Undergraduate and Graduate External Program Review 2012
Department of Biological and Environmental Sciences

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University of Tennessee at Chattanooga

External Program Review 2012

Introduction

Drs. Susan Bratton and Maribeth Watwood visited the campus March 28 through March 31, 2012. We met with numerous constituencies, including regular faculty, adjunct faculty, students, the department head for the Department of Biological and Environmental Sciences, the dean of the College of Arts and Sciences, the dean of the Graduate College, the dean of the library, representatives from the Teaching Resource Center, the Office of Partnerships and Sponsored Programs, the provost, and the director for Planning Evaluation & Institutional Research. Based on the self-study documents provided in advance as well as the on-campus discussions, we are pleased to present this final report, which summarizes our review of the following programs: 1) BS in Biology 2) BS in Environmental Science and 3) MS in Environmental Science.

1) BS in Biology

Major Observations

Faculty in the Department of Biological and Environmental Sciences are clearly devoted to providing outstanding instruction and facilitating student success. To a person the undergraduate students we interviewed expressed their appreciation for the hands-on approach of the faculty. These students feel that they are receiving an excellent education and are pleased to be a part of the scholarly community on the University of Tennessee at Chattanooga (UTC) campus. They appreciate their instructors’ expertise and ability to engage students in active learning. They perceive the curriculum to be effective in providing them with rigorous content; we heard several comments to the effect of “That course was SO hard; it was great!” There are wonderful opportunities for students to engage in research beyond the classroom. The off campus research sites, including an aquatic field station on the Tennessee River, two field stations in the Tennessee River Gorge, and a 200 acre forested research property that includes a wetland and classroom, as well as numerous individual faculty research laboratories provide these opportunities.

Program enrollment has risen dramatically over the past 5 years, with 2011 enrollment in this one program exceeding 650 (2006 enrollment was 363). This enrollment growth is, of course, great for UTC in that it results in additional tuition revenues and speaks to the strength of the campus. However it has also resulted in extreme stress with respect to providing adequate faculty coverage of courses, especially required courses, in the curriculum. It was made clear during the site visit that the single largest problem facing the program and the students in the program is the presence of ‘bottleneck’ courses where there is insufficient capacity to keep students on track with their degree progression. Students are currently having their graduation
delayed by a semester or more due to being unable to register for required courses. This appears to be a regular occurrence, and it is unacceptable. The main courses affected are Microbiology and Botany laboratories. Safety issues mandate that laboratory sections are limited to 24 students. Furthermore, there is simply a dearth of faculty and teaching assistants to staff the courses. Sadly, sometimes students drop a lab course a month or so into the semester, and this is too late to admit other students who need the lab. Students reported to us that being able enroll in a bottleneck course is like ‘winning the lottery’. This is, of course, resulting in financial stress for students and their families, and parents regularly contact the departmental office to complain.

This problem is completely understood by the faculty, and the department has lobbied for additional faculty lines for some time. There has been incremental progress in hiring new tenure track lines and lecturers, but the hiring progress has not kept up with demand and the bottlenecks still exit. Responding to this serious situation the departmental faculty have undertaken a revision of the Biology curriculum with the goal of updating content, making navigation of requirements more straightforward, and, importantly, eliminating bottlenecks. They are to be commended for these efforts.

We strongly suggest that the university continue to fund additional hires in order to keep students on track for timely graduation. This needs to include an appropriate mix of tenure track and non-tenure track faculty as well as teaching assistantships.

Another challenge that impacts the BS in Biology program is space. The department has severe space shortages, and existing space is in many cases substandard for intended uses. We were pleased to learn that a new building for the department is at the top of the capital projects list, and we are very hopeful that planning and construction of this facility can proceed as quickly as reasonable. Other space issues involve safety concerns in research and teaching laboratories. We suggest that the college hire a safety officer to deal with safety issues in this department as well as in other science departments.

Program Outcomes

The UTC BS in Biology program would compare very favorably to other similar programs in Tennessee, the southeast and the US. The department has specific program mission, vision and goals statements that are in sync with the overall UTC statements and focus on promoting outstanding education of students, strong research activities, and a culture of cooperation and respect. There are a number of very specific departmental goals, derived from their last comprehensive review, which have been carefully assessed for alignment with the UTC strategic plan and with the degree of progress toward them. These statements and goals do clearly identify intended program outcomes and are appropriate for undergraduate and graduate program levels and for UTC.

The department should continue efforts to address curricular ‘bottlenecks’ and design changes that preserve rigor, while allowing students to proceed toward degree completion without
experiencing the delays that many students currently face. The department has already committed to this effort and has generated a curricular proposal to increase the class size of the introductory course, reduce the number of concentrations from 6 to 3 and regroup the courses within the concentrations to be more streamlined, require three core courses, and schedule all introductory and core courses for every semester. We are impressed with the thoughtful planning that has gone into these changes, but we also emphasize that curricular change alone cannot completely address the stress that has come from increasing majors from 389 (2007) to 683 (2011). There must be a continued drive to increase staffing in order to cover sufficient sections to prevent delays in degree progressions.

The department has already established appropriate goals for assessing outcomes via standardized exit tests and surveys for seniors, providing opportunities for undergraduate research, and providing field experiences and internships. These assessment goals are being met with carefully structured protocols, data collection and analysis. The reviewers would encourage the department to work closely with the UTC Office of Planning Evaluation & Institutional Research to more closely monitor and assess graduates’ admittance to and performance in graduate schools and their placement in relevant occupational positions. This type of tracking can be extremely challenging, since students often change addresses several times in the years following graduation, and students are not necessarily motivated to stay in touch with their home department. The department has a link on its website where students can update information, but additional strategies for tracking students and their accomplishments are encouraged.

The department has established numerous criteria with which to evaluate sufficient achievement of intended program outcomes. These criteria appear to be appropriate to the intended purpose and robust. The participating departmental faculty members are to be commended for the detailed descriptions of these assessment instruments in their self-study document. It is clear that the department does use results of these instruments to strengthen their programs, and they are committed to continuing and expanding these efforts into the future.

Curriculum

The current curriculum is appropriate to the level and purpose of the program, but as mentioned above, there are some problems that the department has identified and is acting on. The Graduating Student Survey for Biology has revealed that students complain about a shortage of professors and a paucity of course offerings, especially upper division courses. The students (and faculty!) are also very concerned about the bottleneck courses that result in demonstrable delays for students’ graduation. The faculty are currently undertaking major revision of the BS in Biology to deal with these issues, and are continuing to request additional faculty members. The UTC administration acknowledges that incremental faculty gains, which have been realized over the past years, have not kept pace with dramatic enrollment increases, and they have expressed their support for continued faculty gains.
These problems notwithstanding, the current curriculum certainly appears to meet current standards, practices and issues in the discipline. The general education requirements appear to meet current standards for a liberal arts education, and there are substantial opportunities for the development of writing and critical thinking skills. The required sequences in mathematics and chemistry appear to be robust, and the required and elective courses for the major also appear to offer disciplinary breadth and depth. Clearly the department is committed to review and enhancement of its curriculum for this program as evidenced by the current proposal for major revision to facilitate progress to degree while retaining rigor. Requiring instruction in ecology, evolution, and genetics (as described in the new proposal) is in keeping with modern standards for university level education in the biological sciences. We find the curriculum content to be appropriate for UTC in terms of the major as well as the general education requirements. Critical thinking skills, written and oral communication skills, computer and technology skills are all covered in the curriculum, as evidenced by individual syllabi included in the self-study document. Research strategies and skills are also supported, and, importantly, undergraduates are encouraged to pursue internships and/or research experiences in individual faculty research laboratories and at the various field sites associated with the department.

As indicated on the website, the department has developed collaborations and has established numerous field sites that provide students with outstanding opportunities to participate in research, field experiences, and internships. Quoting the website, “In addition to classroom and office space, the department has research and teaching laboratories, a scanning electron microscope, a GIS computer laboratory, animal quarters, greenhouses, an aquatic field station on the Tennessee River, two field stations in the Tennessee River Gorge, a 200 acre forested research property that includes a wetland and classroom, three aquatic research vessels including the Serpentina (a new 26 foot custom river sampling boat), a new covered utility trailer, and three vehicles. The department is formally affiliated with the Gulf Coast Research Laboratory in Ocean Springs, Mississippi, which provides facilities and equipment for studies in marine biology and oceanography and Highlands Biological Station in North Carolina which is a regional field station for biological research and education in the southern Appalachian Mountains. The department has longstanding relationships with a variety of other institutions including the Tennessee Aquarium, Erlanger Hospital, the Tennessee Valley Authority, the Tennessee Department of Environment and Conservation, several agencies of the city of Chattanooga and Hamilton County, the Tennessee River Gorge Trust, the Chattanooga Nature Center, and the North Chickamauga Creek Conservancy.” The external review team enjoyed a presentation outlining several of these important resources and noted the high number of students who were involved in collaborations with and field work with these entities. We are impressed with the number and the nature of opportunities for students beyond the classroom. The one constraint that we would comment on again relates to the shortage of regular faculty. If there is a limitation on research opportunities, with students getting turned away, the obvious solution to that is to add more research active faculty lines.
As mentioned above, the main problem we noted with the curriculum was the frequent delay for students’ degree completion due to bottleneck courses. We also note the survey results indicating students’ frustrations with faculty shortages and a perceived lack of courses, especially at the upper division level. Again, we applaud the department for revision their curriculum to meet these challenges, and we encourage the administration to identify resources to continue to grow faculty lines related to this program.

Teaching and Learning Environment

The department’s instructional practices are consistent with the standards of the discipline. Instructional practices provide strong opportunities for student interactions with one another, faculty, and professionals. The only challenge to this lies in the shortage of faculty relative to dramatic enrollment growth over the past 5 years. The department makes strong efforts to include students in their community of scholars as evidenced by information provided to the external review team by undergraduate students, the results of exit surveys, and the positive response of the faculty to addressing student concerns regarding the curriculum. The department has increase in diversity over the past 5 years so that there are diverse role models, including ethnicity and gender, for students. Their weekly seminar series, which attracts large numbers of undergraduate students, has been deemed a strong success; this type of venue provides opportunities for presentation of perspectives and experiences of diverse scholars.

The department provides strong advising; faculty actively engage in student advising, and it was clear from our visit that this is a role they take very seriously. One potential recommendation is that faculty time could be freed up for teaching and research if a professional advisor was added to the departmental staff.

Library holdings, while problematic for graduate level work and research, are likely adequate for undergraduate students pursing class projects. The lack of broad and immediate access to a wide range of electronic journal articles in the discipline could hamper students’ progress in their research projects, especially those conducted in individual faculty laboratories. This problem is addressed in more detail in the graduate program review section, but the external review team definitely recommends additional resource allocation to the library to increase immediate access to full journal articles from many more sources.

Faculty

The faculty are not adequate in number to meet the needs of the program with reasonable and efficient teaching loads. More sections are needed, especially for bottleneck courses, and more variety in upper division electives is also needed. Regular faculty to adjunct ratios are certainly adequate; that’s not really a problematic issue here. (However, the woeful state of adjunct salaries is certainly a bad situation.) The real issue is covering classes, offering a broad curriculum, and providing more research experiences for students.
Faculty diversity is appropriate for the program and all regular faculty have terminal degrees in their disciplines. Their credentials are excellent and certainly appropriate to the program. Faculty specialties correspond to the needs of the program, except in the bottleneck areas of microbiology and botany, where further hires are necessary.

Faculty are strongly engaged in scholarly, creative, and service activities that enhance instructional expertise in their disciplines. Though we address this issue at length in the graduate program review section, exploring the idea of an additional MS in molecular, organismal, or biomedical science is an idea the review team supports, as implementation would allow faculty whose research interests are in these areas to recruit graduate students, which would help to promote their scholarly activities.

Faculty regularly publish their results, present their results at conferences and engage in other scholarly activities that are appropriate for the program and very strong. Faculty in this department are actively shaping the directions of their disciplines through their scholarly contributions. There is a mentoring program for all new faculty. They are evaluated in the classroom for their first three years, and they are mentored by senior faculty in areas of research, service, and general professional development advice. The junior faculty who met with the review team were unanimously pleased with the way the senior faculty helped guide them through their pre-tenure years. The department has had very few individuals over the years who were unable to attain tenure; this speaks in part to the mentoring that junior faculty receive.

The program has numerous links to the community as described above in the Curriculum section. Faculty are committed to engaging in community support and collaboration, and the review team was able to meet with several constituencies, including local alumni, the Tennessee River Gorge Trust director, faculty from Cleveland State Community College, the deputy director of the Chattanooga-Hamilton County Regional Planning Agency, and the chair of the Chattanooga Green Committee, during our visit. We were impressed with the high degree of collaboration and interdisciplinary interaction between these various constituencies and the Department of Biological and Environmental Sciences.

A system of evaluation and development by objectives (EDO) is employed for annual evaluation of faculty. This system includes information from teaching evaluations and (for the first three years at least) peer review. Expectations are made very clear, faculty self-report annual accomplishments, and the department head holds regular conferences with individual faculty to plan, set goals and objectives and evaluate accomplishments. This system appears to be very successful and fair, and it appears to help faculty plan in such a way that they can maintain high degrees of research productivity, engaged service contributions and effective teaching and support of student learning.
**Support**

The program requires additional resources for faculty lines as well as more teaching assistantships to ensure safe working conditions in all teaching and research laboratories. The review team suggests that the college hire a safety officer to work with this department and other science departments to ensure compliance with all laboratory safety standards.

Another strong need of the department is adequate space. The review team was very pleased to hear that planning and construction of a new science building to house the department will begin soon. Perhaps bringing on a college safety officer to coincide with the new building would make sense.

Equipment and facilities range from good in the newer teaching laboratories in the remodeled building to very poor in some areas of Holt. However, faculty are to be applauded for their efforts at improving teaching laboratories through numerous mechanisms, including successful submission of NSF-CCLI grants.

Since we didn’t get an overview of the total college budget, it is difficult to comment on the appropriateness of departmental resources relative to college resources. However, the college has expressed support for continuing to grow faculty lines in the department. Additional teaching assistantships are also very much needed in support of this program.

The college dean and provost also expressed support for increasing laboratory course fees from the current $25 to higher levels to provide additional resources for program operations, and the review team strongly supports such a shift.

Given the huge growth of this program, it is clearly a popular choice for students, and every indication points to additional growth into the foreseeable future. Therefore, needs of this program should receive high priority the college and university levels. The most pressing needs and additional faculty, additional high quality space, additional electronic library access, and increased class fees to support equipment update and maintenance.

**Summary Recommendations**

This is a strong program, enormously popular with students. The program enrollments have risen dramatically over the past five years, and further growth is anticipated. The faculty are completely engaged in teaching, advising, research and service and actively support student success. All aspects of the program are assessed regularly, thoroughly, and effectively, and results are used to improve the program. Faculty undertake regular and substantive curricular revisions to improve the program. Students have meaningful opportunities for internships, field work and research in individual faculty laboratories. The review team was very impressed with the program and the department as a whole.
Program weaknesses include bottleneck courses that delay students’ graduation, inadequate space and facilities in many cases, inadequate faculty lines to fully support the program, and inadequate access to electronic journals.

We suggest the following goals relative to the BS in Biology for the next 5 years:

1) Hire additional regular faculty and lecturer lines as well as additional teaching assistants in order to reduce bottleneck problems in the curriculum, offer a broader range of upper division courses, and provide additional research opportunities for program majors.

2) Implement curricular revisions and assess their effectiveness at preparing students adequately for occupations or entry into professional or graduate schools. Also assess effectiveness at reducing bottleneck problems.

3) Plan and construct the new science building, paying careful attention to design details that will support the program. Hire a college level safety officer to oversee safety compliance for all science departments.

4) Increase laboratory course fees to adequately cover equipment replacement, updating, and maintenance. Consider implementing course fees for non-laboratory courses to cover costs associated with field trips, etc.

5) Continue to request increased immediate access to full journal articles in appropriate disciplines.

With the exception of goal #2, each of these goals will likely require new resources. In times of budgetary constraints, this is very difficult. However, given the recent and anticipated growth of this program, meeting these goals will be necessary in order to prevent continued delays in student graduation and deterioration of research experiences. Strategies could include capital campaigns targeted in this area, additional development targeting stakeholders in the community, development of a departmental leadership board with a development mission, and, in the case of library resources, a reexamination of the interaction between UTC and UTK with respect to a single vendor contract.

Thank you for the opportunity to participate in this exciting and illuminating review.
2) BS in Environmental Science

Major Observations

Faculty in the Department of Biological and Environmental Sciences are clearly devoted to providing outstanding instruction and facilitating student success. To a person the undergraduate students we interviewed expressed their appreciation for the hands-on approach of the faculty. These students feel that they are receiving an excellent education and are pleased to be a part of the scholarly community on the University of Tennessee at Chattanooga (UTC) campus. They appreciate their instructors’ expertise and ability to engage students in active learning. They perceive the curriculum to be effective in providing them with rigorous content and laboratories, and providing practical experience applicable to their future employment. There are wonderful opportunities for students to engage in research beyond the classroom. The off campus research sites, including an aquatic field station on the Tennessee River, two field stations in the Tennessee River Gorge, and a 200 acre forested research property that includes a wetland and classroom, as well as numerous individual faculty research laboratories provide these opportunities. The departmental faculty members are active in pursuing research concerning the environmental issues of highest concern in the Chattanooga region. The department has strengthens in species conservation and aquatic and microbial systems. Students are responding very positively to this level of engagement, and treat the program as both relevant and intellectually engaging.

Overall undergraduate enrollment for the department has risen dramatically over the past 5 years to approximately 800 at the time of 2012 review. In 2010 enrollment in the Environmental Science B.S. program reached 142 (2006 enrollment was 85, making the 2010 enrollment a 67% increase). The environmental enrollment has expanded in tandem with the Biology B.S. enrollment, while the rate of expansion has been slightly higher. The retention in the Environmental Science B.S. has also slightly higher -- 69.3% as opposed to 56.1% for the Biology B.S. This growth is, of course, has benefits for UTC as it generates additional tuition revenues and speaks to the strength of the campus. However, it has also resulted in extreme stress in terms of providing adequate faculty coverage of courses, especially required courses, in the curriculum. The students in the Environmental Sciences B.S. degree program are less restricted by bottlenecks in enrollment than the pre-health students in the department, while still encountering courses filled to capacity due to restrictions on laboratory sections or classroom seating. Further, the lack of van capacity for field trips is restricting environmental and field laboratory course size. The main offerings affected are Botany laboratories and the various activities at the field stations. Safety issues mandate that laboratory sections are limited to 24 students. Sadly, sometimes students drop a lab course a month or so into the semester, and this is too late to admit other students who need the lab. Students reported to us that being able enroll in a bottleneck course is like ‘winning the lottery’. This is, of course, resulting in financial stress for students and their families, and parents regularly contact the departmental office to complain.
This problem is completely understood by the faculty, and the department has lobbied for additional faculty lines for some time. There has been incremental progress in hiring new tenure track lines and lecturers, but the hiring progress has not kept up with demand and the bottlenecks still exist. In addition, access to a second passenger van, would ease constraints on field laboratories.

We strongly suggest that the university continue to fund additional hires in order to keep students on track for timely graduation, and evaluate means for providing field transportation for larger sections. The department needs more graduate teaching assistants to keep up with the increasing pressures on laboratory enrollments, including field laboratories.

Another challenge that impacts the BS in Environmental Science program is space. The department has severe space shortages, and existing space is in many cases substandard for intended uses. The field laboratories and GIS laboratories are offering excellent educational platforms for the program. The facilities available for other forms of laboratory instruction are overcrowded and lack adequate computer and projection technology. We were pleased to learn that a new building for the department is at the top of the capital projects list, and we are very hopeful that planning and construction of this facility can proceed as quickly as reasonable. Other space issues involve safety concerns in research and teaching laboratories. We suggest that the college hire a safety officer to deal with safety issues in this department as well as in other science departments. Reorganization of departmental responsibilities for field and laboratory safety would also provide better coverage. In addition, the teaching laboratories need adequate computers and projectors to deliver instruction based in environmental modeling and statistical analysis.

**Program Outcomes**

The UTC BS in Environmental Science program compares very favorably to other similar programs in Tennessee, the southeast and the US. The department has specific program mission, vision and goals statements that are in sync with the overall UTC statements and focus on promoting outstanding education of students, strong research activities, and a culture of cooperation and respect. The research culture is sophisticated and accessible to undergraduates. There are a number of very specific departmental goals, derived from their last comprehensive review, which have been carefully assessed for alignment with the UTC strategic plan and with the degree of progress toward them. These statements and goals do clearly identify intended program outcomes and are appropriate for undergraduate and graduate program levels and for UTC.

The department should continue efforts to address curricular ‘bottlenecks’ and design changes that preserve rigor, while allowing students to proceed toward degree completion without experiencing the delays that many students currently face. The curriculum changes incorporating the 3060/3070 Ecology course in the Biology B.S. requirements could influence
availability of this particular class and additional sections may be needed. The current number of specialized Programs of Study offered in support of the Environmental Science B.S. degree is high, relative to enrollment numbers. While this probably causes little problem for students, the number could be reduced by one or two to consolidate advising strategies. Overall, the curriculum offers a diversity of options and can be easily adapted to graduate and professional tracks, such GIS or conservation biology. The Biology Program option is particularly stressed in terms of course access, and potentially needs more staffing. The department should calculate projected growth on key environmental courses, and plan for future needs as new laboratory space becomes available.

The department has already established appropriate goals for assessing outcomes via standardized exit tests and surveys for seniors, providing opportunities for undergraduate research, and providing field experiences and internships. These assessment goals are being met with carefully structured protocols, data collection and analysis. The reviewers would encourage the department to work closely with the UTC Office of Planning Evaluation & Institutional Research to more closely monitor and assess graduates’ admittance to and performance in graduate schools and their placement in relevant occupational positions. This type of tracking can be extremely challenging, since students often change addresses several times in the years following graduation, and students are not necessarily motivated to stay in touch with their home department. The department has a link on its website where students can update information, but additional strategies for tracking students and their accomplishments are encouraged.

The department has established numerous criteria with which to evaluate sufficient achievement of intended program outcomes. These criteria appear to be appropriate to the intended purpose and robust. The participating departmental faculty members are to be commended for the detailed descriptions of these assessment instruments in their self-study document. It is clear that the department does use results of these instruments to strengthen their programs, and they are committed to continuing and expanding these efforts into the future.

**Curriculum**

The current curriculum is appropriate to the level and purpose of the program, and is quite diverse considering the size of the faculty. The department is making very constructive use of courses taught in other departments. With improved vehicle support and staffing, the department could make even greater use of its field facilities, which could become even more of a program distinctive. Increasing the availability of graduate teaching assistants would facilitate laboratory offerings and provide additional backup for faculty in terms of field instruction. As the program is continuing to grow, avoidance of additional bottlenecks is critical. The faculty are currently undertaking major revision of the curriculum to deal with these issues, and are continuing to request additional faculty members. The UTC administration acknowledges that incremental faculty gains, which have been realized over the past years, have not kept pace with dramatic enrollment increases, and they have expressed their support for continued faculty gains.
These problems notwithstanding, the current curriculum certainly appears to meet today’s standards, practices and issues in the discipline. The general education requirements appear to meet current standards for a liberal arts education, and there are substantial opportunities for the development of writing and critical thinking skills. The required sequences in mathematics and chemistry appear to be robust, and the required and elective courses, as well as the Program options, for the major also appear to offer disciplinary breadth and depth. We find the curriculum content to be appropriate for UTC in terms of the major as well as the general education requirements. Critical thinking skills, written and oral communication skills, computer and technology skills are all covered in the curriculum, as evidenced by individual syllabi included in the self-study document. The faculty instructors are requiring term papers in their courses and the students we interviewed responded favorably over the level of writing coaching. Research strategies and skills are also supported, and, importantly, undergraduates are encouraged to pursue internships and/or research experiences in individual faculty research laboratories and at the various field sites associated with the department.

As indicated on the website, the department has developed collaborations and has established numerous field sites that provide students with outstanding opportunities to participate in research, field experiences, and internships. Quoting the website, “In addition to classroom and office space, the department has research and teaching laboratories, a scanning electron microscope, a GIS computer laboratory, animal quarters, greenhouses, an aquatic field station on the Tennessee River, two field stations in the Tennessee River Gorge, a 200 acre forested research property that includes a wetland and classroom, three aquatic research vessels including the Serpentina (a new 26 foot custom river sampling boat), a new covered utility trailer, and three vehicles. The department is formally affiliated with the Gulf Coast Research Laboratory in Ocean Springs, Mississippi, which provides facilities and equipment for studies in marine biology and oceanography and Highlands Biological Station in North Carolina which is a regional field station for biological research and education in the southern Appalachian Mountains. The department has longstanding relationships with a variety of other institutions including the Tennessee Aquarium, Erlanger Hospital, the Tennessee Valley Authority, the Tennessee Department of Environment and Conservation, several agencies of the city of Chattanooga and Hamilton County, the Tennessee River Gorge Trust, the Chattanooga Nature Center, and the North Chickamauga Creek Conservancy.” The external review team enjoyed a presentation outlining several of these important resources and noted the high number of students who were involved in collaborations with and field work with these entities. We are impressed with the number and the nature of opportunities for students beyond the classroom. The one constraint that we would comment on again relates to the shortage of regular faculty. If there is a limitation on research opportunities, with students getting turned away, the obvious solution to that is to add more research active faculty lines. In cases where tenure track faculty members are doing most of the field instruction directly, growing student numbers are overloading both faculty schedules and infrastructure. Well trained graduate teaching assistants could provide a relatively inexpensive means of providing greater undergraduate access to field instruction, and
enhance a current strength of the program. Further delegation to graduate assistants, particularly those studying with the faculty instructors, should be increased in upper division and research-oriented courses.

**Teaching and Learning Environment**

The department’s instructional practices are consistent with the standards of the discipline. Instructional practices provide strong opportunities for student interactions with one another, faculty, and professionals. The only challenge to this lies in the shortage of faculty relative to dramatic enrollment growth over the past 5 years. The department makes strong efforts to include students in their community of scholars as evidenced by information provided to the external review team by undergraduate students, the results of exit surveys, and the positive response of the faculty to addressing student concerns regarding the curriculum. The department has increase in diversity over the past 5 years so that there are diverse role models, including ethnicity and gender, for students. Their weekly seminar series, which attracts large numbers of undergraduate students, has been deemed a strong success; this type of venue provides opportunities for presentation of perspectives and experiences of diverse scholars.

The department provides strong advising; faculty actively engage in student advising, and it was clear from our visit that this is a role they take very seriously. One potential recommendation is that faculty time could be freed up for teaching and research if a professional advisor was added to the departmental staff. The interface with regional government agencies and the business community is particularly beneficial, and the department should make every effort to maintain these ties.

Library holdings, while problematic for graduate level work and research, are likely adequate for undergraduate students pursing class projects. The lack of broad and immediate access to a wide range of electronic journal articles in the discipline could hamper students’ progress in their research projects, especially those conducted in individual faculty laboratories. This problem is addressed in more detail in the graduate program review section, but the external review team definitely recommends additional resource allocation to the library to increase immediate access to full journal articles from many more sources.

**Faculty**

The faculty and graduate assistants are not adequate in number to meet the needs of the program with reasonable and efficient teaching loads. More sections are needed, especially for bottleneck courses, and to continue to expand upper division electives is also needed. Regular faculty to adjunct ratios are certainly adequate; that’s not really a problematic issue here. (However, the woeful state of adjunct salaries is certainly a bad situation.) The real issue is covering classes, offering a broad curriculum, and providing more research experiences for students.
Faculty diversity is appropriate for the program and all tenure track faculty have terminal degrees in their disciplines. Their credentials are excellent and certainly appropriate to the program. Faculty specialties correspond to the needs of the program, except in the bottleneck areas of microbiology and botany, where further hires are necessary.

Faculty are strongly engaged in scholarly, creative, and service activities that enhance instructional expertise in their disciplines. Though we address this issue at length in the graduate program review section, exploring the idea of an additional MS in molecular, organismal, or biomedical science is an idea the review team supports, as implementation would allow faculty whose research interests are in these areas to recruit graduate students, which would help to promote their scholarly activities. In addition, the department could consider addition of a PhD program in environmental science, which could provide additional teaching assistants with more advanced levels of completed training.

Faculty regularly publish their results, present their results at conferences, and engage in other scholarly activities that are appropriate for the program and very strong. Faculty in this department are actively shaping the directions of their disciplines through their scholarly contributions. There is a mentoring program for all new faculty. They are evaluated in the class room for their first three years, and they are mentored by senior faculty in areas of research, service, and general professional development advice. The junior faculty who met with the review team were unanimously pleased with the way the senior faculty helped guide them through their pre-tenure years. The department has had very few individuals over the years who were unable to attain tenure; this speaks in part to the mentoring that junior faculty receive. The distribution of research laboratory space and the availability of shared culture space, with the exception of the greenhouse, is inadequate to provide adequate research space for undergraduates in faculty laboratories. The majority of the faculty members are recruiting undergraduate research assistants, which makes a highly valuable contribution to the education of the most outstanding students. Future planning should consider this presence of undergraduates as a factor determining the size and design of research laboratories.

The program has numerous links to the community as described above in the Curriculum section. Faculty are committed to engaging in community support and collaboration, and the review team was able to meet with several constituencies, including local alumni, the Tennessee River Gorge Trust director, faculty from Cleveland State Community College, the deputy director of the Chattanooga-Hamilton County Regional Planning Agency, and the chair of the Chattanooga Green Committee, during our visit. We were impressed with the high degree of collaboration and interdisciplinary interaction between these various constituencies and the Department of Biological and Environmental Sciences.

A system of evaluation and development by objectives (EDO) is employed for annual evaluation of faculty. This system includes information from teaching evaluations and (for the first three years at least) peer review. Expectations are made very clear, faculty self-report annual
accomplishments, and the department head holds regular conferences with individual faculty to plan, set goals and objectives and evaluate accomplishments. This system appears to be very successful and fair, and it appears to help faculty plan in such a way that they can maintain high degrees of research productivity, engaged service contributions and effective teaching and support of student learning.

**Support**

The program requires additional resources for faculty lines as well as to ensure safe working conditions in all teaching and research laboratories. The review team suggests that the college hire a safety officer to work with this department and other science departments to ensure compliance with all laboratory safety standards.

Another strong need of the department is adequate space. The review team was very pleased to hear that planning and construction of a new science building to house the department will begin soon. Perhaps bringing on a college safety officer to coincide with the new building would make sense.

Equipment and facilities range from good in the newer teaching laboratories in the remodeled building to very poor in some areas of Holt. However, faculty are to be applauded for their efforts at improving teaching laboratories through numerous mechanisms, including successful submission of NSF-CCLI grants. The motor pool system and vehicle support, and the projection and computer access (aside from the GIS laboratory) are not, however, adequate for current course enrollments. The environmental sciences program needs to offer laboratories incorporating statistical analysis and computerized environmental modeling, as well as downloading data collected via probes in the field.

Since we didn’t get an overview of the total college budget, it is difficult to comment on the appropriateness of departmental resources relative to college resources. However, the college has expressed support for continuing to grow faculty lines in the department.

The college dean and provost also expressed support for increasing laboratory course fees from the current $25 to higher levels to provide additional resources for program operations, and the review team strongly supports such a shift.

Given the huge growth of this program, it is clearly a popular choice for students, and every indication points to additional growth into the foreseeable future. Therefore, needs of this program should receive high priority the college and university levels. The most pressing needs and additional faculty, additional high quality space, additional electronic library access, and increased class fees to support equipment update and maintenance.
Summary Recommendations

This is a strong program, enormously popular with students. The program enrollments have risen dramatically over the past five years, and further growth is anticipated. The faculty are completely engaged in teaching, advising, research and service and actively support student success. All aspects of the program are assessed regularly, thoroughly, and effectively, and results are used to improve the program. Faculty undertake regular and substantive curricular revisions to improve the program. Students have meaningful opportunities for internships, field work and research in individual faculty laboratories. The review team was very impressed with the program and the department as a whole.

Program weaknesses include bottleneck courses that delay students’ graduation, inadequate space and facilities in many cases, inadequate faculty lines to fully support the program, and inadequate access to electronic journals.

We suggest the following goals relative to the BS in Environmental Science for the next 5 years:

1) Hire additional regular faculty and lecturer lines in order to reduce bottleneck problems in the curriculum, offer a broader range of upper division courses, and provide additional research opportunities for program majors.

2) Implement curricular revisions and assess their effectiveness at preparing students adequately for occupations or entry into professional or graduate schools. Also assess effectiveness at reducing curriculum bottlenecks.

3) Plan and construct the new science building, paying careful attention to design details that will support the program. Hire a college level safety officer to oversee safety compliance for all science departments.

4) Increase laboratory course fees to adequately cover equipment replacement, updating, and maintenance. Consider implementing course fees for non-laboratory courses to cover costs associated with field trips, etc.

5) Increase the number of teaching assistants, including those with expertise appropriate to field laboratories.

6) Find a practical way to provide improved transportation to field study sites. This could be accomplished by an additional van purchases, or by improved management of a motor pool shared with other departments. This limitation is adding to bottlenecks in laboratory enrollment.

7) Improve the technology available in the teaching laboratories, including the availability of projectors and of computers for running environmental modeling software and statistical programs, such as SPSS.
8) Review and consider revising the Programs of Study offered with the major. Low enrollment Programs could be dropped or replaced with more effective options.

9) Raise the laboratory fees, particularly field courses requiring vehicle use, and those deploying complex arrays of equipment.

10) Continue to request increased immediate access to full journal articles in appropriate disciplines.

With the exception of goal #2, each of these goals will likely require new resources. In times of budgetary constraints, this is very difficult. However, given the recent and anticipated growth of this program, meeting these goals will be necessary in order to prevent continued delays in student graduation and deterioration of research experiences. Strategies could include capital campaigns targeted in this area, additional development targeting stakeholders in the community, development of a departmental leadership board with a development mission, and, in the case of library resources, a reexamination of the interaction between UTC and UTK with respect to a single vendor contract.

Thank you for the opportunity to participate in this exciting and illuminating review.
3) M.S. Program in Environmental Science

Overview

Faculty in the Department of Biological and Environmental Sciences are clearly devoted to providing outstanding instruction and facilitating student success. To a person the graduate students we interviewed expressed their appreciation for the hands-on approach of the faculty. These students feel that they are receiving an excellent education and are pleased to be a part of the scholarly community on the University of Tennessee at Chattanooga (UTC) campus. They appreciate their instructors’ expertise and ability to engage students in practical problem solving and research. They perceive the curriculum to be effective in providing them with rigorous content and laboratories, and providing practical experience applicable to their future employment. University of Tennessee Chattanooga offers an impressive array of opportunities for students to engage in research beyond the classroom. The off campus research sites, including an aquatic field station on the Tennessee River, two field stations in the Tennessee River Gorge, and a 200 acre forested research property that includes a wetland and classroom, as well as numerous individual faculty research laboratories provide these opportunities. The review team was able to meet with several constituencies, including local alumni, the Tennessee River Gorge Trust director, faculty from Cleveland State Community College, the deputy director of the Chattanooga-Hamilton County Regional Planning Agency, and the chair of the Chattanooga Green Committee, during our visit. The departmental faculty members are active in pursuing research concerning the environmental issues of highest concern in the Chattanooga region. The department has strengths in species conservation and aquatic and microbial systems. Students are responding very positively to this level of engagement, and view the program as both relevant and intellectually engaging.

The program meets an important need for advanced environmental training in the Chattanooga metropolitan area. The Environmental Science M.S. accepted its first students in 1997, and has developed at a steady pace, adding faculty expertise, field facilities and instrumentation. Graduate enrollment has risen to an average of 35 per year with 8 tenure track faculty serving as major advisors. The program’s research has displayed a healthy advance in publication rate and external funding during a period when national competition for external funds has intensified. The Environmental Science M.S. offers an enriching professional environment, well networked with employers and government agencies. The faculty are friendly and collegial providing robust support for graduate students both in class and in research venues.

Overall undergraduate enrollment for the department has risen dramatically over the past 5 years to approximately 800 at the time of 2012 review. This growth is, of course, has benefits for UTC as it generates additional tuition revenues and speaks to the strength of the campus. However, it has also resulted in extreme stress in terms of providing adequate faculty coverage of courses, especially required courses, in the curriculum. The students in the Environmental Sciences M.S. degree program are less restricted by bottlenecks in enrollment than the undergraduate students.
in the department, but do still occasionally encounter courses filled to capacity due to restrictions on laboratory sections or classroom seating. The surge of undergraduate enrollments is also straining administrative and office support for the graduate program.

These problems are completely understood by the faculty, and the department has lobbied for additional faculty lines and teaching assistants for some time. There has been incremental progress in hiring new tenure track lines, lecturers, and teaching assistants, but the hiring progress has not kept up with demand and the bottlenecks still exit. The department needs more graduate teaching assistants to keep up with the increasing pressures on laboratory enrollments, including field laboratories. Additional graduate teaching assistantships would enhance the quality of the graduate program, and would provide supported graduate students for a greater number of faculty mentors raising the department’s research productivity. Numerous graduate students indicated that they had to support themselves with loans or off-campus jobs, and this is not ideal.

Another challenge that impacts the MS in Environmental Science program is space. The department has severe space shortages, and existing space is in many cases substandard for intended uses. The field laboratories and GIS laboratories are offering excellent educational platforms for the program. The facilities available for other forms of laboratory instruction are overcrowded and lack adequate computer and projection technology. Several faculty graduate mentors are sharing research laboratories, and new faculty may not have research space immediately available. This situation is inhibiting the performance of the graduate program, particularly in terms of research. We were pleased to learn that a new building for the department is at the top of the capital projects list, and we are very hopeful that planning and construction of this facility can proceed as quickly as reasonable. Other space issues involve safety concerns in research and teaching laboratories. We suggest that the college hire a safety officer to deal with safety issues in this department as well as in other science departments. Reorganization of departmental responsibilities for field and laboratory safety would also provide better coverage.

The graduate program in the Department of Biology and Environmental Science has made major strides in research over the past 15 years. The program is continuing to mature and has unrealized potential in terms of publication, sponsored programs, and offering additional degrees or tracks. The graduate program should plan for a future with an even larger undergraduate enrollment, more faculty engaged in research, improved research facilities, and a greater diversity of graduate options.

**Student Experience**

**Admission and retention standards.** Admissions standards are adequate to the level of the degree, and these are clearly outlined in the catalog and in other informational materials including the department’s website. Recruitment is successful enough that the department could
consider raising admission standards in the near future. Despite the high percentage of non-
traditional students and students working full time in the graduate program, retention and
completion rates are satisfactory. As the department raises its research productivity it should
consider raising the requirements to enter the M.S. thesis track, in order to enroll students with
better developed writing and scientific skills, as well as a more mature work ethic. The program
currently requires an overall GPA of 2.75. Requiring a GPA of 3.0 is a more typical entry
standard for graduate admission into a research track.

**Catalog.** The admissions requirements and retention standards are clearly outlined and easily
available to applicants and enrolling students.

**Recruitment.** The department is advertising the availability of the M.S. The graduate school
has further resources available is support recruitment. The graduate program could improve its
efforts by soliciting additional funds for advertising, developing posters and other mailings, and
further enhancing its website. While the program is recruiting nationally, further out reach
nationally should increase the applicant pool in numbers and quality.

**Diversity.** Since its last external review, the department has made major gains in diversity,
particularly in terms of faculty composition. This effort should be continued with efforts to
support diverse candidates for tenure, including assuring adequate research space and support for
all tenure track faculty. The recruitment of an ethnically diverse cadre of graduate students could
be further improved, and the department should continue its efforts to reflect regional ethnic
composition.

**Enrollment levels.** Enrollment levels of approximately 35 are satisfactory to ensure a critical
mass of students necessary for appropriate peer groups. The department, in fact, has the opposite
problem of having enrolled so many undergraduate and graduate students that the graduate
program is suffering space limitations, which are becoming increasingly restrictive of optimal
educational function. The enrollment includes significant cohorts of students already employed
in environmental positions, research oriented students, students with environmental
undergraduate degrees, and students with backgrounds in other fields, such as biology. This mix
ties graduate students who have never held a full time environmental job to peers who have
significant professional experience. It also supports the inherently interdisciplinary nature of the
graduate program.

**Program structure and advising.** The UTC MS in Environmental Science program would
compare very favorably to other similar programs in Tennessee, the southeast and the US. The
department has specific program mission, vision and goals statements that are in sync with the
overall UTC statements and focus on promoting outstanding education of students, strong
research activities, and a culture of cooperation and respect. The research culture is sophisticated
and accessible to graduate students. There are a number of very specific departmental goals,
derived from their last comprehensive review, which have been carefully assessed for alignment
with the UTC strategic plan and with the degree of progress toward them. These statements and goals do clearly identify intended program outcomes and are appropriate for the graduate program levels and for UTC.

**Orientation and guidance.** The department has an orientation program, including written materials and a graduate handbook. The personal advising begins from the first week, and contact between faculty and graduate students is frequent and continually available. Advising concerning career options is superior to that at many similar institutions and incorporates a substantial off-campus network. The department chair and faculty maintain a high level of awareness of student progress and have installed a centralized record keeping system accumulating data on graduate students. The graduate students we spoke to requested an additional event each year to allow them to meet all the faculty. In 2012, the graduate handbook was out of date. The department needs to set a regular schedule of revising the graduate handbook of every other year or every third year, and should also maintain and regularly revise handbooks covering other functions, such as internships.

**Graduate program administration:** The students were highly positive about the efforts of their advisors, and appeared to be knowledgeable concerning the department’s resources and policies. The graduate students commented that graduate faculty and the department chair were highly accessible and consistently helpful. Several different faculty have acted as graduate program director in recent years, leading to variations in administrative procedures and strategy. The students commented that the graduate handbook is out of date. The department should develop a simple written protocol for managing the program, which will be maintained as the director changes. Since the program is growing, the department should continue to assure the graduate program director has adequate assistance from other faculty and receives appropriate course releases and compensation. The graduate students requested an additional meeting each fall so they could get to know the entire graduate faculty, receive an update on annual scheduling, and review reporting requirements. The department should consider such minor adjustments to improve internal communication and networking as the department grows.

**Appropriateness of curricular offerings.** The graduate program is not offering short courses or engaged in distance education, so these modes of course delivery are not a concern at this time. The graduate classroom courses are typical of a scientific masters level curriculum. The curriculum is traditional and appropriate to the field of study. Overall, the curriculum offers a diversity of options and can be easily adapted to graduate and professional tracks, such GIS or conservation biology. The department should calculate projected growth on key graduate environmental courses, and plan for future needs as new laboratory space becomes available.

**Appropriateness of extracurricular offerings.** The department is sponsoring external speakers and seminars. The graduate program is particularly effective in exposing students to regional opportunities, such as working with the aquarium or with non-profit organizations. While increasing such activities, particularly invited lectures, would further enhance the academic
atmosphere, the current levels are adequate to the support the graduate program. Of the three tracks available in M.S. degree, two appear to be functioning well in terms of providing professional development. Students in the Thesis Option are engaged in legitimate and scientifically significant research projects and acquire credentials suitable for entering a terminal degree program, such as a PhD, at another institution. Thesis students are well prepared for entry into the work force, particularly in positions requiring laboratory or field sampling skills. The Internship Option is also effective, particularly for preparing students for work force, and serves students who are already professionally employed in an environmental field and are enhancing their skills. Students are encouraged to attend workshops and conferences and are particularly active in attending events in the southeastern region. The department does support student travel to conferences. The third option, Learned Discourse, is largely viewed as a ‘consolation’ degree for those students who struggle to complete the Thesis and Internship options. The graduate faculty should discuss the future of this option, and if the program intends to keep it, revise the option to increase the level of extracurricular enrichment.

The department has done an exceptional job relative to its size and recent growth of providing field study opportunities and access to Geographic Information System technology to its graduate students. The friendly relationships with government agencies have been very beneficial, and have supported numerous thesis projects and internships. The impressive array of opportunities for students to engage in research beyond the classroom, includes the off campus aquatic field station on the Tennessee River, two field stations in the Tennessee River Gorge, and a 200 acre forested research property that includes a wetland and classroom, along the National Guard bases, and the city aquarium.

The one concern is the opportunity for publication for students. While many thesis projects are reaching publication phase, the majority are not. The department should consider strategies to slowly raise publication rates. These might include encouraging more pre-publication of thesis contents or establishing publication of a refereed professional journal article as an alternative to thesis completion. Graduate students not entering terminal degree programs are less likely to publish after completing a master’s degree, and encouraging preparation for publication prior to departure might be effective. In addition, faculty could make agreements concerning final authorship prior to student graduation, and negotiate deadlines for publication.

**Graduate Faculty Quality**

**Faculty competencies and qualifications.** The faculty credentials are appropriate to the degree offered, and are good to excellent relative to the demands of the graduate program. The graduate major advisors all have completed terminal degrees and have relevant research and publication experience. The terminal degrees of the faculty advisors are from competitive research universities, both in the southeast and outside the region, providing an impressive range of backgrounds and expertise. Recently hired graduate faculty members are all research active and engaged with the greater academic community. The degrees are appropriate to program needs
and well aligned with normative environmental course offerings. The coverage of specialties is adequate to the size of the program and the master’s degree. The departmental trend is toward a completely research active tenure track faculty.

**Faculty mentoring.** The faculty mentors have very sound practical and research experience for graduate supervision, and are maintaining their academic resumes. The graduate students believe the department is supportive and offers thoughtful and caring guidance for their preparation as future environmental professionals. Faculty mentors are spending adequate time in supervising their research students, and interaction between faculty and students provides sound guidance, as well as being generally amicable and friendly. The department’s atmosphere is energetic and optimistic, due to the positive attitudes of the faculty. The high level of collegiality among the faculty creates a departmental culture accepting of graduate students of diverse backgrounds and different personal circumstances, and stimulates academic interaction among students and research operations.

**Faculty professional development.** Both faculty and graduate students have funds to travel to regional meetings and the graduate faculty are unilaterally active in environmental or biological professional societies. Faculty in this department are actively shaping the directions of their disciplines through their scholarly contributions. There is a mentoring program for all new faculty. They are evaluated in the class room for their first three years, and they are mentored by senior faculty in areas of research, service, and general professional development advice. The junior faculty who met with the review team were unanimously pleased with the way the senior faculty helped guide them through their pre-tenure years. The department has had very few individuals over the years who were unable to attain tenure; this speaks in part to the mentoring that junior faculty receive.

**Faculty teaching loads.** The teaching loads are high, relative to the research responsibilities, and the department can be fairly described as hard working. The teaching loads exceed those typical of a Carnegie-standard research university. Under current teaching loads and class enrollments, supervising more than three graduate students, is a very elevated workload. Currently, some faculty supervisors have far more graduate students than others. The average load for the active major advisors is four to five. A few mentors are managing seven or more. While such patterns are often generated by success in grant funding, over and under loading both have negative consequences for research quality and productivity. In order to guide the department concerning optimal mentoring strategies, the department chair should monitor basic metrics such as annual publication rate, percentage of theses published, and graduate time to completion by the number of graduate students in a particular research operation or working under a faculty mentor. The department and the university should consider further load reductions for exceptionally high graduate supervisory loads.

**Faculty and graduate student research quality and productivity.** The department has steadily increased its research productivity, and grant support for graduate student projects. The
graduate school and the departmental administration should continue to encourage and reward outstanding faculty mentoring of graduate student scholarship. Graduate students are engaged in projects preparing them for future employment, and admission to terminal degree programs. The research produced by the department is highly useful for environmental management, particularly in the region around Chattanooga. The program continues to fill a unique and important niche concerning the environmental and planning needs of the city. The projects are supporting institutional grants and contracts, which in turn improve faculty credentials. Graduate students are presenting research at regional professional meetings, and the department is making an effort to provide an interface with the greater academic community.

On average for the department, the majority of thesis projects do not reach the phase of refereed publication. The department should establish goals for raising the percent of theses published, which will enhance the scholarly reputation of the faculty supervisors, the graduate program, and the graduating masters students. The department could consider establishing publication of a refereed professional journal article as an alternative to thesis completion. While some theses may not be suitable for journal publication as they are components of contract projects intended for other functions, such as environmental compliance or planning, greater presence in the refereed literature will create positive feedbacks in terms of the quality of students recruited, program reputation, and obtaining additional external financial support for student assistantships.

**Lack of graduate assistants and research productivity.** The M.S. in Environmental Science is providing only partial access to graduate student assistants for research oriented tenured and tenure track faculty in a department with expertise in life sciences subfields such as human physiology and molecular biology. About half of the tenure track faculty members teach graduate courses and about half serve as graduate committee chairs, while the remaining tenure track serve only as committee members (eight serve as chairs and the others only as members according to the self-study documentation). The departmental tenure and promotion process currently does not differentiate faculty without access to graduate students in their primary research areas, from those who can easily recruit students aligned with in their primary research interests. Yet lack of access to graduate students can greatly reduce faculty research productivity. A culture of “haves and have-nots” will limit departmental development in the long run. The current situation is causing surprising little inter-personal tension among the faculty, while faculty without access to graduate students in their primary areas of research did express a desire to supervise graduate students as major advisor. In the long run, departmental reputation and strength depends on the research productivity of its entire tenure track faculty, and a major divide presents more liabilities than advantages. We think that the department would be wise to consider adding another MS program in organismal biology, biomedical science, or cell and molecular biology in order to provide additional opportunities for students as well as potential new faculty members.
Teaching/Learning Environment

Curriculum structure and content. Of the three tracks available in M.S. degree, two appear to be functioning well. Students in the Thesis Option are engaged in legitimate research projects and acquire credentials suitable for entering a terminal degree program, such as a PhD, at another institution. Thesis students are well prepared for entry into the work force, particularly in positions requiring laboratory or field sampling skills. The Internship Option is also effective, particularly for preparing students for work force, and serves students who are already professionally employed in an environmental field and are enhancing their skills. The third track, the Learned Discourse Option, is rarely utilized by students and is marginally appropriate to a degree emphasizing applied science. The track does not provide significant hands on engagement in the environmental field. We suggest the department review the track and either revise it to provide a higher level of practical professional skills acquisition, or drop it from the program.

The current graduate catalog and courses have sound coverage of major topics in environmental sciences. The syllabi indicate the courses provide exposure to the professional literature at an appropriate level, and develop necessary skills, such as writing and critical thinking. Faculty resumes are well aligned with the teaching assignments. The core curriculum is offering a solid alignment of classes, both on ecological and toxicological topics and in social sciences areas, such as environmental law and policy. The array of courses is also offering an adequate degree of specialization, while having greater strengths in ecological subfields than in non-science subfields. At its current size and level of development, the concentration on ecology is appropriate, and supports the biological function of the department. Dual-listed courses comprise an appropriate percentage of the curriculum.

Hands on learning and practice. The department excels at opportunities to learn the practical skills necessary to solve environmental problems. Students are clearly acquiring tools to participate in resources management, environmental planning, and environmental compliance at a professional level. The graduate students we spoke to lauded the city of Chattanooga as an educational resource and were highly positive about internship and laboratory experiences.

Course offerings and progress to the degree. Graduate courses are adequately available, while affected by the general overloading of sections due to speedy growth in enrollment.

Participation in extra-disciplinary courses and opportunities. The environmental graduate students have adequate extra-disciplinary opportunities, and did not express concerns about access to curricular options outside the department.

Curriculum updates. The graduate faculty have been conscientious in managing and updating the graduate curriculum and should continue their efforts. The curriculum does not need an immediate update, although this should be undertaken should the department move to a new building. In addition, the department could consider adding courses or a faculty member in
subfields where there is regional employment demand. A possible areas for strengthening the
curriculum in the future are environmental design and planning, sustainability management for
business and industry, or environmental health and safety. The department currently does not
have a faculty member with terminal degrees in planning, for example. Any such additions
should not be made at the expense of the department’s strengths in environmental life science,
which are the most likely to provide a solid platform for further expansion, and perhaps even a
potential PhD program sometime in the future.

Development of additional graduate degrees and faculty access to graduate research
assistants. Through the past two decades, the department has greatly improved its research
functions, and has admirably increased both granting and refereed publication. The current
graduate enrollment and the quality of research generated indicate the department has the
potential to develop a PhD program in Environmental Science. The fact that a portion of the
tenure track faculty are not currently serving as mentors for masters students poses a major
barrier, however. Should the department progress to granting PhDs, the increasing differential
could create serious internal tensions, and inhibit the development of faculty resumes appropriate
to a PhD level graduate program. The current graduate degree structure also limits graduate
student options in fields such as plant taxonomy, where some graduate students might prefer a
degree in biology, and departmental access to graduate teaching assistants specializing in fields
with numerous undergraduate laboratory sections, such as anatomy.

We recommend that the department establish a task force or committee to investigate the
possibility for adding new degrees. The first priorities should be greater inclusivity of tenure-
track research interests, and further aligning graduate degrees or tracks with major areas of
undergraduate instruction. While the task force will determine the best fit and a strategy
acceptable to the University of Tennessee system, possibilities include organismal biology or a
biomedical degree intended to prepare students for entering terminal degree programs in health
sciences, and for laboratory employment in the health care industries. The addition of a second
graduate program within a department often generates strained interpersonal relations due to
competition between graduate degree programs for resources. The department currently has a
spirit of equity and mutual support. As opportunities for new graduate degrees or tracks emerge,
departmental administrators should consciously work to encourage faculty participation, as
appropriate, in more than one degree program and to maintain a fluid and open interface between
the current environmental science masters and any new degrees or tracks. The department chair
and graduate director should, in discussion with the tenure track faculty, strive to distribute
resources fairly and support all research areas per their needs.

In addition, the department has an inadequate number of graduate teaching assistantships for its
current laboratory enrollment. The number of funded assistantships is half the number of tenure
track faculty members. The work load per graduate student is reasonable, while the department
needs more sections of required courses and the availability of laboratory seats is limiting
enrollments per course. A desirable ratio for graduate program development is at least one
teaching assistant per tenure track, although other considerations, such as the low expense of hiring adjuncts, will also influence staffing strategies. We suggest increasing the number of teaching assistantships and adding laboratory sections (at alternative times, such as night sections, if necessary) both to enhance the graduate program and to improve timely course enrollment for undergraduates.

**Graduate courses: Are Adequate Resources Available to Students?**

**Materials and secretarial support.** While the administrative staff meets the minimum requirements of a program of this size, the administrative staff is overloaded with advising issues, undergraduate demands, and problems caused by curriculum bottlenecks. Neither faculty nor students expressed concerns about availability of office staff relative to publications, however, there are issues with all the laboratory orders for supplies being channeled through the laboratory coordinator, who is heavily overloaded due to the increased enrollment. The increased size of the program and the growth in research productivity are causing strains. A suggestion is purchasing functions should be moved to administrative office, and if the department grows further, that one office staffer be hired to manage accounts and provide support to the graduate program. This aspect of the program, at the very least, needs reorganization and redistribution of specialized tasks.

**Library support.** While graduate students and research faculty do have all necessary references available via inter-library loan, their access to full text electronic copies of journal articles and technical books should be increased. The current situation is slowing research paper and thesis completion. We suggest the departmental faculty should meet with the librarians to discuss current availability and reduction of interlibrary loans by modifying UTC licensing of publication data bases.

**Laboratory space, office space, and physical infrastructure.** The department currently has a wide range of infrastructure support for its graduate program, from superior to inadequate. The availability of field laboratory space near campus, and the well-established and friendly relationships with managers of natural areas and government facilities are highly beneficial to the program. Faculty investigators have obtained boats and trucks to support field studies. The geographic information system laboratory is well maintained and provides large printers and professional software. Up-to-date instrumentation is available to support microscopy and molecular research. Faculty investigators have obtained instruments and equipment through both research and educational grants and should be commended for their efforts.

The research laboratory space available to individual faculty members is highly variable, and new faculty hires do not automatically have an individual research laboratory available. There is wide variation in the square footage per faculty researcher and per graduate student, and the department lacks an allocation and management plan. Some laboratory space is cluttered with old equipment and utilization efficiency could be improved. The department lacks a system of
individual graduate student desks or carrels either in or adjoining the laboratories. The graduate students do have a shared office with adequate desk space, and older computers. Assuming a new science building will be constructed in the near future, the university should examine norms of spatial allocation at other similar institutions, and establish guidelines for appropriate allocation of shared space versus individual faculty laboratories. The department should evaluate current levels of research laboratory use and instrumentation and develop a plan to guide research laboratory management for the long term. Each graduate student engaged in research should have an assigned desk in or near their research laboratory area, and should have adequate bench space available, relative to the specific genre of research. Teaching assistants should have access to desk space and computers where class materials such as tests can be well-secured, and graduate assistants can meet with undergraduates who are experiencing difficulties in courses or laboratories in a appropriate setting for individual discussions. Since the students we spoke to indicated copies of tests are in circulation prior to examinations, graduate offices and desks do need locks and other forms of controlled access.

The reviewers noted numerous issues with both teaching and research laboratory management, including absence of standard safety practices, inadequate storage for chemicals and preserved specimens, non-specific collection of chemical wastes, and clutter. The growth of the department and increased enrollment has over-whelmed the department’s established system of risk management. Rather than wait for a new building, the department should reorganize its safety program, to provide better and more consistent risk management practices for its laboratories. The supervision of safety for research laboratories could be transferred to experienced faculty. The department should improve training for both faculty and graduate students. While adequate storage is best provided by the expected building program, the department should develop an interim plan based on best practices for flammables, and other hazardous materials. Tidying areas with accumulations of boxes, older instruments, and specimens could recover useable space. Engaging graduate students in these procedures prepares them for the work force, and safety certifications may be added to their resumes.

**Program evaluation**

**Definition of program outcomes.** The department has already established appropriate goals for assessing outcomes via standardized exit surveys, providing opportunities for research, and providing field experiences and internships. These assessment goals are being met with carefully structured protocols, data collection and analysis. The department has established numerous criteria with which to evaluate sufficient achievement of intended program outcomes. These criteria appear to be appropriate to the intended purpose and robust. The participating departmental faculty members are to be commended for the detailed descriptions of these assessment instruments in their self-study document. It is clear that the department does use results of these instruments to strengthen their programs, and they are committed to continuing and expanding these efforts into the future.
Skills and student outcomes. Considering the size and institutional context of the program, the M.S. in Environmental Science is performing well in terms of placing its graduates and has practical curriculum in terms of expected skills. Basic knowledge of environmental law and compliance, ecosystem management, geographic information systems, environmental chemistry, hazardous materials, environmental toxicology, and statistics are all covered in the graduate curriculum and are backed by laboratory or field instruction where appropriate. The program should carefully consider cases where students are currently entering fields, such as planning or environmental health and safety, without extensive supplemental course work. As the program grows and matures it should carefully weigh the regional employers’ needs in determining the skills provided by future faculty hires. If an additional master’s degree is ultimately added, the department should consider the possibility of further enhancement of skills development between the degrees. Possibilities include expanding opportunities for skills acquisition in fields such as conservation genetics, or environmental health.

Oral examinations and final defense. The program requires a final examination including oral questions to determine level of expertise, and depth of knowledge, as well as a defense for thesis students. This process appears to functioning well. The completion of student publications is currently the greater concern. The thesis process is rigorous and is producing documents of adequate professional quality to serve as contributions to contracted technical reports. The proportion reaching refereed publication, however, remains below half and should be increased. The successful completion of professional internships is also effective, and provides a successful interface with regional employers.

Research mastery. The thesis process is carefully structured and demanding, providing an appropriate level of professional discipline. The process could be improved by further emphasis on refereed publication.

Are completion rates at an acceptable level?

Current trends in degrees awarded. The M.S. in Environmental Science has a high percentage of students who are employed off-campus, a factor which can slow progress to completion in a graduate degree program. Environmental programs with field-based theses or internships are often slower to completion than masters programs based in library or archival research. The Environmental Science M.S. internship option requires 15 weeks of 40 hours per week employment, thus it requires an entire term in addition to course work. The program has approximately 35 students enrolled annually and over the past four years has averaged around 8 completed masters degrees per year, although 2011 and 2010 had fewer graduates (11) than 2009 and 2008 (20). The enrollment has fluctuated between 27 (fall 2009) and 41 (fall 2008). Graduation rates are thus about .22% of enrollment, or conversely, the completion rate per one enrollment is more than 4 years. The self-study report did not distinguish between full time and part time enrollments in terms of time to completion. While current retention and graduation rates appear to be adequate, the department should consider further monitoring and setting
additional goals for completion of full-time versus part-time students. While a completion rate per enrollment of 4 years is reasonable for part-time students, the goal for full-time graduate students should be 3.0 or less. The available data do suggest the department should consider strategies to speed degree completion. Possible barriers include course access for students with full-time employment, the current limitations on research space, and the differential number of students supervised by graduate major advisors.

**Evaluation of completion rates.** While the program is maintaining data on completion, the growth of the department overall and the number of graduate students suggests the department should further evaluate the retention and progress of graduate students who are teaching assistants versus those with other sources of support and determine where losses and barriers to graduation are concentrated. The department should track research success versus entering student credentials, including GPA and GRE scores. A key question with increased research productivity is: which graduate students are pursuing research to refereed publication, and what are indicators of timely completion of research?

**Does the program systematically track its graduates?**

**Tracking mechanisms.** Since the last review, the department has improved its tracking of graduate outcomes. The department should continue this effort to enhance its collection of student data, its efforts at placing completed students with suitable employers, and its communications with regional businesses, government agencies, and NGOs. The program does maintain personal contacts with graduates remaining in the region and provided a detailed list of outcomes in terms of placement of its graduates. The reviewers would encourage the department to work closely with the UTC Office of Planning Evaluation & Institutional Research to more closely monitor and assess graduates’ admittance to and performance in graduate schools and their placement in relevant occupational positions. This type of tracking can be extremely challenging, since students often change addresses several times in the years following graduation, and students are not necessarily motivated to stay in touch with their home department. The department has a link on its website where students can update information, but additional strategies for tracking students and their accomplishments are encouraged.

**Placement of graduates.** The department is effectively using its regional network and internships for graduate placement. Many of the students are already employed and are seeking credentials which will enhance their salaries or their professional mobility. The department has already achieved a high level of placement within the environmental and related fields. The program has earned academic credibility for its degree, and is already sending a portion of its graduates to J.D. and Ph.D. programs. As the department improves its research strength, it should consider a greater emphasis on placing the best students in terminal degree programs.
Overall impressions

A first impression is this is an Environmental Science M.S. program that is accomplishing “alot with alittle”. The department is working around shared lab space, while making intelligent and efficient use of its admirable alignment of field resources. The graduate faculty are strongly committed, and have caring attitudes toward their students. A high level of collegiality is compensating for fiscal and infrastructure limitations. The graduate students are satisfied with the curriculum and have a strong identification with Chattanooga and the east Tennessee region. Students are receiving sound professional training, and the department is steadily improving its research productivity and quality. The internship program is functioning well, and the graduate program’s network with regional employers is solidly rooted. The program has much potential to expand its research base and to further improve its scholarly standing.

The major weaknesses are the deficiencies concerning research space for both faculty and graduate students, the inadequate number of teaching assistantships and their noncompetitive compensation, and the differential role of the tenure track faculty in graduate mentoring. The refereed publication of theses is sporadic. The program has had more than one graduate director in recent years, and some administrative processes need to be stabilized.

Recommendations and goals

1 – The most serious need of the program is greater and improved laboratory space to support graduate student research projects. The graduate students needs carrels or desks adjoining the labs, and shared office space needs computers with adequate speed and security. The planned new building should meet these needs. Each research faculty member needs an individual laboratory with adequate space for graduate and undergraduate research assistants. In the meantime, the department should consider improving their system of laboratory space allocation and management, might recover some space by temporary reorganization until the new building is available. New faculty members need working laboratory space as soon as possible after their arrival.

2 – Due to the great increase in undergraduate enrollment and the expansion of the research program, the department should increase the number of teaching assistants. A plan should be in place to expand the teaching support in tandem with enrollment growth, as university budgets allow. The department has fallen behind and has labs currently filling to capacity. The addition of a teaching assistant per year for the next five years will probably fall woefully short if current growth continues. Laboratory sections should be planned with a few open seats when enrollment finishes to allow students to move sections and to prevent closing students out as enrollment fluctuates. A usual minimum for life sciences departments is one teaching assistant per tenure track faculty member, although the optimal figure does depend on laboratory structure, and the number of adjuncts teaching laboratories.
3 – The department faculty should establish goals for slowly raising graduate student publication levels, and should increase the emphasis on refereed products. While the department should determine the most practical strategy, a five year goal might be at least 50% of research track masters students producing a refereed publication.

4 – Teaching assistant compensation is currently below the lowest level reported by the Chronicle of Higher Education, placing it near the bottom nationally. The university should improve compensation, and consider a program to provide health insurance for graduate students at a reasonable cost. The compensation should rise to levels comparable with similar programs at middle-sized state universities in the southeast.

5 – The department should establish a long term protocol for graduate program management, including outreach, regular revision of handbooks and other activities.

6 – The department should evaluate the potential for additional degrees or tracks which would provide better access to graduate research assistants for all tenure track faculty, and thereby improve the department’s research profile. Possibilities that would enhance the M.S. in Environmental Science include an organismal biology program, or a graduate option with a biomedical emphasis. The department should consider planning for an applied environmental PhD program, although this would likely be further away than a second M.S. program. Important steps toward an eventual PhD include raising student publication levels, better distribution of graduate advisees among the tenure track faculty, and developing improved research laboratory facilities.

7 – The departmental safety program should be reorganized, if possible under the guidance of a professional safety officer, and the graduate students should receive training appropriate to both teaching laboratories and research laboratories. As the department expands its research repertoire, additional specialized safety training will be necessary. Monitoring of chemical hazards and implementation of standard safety practices needs to be improved. The expansion of the research and teaching laboratory activities has over-whelmed the current system of safety management based on a single teaching laboratory coordinator. This is a very immediate need and should be addressed as soon as possible, with an interim plan, rather than waiting for improved space in a new building. Formal training for graduate students is beneficial in terms of preparation for long term employment and can be included in their academic resumes.

8 – Departmental faculty should meet with the senior library staff to discuss improvements in access to electronic resources, particularly full text journal articles.

9 – The department should make further use of graduate school resources to improve advertising and outreach to potential applicants.

10 - The department should consider dropping or enhancing the Learned Discourse degree option.
In order to guide the department concerning optimal mentoring strategies, the department chair should monitor basic metrics such as annual publication rate, percentage of theses published, and graduate time to completion by the number of graduate students in a particular research operation or working under a faculty mentor. The department and the university should consider further load reductions for exceptionally high graduate supervisory loads.

**Strategies for attaining these goals**

**Goals not contingent on budget**

An increase in publication and improvements in graduate program administration and safety can be attained by testing new administrative strategies and developing temporary task force groups (rather than permanent committees) to manage future planning. Possibilities for increasing refereed publication rates might include encouraging more pre-publication of thesis contents or establishing publication of a refereed professional journal article as an alternative to thesis completion. Graduate students not entering terminal degree programs are less likely to publish after completing a master’s degree, and encouraging preparation for publication prior to departure might be effective. In addition, faculty could make agreements concerning final authorship prior to student graduation, and negotiate deadlines for publication.

The department could ask the graduate students to assist with some tasks, such as updating sections of the graduate handbook which are primarily informational, or organizing a fall “meet-the-faculty” event. With appropriate training, graduate students can become safety “officers” or monitors for individual laboratory or storage areas, and can perform regular inspections and clean-ups. A permanent protocol for managing the graduate program will reduce fluctuations and provide guidance as graduate directors rotate. Modifications in degree requirements may improve publication rates, as may changes in the way research is converted into thesis formats. Department representatives or the graduate director can meet with the libraries and the graduate school to improve graduate student or program access to resources.

**Goals contingent on funding allocations**

By far the most critical strategy is the continuation of the proposed building program, and careful implementation of planning for new laboratory areas. Members of the faculty should visit other campuses to look at superior designs for science buildings prior to interacting with architects and building design specialists. The department needs to avoid “living in the past” and should consider which patterns of spatial management it should keep and which should be replaced and completely revised. Conversations with the faculty indicate they recognize this and are proceeding accordingly.

The department is already competing successfully for grant funding for graduate student stipends and research support. Providing better access to graduate student research assistants for faculty members in molecular biology and other fields which are not directly environmental has the
potential to raise the level of graduate support. The department should continue its efforts to align graduate assistantships with undergraduate enrollment growth, and to exercise good stewardship of graduate positions. The department and the administration should agree on a plan to supplement teaching support in line with enrollment curves.

Thank you for the opportunity to participate in this exciting and illuminating review.