continue to invest in public understanding of science and the environment. Similarly we have seen exceptional growth in the numbers (and quality) of MSU students applying to summer academic programs at KBS as a result of having developed strong partnerships with advisors in CANR and CNS departments. Critical to our ability to continue and grow Outreach programs and strengthen partnerships with campus for academic programs is to have staff in permanent positions that can lead them.

Unfortunately funding for the two specialists positions that coordinate Science Education & Outreach (Haas) and Academic Programs (Zoellner) at KBS is highly depended on grants or non-recurring allocations While we expect that given the national prominence of KBS programs in these areas we can/will be able to fund these position in part (up to

25%) with external grants; both are now highly leveraged (65% for Haas, Outreach; 75% for Zoellner, Academic Programs). This creates uncertainty and instability for the future of these positions which could be addressed by having more general funding (CANR, CNS, MSUE) for this important positions at KBS.

Academic Programs Coordinator: This position plays an important role not only in assuring that KBS summer programs support the needs of MSU students, it is also critical to our ability to recruit, mentor and support students from under-represented minorities in KBS programs.. For example, while only 30% of the students in our URA program in 2016 were from under-represented groups, the KBS academic program coordinator was able to obtain a commitment from the Dow STEM scholars program to partially support two Dow students at KBS in 2017. Similarly we have had support in the past (and hope to again this year) to support DREW students (a CNS program) to take courses at KBS. We are also involved in a newly funded NSF grant for the Michigan Louis Stokes Alliance for Minority Participation (MI-LSAMP) program at MSU. A KBS experience can/does provide a life changing – career affirming – experience for all students that can be especially impactful for first generation and under-represented students (see NRC report)

Science Education and Outreach: We have invested significant effort over the past five years to better align the outreach programs at KBS to communicate the research done by KBS faculty and others at MSU that reflects our mission. There has also been significant investment in developing professional development programs for K12 teachers, and more recently an emphasis on expanding this for elementary teachers. While we have been successful in obtaining grant funds for these programs – and part of that funding has been to support staff – several of these large grants are ending (e.g. NSF GK-12). Funding from MSUE for outreach programs at KBS would be important for us to continue to work with and support Extension programs in the Greening Michigan (GMI), Agriculture and Agribusiness (AABI) and Children and Youth (CYI) Institutes.

Graduate Support and Fellowships: While KBS faculty have been very successful in obtaining training and research grants to support graduate students, the number of training grant opportunities is shrinking and research funding increasingly competitive. Fellowship support for graduate students in residence at KBS would provide a bridge for students when grant or other funding lapses and also allow us to fund their involvement in outreach and educational programs such as the K12 partnership and to pursue opportunities for “citizen science” programs that our current staffing cannot support. We would also like to have research fellowships for KBS graduate students that can complement funding that is available (and KBS students have been very competitive for) from MSU and federal agencies (see **Graduate Fellowships**). Development activities to establish and support graduate fellowships at KBS have had modest success, and we look forward to working with MSU advancement to pursue other opportunities for this.

Infrastructure: While the research facilities at KBS are exceptional by the standards of most biological stations, they are aging and this is beginning to limit our ability to support research work of non-KBS faculty. With new faculty hires we can (and do) make investments in new equipment and update labs, but these improvements expose the

limitations of our facilities. For example, we have recently had to upgrade HVAC and airflow to labs in the Academic building to accommodate new equipment. As a biological field station we can apply for, and have been successful in obtaining, grants from the NSF Field Station and Marine Labs (FSML) program to improve facilities at KBS. Over the past 10 years we have been awarded over \$725,000 (all direct costs) from FSML to update, renovate, construct new facilities (a research greenhouse) and improve connectivity. We have a pending FSML grant that will provide funding to expand and further develop the new Molecular Ecology and Genomics facility at KBS (\$240,000.).

We have also been successful in obtaining funding through MSU TLE (Teaching and Learning Enhancement) to improve classrooms, technology and equipment used for teaching (\$162K over the past 5 years). The past three years MABR has had non-recurring funds available to improve research capacity in units who have faculty with MABR appointments. While we have been successful in obtaining funds from MABR (~\$380,000 over the past 3 yrs, including \$25,000 for a graduate recruiting fellowships), there are few KBS faculty the MABR appointments (~1.3 FTEs) and so this limits our competitiveness for these funds. While we can (and will) continue to pursue external funding to improve and expand the research capacity of KBS, we will need support from MSU to both identify possible donors and help us leverage the investments we have to update and improve the KBS facilities in support of research, teaching and learning.

There is also a need to improve housing facilities at KBS for visiting researchers – including faculty (some of whom have families and want to be in residence for several month over the summer), postdocs and technicians. Although we have recently dedicated some of the housing in the KBS rental pool (managed by Physical Plant) to visiting researchers, the demand is outstripping the availability. KBS housing is at capacity for several weeks in the summer, making it challenging to provide short term housing for seasonal staff (including those how work with KBS faculty) and conference groups. While in some ways it is good to have a ‘housing shortage’ at KBS, it limits our capacity to support research of non-resident faculty, their students and postdocs.

Bird Sanctuary facilities: For over 90 years the Kellogg Bird Sanctuary has been a focus of outreach and educational programs at KBS and it continues to be so (see **Outreach**). However the facilities at the Sanctuary are aging and limit our capacity to develop education and outreach programs. There is also limited accessibility – it is not ADA approved and it can be a struggle for older people and families with young children to access the trails of the Sanctuary. We have been exploring the opportunity to remodel and update the Sanctuary and have included funding for this in our Capital Campaign. Small gifts have allowed us to begin this project by removing overgrown vegetation and putting in native plantings and improving the Overlook. We have a commitment for a lead gift to this project and are working with Advancement/Development staff in CANR (primarily) and CNS to identify others in the community and foundations that can contribute to this project. Enhancing the Bird Sanctuary facilities is important to the growth and impact of Science Education and Outreach programs for all of KBS.