

Kellogg Biological Station Review

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Thank you for the opportunity to visit Kellogg Biological Station for this review. We appreciate the extensive documentation provided prior to the visit, and all the hospitality shown to us during our visit. Prior to the review, none of us was aware of the rich portfolio of activities and diverse facilities that make up KBS. We all came away impressed with the station's leadership, the commitment of the faculty, staff and students, and the extensive contributions of KBS to research, education and outreach.

We provide responses below to the questions posed, along with some recommendations. The time provided on-site did not allow for an extensive review of all areas, especially subjects such as availability of fiscal resources, the university's budget model and curricular policies and structure.

Questions related to Research and Scholarship

What unique assets with regard to research scholarship and extramural funding does KBS bring to MSU?

KBS itself is a unique asset for MSU, the Midwest and the country. The faculty, staff, and students at KBS are effectively fulfilling the goals of research, teaching, and outreach expected at a land grant university; in many cases, they are achieving these goals at a remarkably high level. It is clear that this is due to the excellence of the faculty, administration, and staff, including the sense of community they have created; the unique land and facilities at the field station; and the residential nature of the field station.

KBS is remarkable in how it has responded to the research opportunities presented by a residential field station. KBS has a 40+ year history of impactful research in ecology, several decades of innovative long-term research on the ecology of agricultural systems, and a more recent history in innovative agricultural research. Historically and currently, KBS has excelled in performing manipulative experiments in natural settings and over highly replicated, large experimental units to answer questions in ecology and evolution that cannot be answered in the lab alone. The early community ecological work at KBS was recognized for making contributions that could not have arisen from either small-scale laboratory experiments or large scale field surveys, but required a level of understanding that can come about only by doing experimental research at multiple temporal and spatial scales, as is possible only at an institution that combines field and laboratory facilities. The impact of this work has made KBS researchers unusually competitive for NSF grants, which has expanded into being successful with large grants from other federal agencies as well. The KBS overview provided to the reviewers included an impressive listing of high-impact papers in the primary literature resulting from this research.

The sense of community at KBS is palpable. The faculty, administrative groups and graduate students feel as if they are parts of close-knit families, and those distinct families interact well with and support each other. Faculty stated that this strong sense of community has characterized the residential faculty for many years. Rather than being a unique attribute of the current composition of the faculty, it appears to be built into the culture, the DNA, of KBS. The grad students and postdocs feel like members of the larger family, and appreciate the ready access they have to faculty.

The strong community nature of KBS is attributed largely to having scholars in residence who have a common focus in evolutionary, ecosystem, and agricultural ecology. Without the residency component, it is unlikely to have developed or to be sustained. As stated by one faculty member, “we are always on a retreat.” As scholars in residence, away from the bustle and distractions of the main MSU campus, the faculty can focus their interactions, and think creatively and productively about current problems and future opportunities.

A strong sense of professional community both enhances, and is enhanced by, productive research activity. The residential community facilitates interaction and synergy, which in turn promotes creative science, which feeds back to build community.

The tight-knit, residential community of scientists has enabled leveraging of one large scale research project into another. The NSF LTER (agricultural ecosystems) provided the research platform that facilitated location of the DOE GLBRC field site here, and both helped leverage establishment of KBS as a USDA LTAR site. In many ways, much of the world-class science of KBS, unique in magnitude and scope, traces back to a residential community of scientists.

What are the developing scientific questions and directions that biological field stations in general and KBS in particular are uniquely positioned to address?

Biological field stations, in general, specialize in site-based research that can generate long-term data sets. They organize around a community of researchers working in a common place, which allows comprehensive understanding of the underlying processes. Research questions can be answered at spatial and temporal scales at which the relevant ecosystem processes are taking place, and which would be difficult to achieve without resident scientists. KBS researchers are positioned to address high priority research needs of the future, including:

- Microbial community ecology and the soil microbiome: linking diversity to function
- Natural selection in real (ecological) time; temporal/spatial variation as drivers of selection
- Use of a systems approach in agroecology – e.g., pasture grazing/dairy systems, including interaction of soil and bovine digestive microbiomes
- Ecological and evolutionary responses to human impacts (e.g., climate change; invasive species)

What components of research and scholarship carried out at KBS can only be carried out at a residential field station?

A residential faculty allows for science to be done at temporal and spatial scales that could not otherwise be accomplished (e.g., frequency and intensity of sampling; fewer hindrances due to seasonality, etc.). Faculty, postdocs and students all greatly benefit from having field, greenhouse and laboratory research facilities in close proximity to each other, enabling research that could not be accomplished if researchers were based on the main campus.

A residential faculty allows for projects of considerable magnitude (LTER, GLBRC) to be undertaken. These would not be possible if faculty, postdocs and students were not located nearby. A residential faculty allows research and teaching/mentoring to be integrated to a degree not otherwise achievable.

Finally, the review team learned that the residential nature of the KBS facility is a major draw in the recruitment of faculty. Several faculty mentioned that they would not have been as inclined to join the

MSU faculty if their appointments were on the main campus. Given the overall stellar productivity of the KBS faculty, the value of this strong draw of topnotch faculty to an acclaimed research station should not be underestimated.

What components of research and scholarship carried out at KBS could be carried out at a non-residential field station?

Individual elements and selected components of many studies could likely be carried out at non-residential field stations. What could not easily be accomplished are the large, integrated, sampling-intensive studies characteristic of KBS nor could studies incorporating a temporal scale beyond that of the growing-season. Having researchers in residence also makes it possible for immediate laboratory analysis of field samples, which is necessary, for example, in research on microbial ecology. At many universities, fiscal and academic barriers can hinder cooperation among departments and colleges, but the KBS residential model inherently breaks down many of those barriers to allow fully integrated projects.

Most “non-residential” biological field stations are residential during summer months, and research is limited to those months. Researchers can use these facilities only if they are able to move from their main residences for the summer, which may be limited by 1) family needs, 2) financial constraints, and 3) being away from their main research laboratory. Thus, research in non-residential biological field stations is generally much more limited in scope.

What components of research and scholarship carried out at KBS could be carried out on the main campus at MSU?

We will restrict our answer to greenhouse and laboratory research, as we are not aware of the extent to which the main urban campus provides space for field plots. Much of the greenhouse work conducted at KBS could likely be conducted on campus with sufficient new facilities. The complication would come in transferring large numbers of plants from the greenhouse to the field, and vice versa. For example, the research of one faculty member addresses pollination; plants are brought to flowering in the greenhouse and then deployed to field sites. That can readily be accomplished if the pots can be hand-carried or carted to field sites, whereas travel within a vehicle has much greater potential for pollen loss and inadvertent cross-pollination. Finally, most of the laboratory research (e.g., molecular genetics/genomics and chemistry) could be done on campus, and in some respects campus facilities may be better equipped. On the other hand, faculty mentioned that the close proximity of labs to field sites allows them to collect samples in the field, analyze them the same day, and return to the field to collect additional samples if warranted. Further, research on Automatic Milking Systems (AMS) could be carried out at the campus dairy farm if the expensive technology were replicated there. However, it would be unlikely that one could devote as much land near campus to allow for the very unique integration of AMS and grazing systems.

An interesting exercise would be to determine which of the high-impact studies completed by and federal grants awarded to KBS researchers would have been possible with research out on the main campus.

What is the critical mass of faculty and staff required to maintain an intellectually stimulating and scientifically productive environment at KBS?

A critical mass of faculty for KBS is probably between 10 and 15 scholars. A larger cohort could not be supported by the current facilities and runs the risk of fracturing into groups, losing some of the benefits of a small community as outlined above. Each faculty member is probably most productive with a lab group of 5-10 people (including graduate students, post-docs and technicians) and with the associated general staff needed to run the research operation.

Are there programs/activities at KBS that should be considered for building upon?

As outlined above, there are several important research foci that could be considered for future directions. Replacement of impending faculty retirements will be important to keep KBS at the cutting edge of ecology, evolutionary biology and agro-ecology. The quality and quantity of research conducted by KBS faculty is excellent, by any of several comparative standards.

Are there programs/activities at KBS that should be considered for reduction/elimination?

The onsite review did not allow time for assessments of individual research programs of faculty. We are unaware of smaller projects/activities that may not be mission critical. Tours emphasized the large, collaborative projects such as the NSF LTER site, NSF aquatic ecology facility, DOE GLBRC plots, and the integrated pasture dairy system. All of these programs appear to be thriving; many incorporate scientists from outside MSU, and all provide platforms for important, large-scale, and interactive research.

Are faculty and programs at KBS well integrated into the faculty member's home departments and other programs/activities in East Lansing?

KBS has good facilities for video conferencing and communicating with units on campus. Faculty travel regularly to campus for teaching in the fall and spring semesters. It was noted by several that this commuting time is typically shared by several faculty and graduate students, allowing for informal research discussions and mentoring. Although not discussed extensively, faculty seemed to be comfortable with the mentoring they are receiving in the tenure and promotion process, and residential faculty have been successful in earning tenure and promotion. Graduate students also seemed well supported in their professional development and several are engaged with campus-based graduate student organizations. The review team anticipated that faculty and graduate students would feel disconnected from important activities and opportunities on campus, and was surprised to learn that they do not. Without opportunity to interview faculty from home departments on main campus, the review team cannot comment on whether home departments consider KBS faculty and students to be appropriately integrated.

Main campus faculty involved in ecology and evolution research appear to be increasingly interested in basing some of their research at KBS (which is possible only if there is a core of resident researchers building and maintaining research infrastructure), which suggests a good integration of faculty. At the farm/dairy, however, there appear to be resources at that are not being fully utilized, especially by campus-based research and Extension faculty. It is unclear why campus-based faculty are not more involved with new and ongoing agricultural research at KBS. Our limited time did not allow us to fully understand these reasons, but we encourage you to examine any barriers that may be preventing involvement and seek to remove any obstacles and perhaps to incentivize such collaboration.

Recommendations related to Research and Scholarship

- Hire faculty to replace retirements and maintain a critical mass of 10-15 faculty in residence
- Hire faculty in areas that will keep KBS research at the cutting edge of ecology, evolution, and agricultural ecology
- Clarify the long-range plan for hiring faculty into critically important research areas. The KBS document describes hires in classical disciplines of ecology (e.g., community ecology). Faculty informed the review team that these general descriptions are by design, enhancing their capacity to hire the very best scholar. Nonetheless, we recommend that the faculty identify critically important research needs for the future in the context of those classical disciplines.
- Reallocate or find new sources of funds for graduate student support; graduate student support is the number 1 concern of faculty – CNS and CANR need to be intentional in allocation of university-based and/or college-based funding for graduate education to include faculty and students at KBS; other options might be TA appointments for online courses, which would allow the graduate student to remain in residence at KBS; it should be noted that Graduate students feel Kay Gross does an excellent job of finding small pools of funds to help them execute their research projects
- Develop a long-range plan, with MSU physical plant, for improvement of aging facilities; KBS should continue to be aggressive in seeking funds for facility improvements
- More centralized support of IT is needed for KBS, in both staffing and long-term data security

Questions related to Outreach and Development

Are opportunities for development/fund raising at KBS being realized? Are there opportunities to better utilize the unique aspects of KBS to attract major gifts?

There appears to be unrealized potential for development/fund raising at KBS. Opportunities depend on the availability of resources and priorities of central advancement and the colleges. Some suggestions include:

1. Utilize central advancement services for additional foundation fund raising support.
 - a. Review list of current research funders (mainly foundation) to see if there is the possibility of a larger relationship.
2. Utilize central advancement services for additional planned giving support.
 - a. Include estate / planned giving information in all KBS appropriate materials (newsletters, brochures, website, etc. (WK Kellogg Manor House Endowment Brochure has no reference to planned giving).
 - b. Introduce a gift planning educational session to volunteers and as part of educational outreach sessions.
3. Utilize central advancement services for additional prospect research information on individuals living around Gull Lake.
 - a. Once list is secured, utilize volunteers, Advisory Board, etc. to discuss engagement strategy.
4. Begin internal discussion around a fund raising initiative related to the upcoming retirement of Kay Gross.
5. Create and implement systematic process to annually provide names and contact information of KBS friends (volunteers, members, attendees, alumni, etc.) to University Advancement in order to be added (and coded) in the University database. Reach back during first year on implementation.

6. Expand Sarah Carroll's role to include major gift fund raising work for KBS and possibly for MSU in the region.
7. Review Director's job description to reflect needed percentage of time allocated for fund raising and engagement.
8. KBS provides unique opportunities for public-private partnership.
9. Consider Farm Show events at KBS related to different themes (agricultural system, agricultural sustainability, agricultural sustainability for food companies hosted by Kellogg's, etc.).
10. Host influential campus groups, e.g., Foundation Board, Board of Trustees, President's Cabinet, Athletics, for an event to showcase the facilities.
11. Continue relationship with WK Kellogg Foundation – stewardship for right now.

What is the value of KBS for outreach to the local community?

There are many examples of active and popular outreach programs being carried out at KBS and provide a window for the local community and others to understand the importance of KBS programs. Examples include:

- Bird Sanctuary programs
- Dessert with Discussion
- KBS K-12 Partnership
- Social media
- Training for professionals (see Extension)

Should community outreach be a major element of the KBS vision/program?

Community outreach is needed to maintain KBS's "license to operate" and is critical for supporting volunteerism (an annual value of \$65,994). The Advisory committee plays an important role for two-way communication with the community. It is not currently used as a sounding board for financial decisions, but members indicated a willingness to provide that advice for outreach programs, especially those related to the KBS heritage, such as operations of the Manor House. There may be a service learning opportunity to provide offsite problem solving by students trained at KBS locally, regionally, nationally, or internationally.

Should MSU Extension have a stronger presence at KBS?

No one we encountered at KBS was opposed to this opportunity; it appears to be not so much a KBS issue, but an Extension/CANR issue dating back to downsizing of Extension. There are many professional training opportunities afforded by KBS where Extension could be involved including topics such as:

- Ecology and pasture management
- Climate change
- Sustainable use of nitrogen

A stronger Extension presence at KBS would make use of the unique opportunity of a Biological Station/Ag Research Station combination. KBS fosters truly multi-disciplinary research and integration of Research/Teaching/Extension and provides opportunities also for campus-based Extension specialists. Other areas to consider include organic dairy production (whether certified organic or not), animal health in organic systems, natural resource economics and ecosystem valuation.

Having an area Extension educator (dairy, forage, or agronomy) located at KBS would foster transfer of knowledge from KBS to the state. This position could potentially transition to be self-funded through Extension and applied research grants. It is critical that Extension funding be allocated to support one or more individuals that are fully connected with the MSU Extension system and devote a significant portion of their effort to the continuum of Extension from applied research to technology transfer and program evaluation. Piecemeal funding minority portions of multiple staff presently involved in outreach is very unlikely to maximize contribution to Extension's mission.

There also may be an opportunity for 4-H SPIN Clubs organized around ecology, evolutionary biology, agro-ecology, conservation, etc. given the growing 4-H interest and funding in STEM (Farm, Bird Sanctuary, pollinator garden, etc.). This would further foster community engagement.

How do hospitality activities (weddings, conferences, workshops) affect the research and scholarship activities at KBS?

Management time to supervise/operate these facilities takes time away from other functions. However, this is a historic location of significance. If operated well and near break-even, continuing these functions stands to earn a heap of goodwill for KBS.

The review team was not provided with sufficient information to assess the financial viability of hospitality activities. Increasing or decreasing such activities in the future should be guided by whether they are break-even, positive or negative in terms of revenue generation and whether they detract from management time better devoted to KBS critical missions. We felt that more effort in marketing could increase the use of conference and event facilities during off seasons.

Refurbishing the apartments could make them more attractive to students and create more hospitality/conference business in the shoulder seasons. Finally, there appears to be strong community support for MSU to maintain the venue. Could MSU campus programs in Hospitality Management play a role in maintaining the facilities while advancing educational opportunities?

Questions related to Instruction

Do the summer educational programs provide unique opportunities for instruction that cannot be duplicated on campus? Could they be improved? If so, how?

Field based courses are always a unique opportunity for instruction and cannot be readily duplicated on campus. The Ecology course with lab (IBIO 355/355L) taught in the summer is a much richer experience that includes authentic research as compared to the course during the fall or spring semester on campus. Although the size of the cohort who can take such a course at KBS is naturally limited, the richness of the experience is hard to match, and is especially valuable for students who aspire to careers in ecology and natural resource conservation. Other courses that are uniquely taught at KBS offer authentic field-based research experiences for undergraduates, and are important components of the curriculum. These experiential education opportunities are considered high impact practices in pedagogical research.

Without more specific details about the courses, expected learning outcomes, etc. it is difficult to recommend improvements. To the extent possible, metrics related to performance in subsequent courses (e.g. for the Launch your Major cohort) and further engagement with KBS as URAs or interns

and matriculation to graduate study (which are being collected) would be helpful in demonstrating effectiveness. It appears the current level of summer course offerings combined with placement in REU and URA experiences has housing and classroom space fully utilized, so without additional facilities, it's hard to imagine much growth in numbers.

Targeted selection for the Launch Your Major program to assure reaching first-generation, under-represented students is recommended. This type of cohort-based program has been suggested to increase retention of at-risk undergraduate populations in other institutions. This program lends itself to the scholarship of teaching and learning in order to identify and demonstrate benefits, particularly in increasing selection of STEM majors and persistence to graduation.

Do the summer programs/instruction provide an appropriate return on investment and/or provide a unique opportunity to attract students who would not otherwise engage in MSU programs?

The metrics described above will help to track return on investment. Evaluation of KBS undergraduate research programs is very strong, especially in comparison to other REUs. Summer programs provide an important and unique opportunity for graduate students to engage in mentoring that would not be afforded without residential faculty and graduate students. Engaging freshmen in URAs is an effective strategy for increasing retention in STEM and will allow these students to make more significant contributions to the research programs of future faculty mentors. REUs attract students who might not otherwise engage with MSU; the professional development program provided to undergraduate and graduate students is an important addition to the instructional programs and has untold benefits for these students in the future; publication and presentation opportunities for students are also valuable in building professional skills.

Are there other ways beyond the summer programming that KBS could engage in instruction during the regular academic year that is meaningful and cost effective?

- Depending on the size of campus-based fall/spring courses there would be opportunities for field trips and/or weekend short courses
- KBS seems like a natural partner for Course-based Undergraduate Research Experiences (CURE) and citizen-science projects
- Boot-camp field labs that could be completed in a week-long intensive session
- Spring break intensive field course
- Service-learning projects for classes and/or student organizations
- Field-based experiences for elementary and secondary education students at MSU to build confidence in using the outdoors as part of the K-12 classroom
- Semester-long residential undergraduate internships, in areas that include research, communications, science education, conference services, event planning, agriculture, dairy science would take advantage of the unique variety of facilities at KBS and engage students from other parts of campus
- Any of these opportunities as well as summer programming could utilize facilities at the Bird Sanctuary and the Farm.

Recommendations related to Instruction

- Additional summer courses may be limited by classroom and housing space

- Targeted selection of participants in summer courses (especially Launch Your Major) to increase participation by first-generation, URM students
- Academic year programming could broadly utilize facilities (Farm and Bird Sanctuary) and provide opportunities for other majors
- Fully fund Academic Programs Coordinator, Science Education Outreach Coordinator and Bird Sanctuary staff

Questions related to Administration

There is very high regard across KBS for Kay Gross as Director. She has been an exemplary leader and scientist. The administrative group experienced major turnover coincident with and soon after hiring of Andrew Widner. The current team all expressed great satisfaction with their work environment and professional colleagues. Kay and Andrew keep the mission foremost; staff are aware of and appreciate that the KBS mission directs and channels activities. They all work well together as a team. The leadership emphasizes versatility, cross-training, and looking out for each other.

The administrative and support personnel feel they run a very lean operation; in fact, what they are able to do with limited resources is impressive. A common theme is that they are resource-strapped and can't afford to do what they would like, or even what is needed, to support the full intent of the KBS mission.

Is the KBS administrative structure appropriate to deliver its core scientific program and maintain a large, complex infrastructure?

While challenging, the benefits of a single Director with overall responsibility for all areas of KBS outweigh dividing the responsibilities into co-Directors or other models. The Director can coordinate and establish priorities of the Academic Program, rather than, for example, Conference Services dictating desires to book events and guests in housing.

With a skilled set of Direct Reports, the Director can manage these rather than deal with the day-to-day functions, so as to focus more attention on other responsibilities of the Academic Programs. However, without permanent support for Academic Program Coordinator and Science Education Outreach positions, maintaining the high quality and impactful professional development, undergraduate research, community education, and outreach programs will be difficult.

Presently the non-academic and academic activities are administered as Unit. Is this organizational structure optimal?

This structure allows for full integration of programs, however, does place a burden of responsibility on the Director that is truly unique to KBS. Shifts in administration of the Conference Services, for example, away from the Director, while benefiting the Director's time and focus on more academic functions, might create problems that do not exist currently (e.g. priority of scheduling academic programs). However, development and implementation of a business model for Conference Services would likely improve financial balance.

Are there significant research, educational, outreach or service opportunities that KBS is not addressing?

- Extending the Bird Sanctuary educational opportunities further than the local region (programming is currently very limited with only 1 full-time staff and absence of ADA compliance).
- Resident undergraduate program (specialized for research projects).
- Increased summer opportunities for Fisheries and Wildlife programs.
- The lack of a faculty member with an Extension appointment severely limits outreach activities, especially in agriculturally focused areas, though there are outreach opportunities in many areas, e.g., clean air, agroecology, small farm, water, birds.
- Current housing availability and condition limits the number of programs offered.
- Missed opportunity: relay to neighbors on Gull Lake that the condition of the lake (being one of the cleanest in the state) is because of the research conducted at KBS.

Are there any alternative models for operation of the KBS?

An option would be to move Conference Services and other revenue-generating operations to a separate reporting unit and shift staff accordingly; however, this is not recommended for reasons described above. If such a change were made, it would be essential to have an agreement that Academic Programs are priority for scheduling housing and other services.

Recommendations related to Administration

- Continue current administrative structure
- Fully fund Academic Programs Coordinator, Science Outreach Coordinator
- Increase staff for Bird Sanctuary
- Continue to pursue linkages with additional MSU colleges/departments in all areas: research, instruction, outreach
- Faculty, staff and graduate students need the same training opportunities for research protocols (animal care, IRB, etc.), diversity and inclusion, sexual harassment, Title IX, FERPA. While the open access and collaborative work environments are valued, spaces for confidential conversations need to be available.

What are the most compelling reasons for the continued support of KBS as a residential field station?

- Strength of intellectual community provides opportunities for new faculty to interact much more closely with senior faculty,
- Increases the peer-to-peer sharing of ideas and information.
- Effectiveness at collaborative, long term projects that in turn leverage additional large projects.
- Research opportunities/ideas/collaborations that arise because of close relationship of faculty, students, and technicians, and that arise because of the unique residential situation
- Year-round, spatially and temporally intensive sampling.
- Increased quality of training for graduate students.
- Ability of researchers to translate their work into significant scientific contributions/findings.
- Ability to develop and participate in long-term multi-site projects.
- Maintain status as global leader in integrating ecological research with agricultural practices.

As summarized by one team member, If KBS didn't exist, people would be thinking of ways to invent it.

Although not part of our charge, we compiled the following list of recommended characteristics for the new Director (in no particular order) based on our observations and conversations:

- Extensive field station experience
- Ability to advocate for KBS as a whole
- Applied and empirical interdisciplinary research experience
- Intellectual leader in ecological or agricultural research with appreciation for both
- Ability to maintain and develop staff
- Values interdisciplinary work; can lead and develop others
- Embraces diversity, especially in summer educational programs
- Fundraising ability, experience a plus
- Ability to advocate for on campus resources