

## LEVEL II MEMORANDUM

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**DATE:** July 5, 2011

**TO:** Chief Academic Officers, Montana University System

**FROM:** Sylvia Moore, Deputy Commissioner for Academic, Research, & Student Affairs  
John Cech, Deputy Commissioner for Two-Year & Community College Education

**RE:** Level II Submission Items

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The campuses of the Montana University System have proposed new academic programs or changes under the Level II approval process authorized by the Montana Board of Regents. The Level II proposals are being sent to you for your review and approval. If you have concerns about a particular proposal, you should share those concerns with your colleagues at that institution and try to come to some understanding. If you cannot resolve your concerns, you need to raise those concerns at the Chief Academic Officer's conference call on **July 6**. Issues not resolved at that meeting should be submitted in writing to OCHE by noon on **Friday, July 15**. That notification should be directed to Summer Marston, Assistant to the Deputy Commissioners. If Summer does not hear from you, in writing, by noon on July 15, OCHE will assume that the proposals have your approval.

**The Level II submissions are as follows:**

**The University of Montana-Missoula:**

- Systems Ecology Graduate Program (MS and PhD); The University of Montana–Missoula  
[ITEM #152-1002-R0811](#)

# Montana Board of Regents

## LEVEL II REQUEST FORM

Item Number: 152-1002-R0811 Meeting Date: August 2, 2011  
Institution: The University of Montana-Missoula CIP Code: 26.1301 Ecology  
Program Title: Systems Ecology Graduate Program (M.S. and Ph.D.)

Level II proposals require approval by the Board of Regents.

**Level II action requested (place an X for all that apply and submit with completed Curriculum Proposals Form):**

Level II proposals entail substantive additions to, alterations in, or termination of programs, structures, or administrative or academic entities typically characterized by the (a) addition, reassignment, or elimination of personnel, facilities, or courses of instruction; (b) rearrangement of budgets, cost centers, funding sources; and (c) changes which by implication could impact other campuses within the Montana University System and community colleges. Board policy 303.1 indicates the curricular proposals in this category:

- 1. Change names of degrees (e.g. from B.A. to B.F.A.)
- 2. Implement a new minor or certificate where there is no major or no option in a major;
- 3. Establish new degrees and add majors to existing degrees;
- 4. Expand/extend approved mission; and
- 5. Any other changes in governance and organization as described in Board of Regents' Policy 218, such as formation, elimination or consolidation of a college, division, school, department, institute, bureau, center, station, laboratory, or similar unit.

**Specify Request:**

The University of Montana – Missoula requests permission to create a graduate program (MS and PhD) in Systems Ecology as an intercollegiate program between the College of Arts and Sciences (CAS) and the College of Forestry and Conservation (CFC). Systems ecology is an interdisciplinary approach to the study of ecosystems that recognizes spatial and temporal boundaries, defines internal elements of physical, chemical and biological character, and resolves the ecological behavior that results from their interactions. The program will consolidate the discipline of systems ecology developed at the University of Montana within the framework of a single administrative and academic program. The Division of Biological Sciences (CAS) will be the primary administrative home for the program. The program is based on existing interdisciplinary faculty distributed across several departments in both CAS and CFC, but will welcome associate and affiliate faculty members from other units, colleges, universities and agencies. The Systems Ecology graduate program will be highly interdisciplinary, cross-cutting, and collaborative. We particularly expect close collaboration and complimentary research and academic activities with MSU faculty through the Ecology and Environmental Sciences academic program. This will be facilitated by the recently funded MUS NSF-EPSCoR program that sets a goal of collaboration between a future Systems Ecology graduate program at UM with the EES graduate program at MSU.

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### 1. Overview

#### ***Mission Statement – The University of Montana-Missoula (in italics)***

*The University of Montana-Missoula pursues academic excellence as demonstrated by the quality of curriculum and instruction, student performance, and faculty professional accomplishments. The University accomplishes this mission, in part, by providing unique educational experiences through the integration of the liberal arts, graduate study, and professional training with international and interdisciplinary emphases. The University also educates competent and humane professionals and informed, ethical, and engaged citizens of local and global communities; and provides basic and applied research, technology transfer, cultural outreach, and service benefiting the local community, region, State, nation and the world.*

The University of Montana-Missoula (UM) proposes to create a graduate program in “Systems Ecology” as an intercollegiate program between the College of Arts and Sciences (CAS) and the College of Forestry and Conservation (CFC). Systems ecology is an interdisciplinary approach to the study of ecosystems that recognizes spatial and temporal boundaries, defines internal elements of physical, chemical and biological character, and resolves the ecological behavior that results from their interactions. Systems Ecology emphasizes understanding and adapting to complexity arising from natural-cultural structure, processes and dynamics of regional landscapes and focuses on how cultural attributes of large landscapes influence availability and value of natural ecosystem services (e.g., water, food, fiber, amenities). The proposed Systems Ecology graduate program very closely fits the UM Mission Statement given above. As a discipline, Systems Ecology is inherently interdisciplinary. Foundational to the purpose of the graduate program will be broad collaboration across colleges and departments within the university and close collaboration and development of an integrated academic program with the Ecology and Environmental Sciences graduate program at MSU, as complementary “sister” programs. (We address details of this collaborative relationship between the UM – SE graduate program and the MSU – EES graduate program more fully below in Section 4E.) The Systems Ecology graduate program will fully incorporate the principles and approaches to academics expressed in the UM Academic Strategic Plan “Strategic Initiatives to Guide Academic Affairs at The University of Montana 2010–2015” (October 30, 2009). Specifically it addresses issues inherent in both the Graduate Education and Research initiatives within the Academic Strategic Plan. In addition, the Systems Ecology graduate program is a foundational component of the Flathead Lake Biological Station Strategic Plan (January 31, 2008) to bring stronger integration of FLBS faculty and graduate students with the UM campus. The Systems Ecology program, as proposed, specifically fosters strong academic, research and strategic ties with graduate programs with similar areas of interest at MSU and other universities in the region, particularly University of Idaho and University of Wyoming. The program will also enhance UM’s potential for expanded international graduate study.

### **2. Provide a one paragraph description of the proposed program. Be specific about what degree, major, minor or option is sought.**

Proposed is an intercollegiate MS and PhD graduate program with the stated degree in “Systems Ecology” that would produce graduates with critical skills and knowledge to deal with Montana’s environments, enhance the ecological research activities of Montana’s companies, agencies, non-governmental organizations, and universities, and help meet goals established for the future of the MUS and UM. Systems ecology as a discipline, is an especially valuable approach for research (both basic and applied) and education. The systems ecology approach is to stratify the research into study of interrelated parts

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and processes and to facilitate synthesis and broad understanding at very large spatial and/or temporal scales. Systems ecology recognizes that critical ecological goods and services are accomplished by large, landscape-scale ecosystems that have important natural and cultural values (e.g., cleansing of water, recycling of nutrients, production of food and fiber, mitigation of pollution and wastes). Systems ecology also recognizes that natural and social systems are strongly coupled, complex, and continuously evolving. Systems ecology recognizes the strongly interactive role that humans play affecting most of the earth's ecosystems. As such, this program will play a vital role in the fundamental understanding of interactions of physical, chemical and biological factors affecting ecology at large spatial and temporal scales. The Systems Ecology graduate program will integrate teaching, research and outreach through an interdisciplinary approach to ecological understanding and problem solving. Research emanating from the program will promote healthy ecosystems, understanding of system processes across the large landscapes of Montana, and will enhance UM's role in advancing principles of environmental stewardship throughout the Northern Rocky Mountain Region and the nation. The Systems Ecology program will build on existing faculty-to-faculty collaborations and research relationships and will seek to develop a strongly inactive and complementary graduate program with the Ecological and Environmental Sciences graduate program at Montana State University.

### 3. Need

#### A. To what specific need is the institution responding in developing the proposed program?

*Board of Regents Goals (from: [http://mus.edu/data/strategic\\_plan.asp](http://mus.edu/data/strategic_plan.asp)) (in italics)*

*1) Increase the overall educational attainment of Montanans through increased participation, retention, and completion rates in the Montana University System. 2) Assist in the expansion and improvement of the state's economy through the development of high value jobs and the diversification of the economic base. 3) Improve institutional and system efficiency and effectiveness.*

*Maintaining the high quality of our institutions and the education provided to our students is not listed as an explicit goal. This is because it is THE MOST IMPORTANT consideration for every goal and initiative of the Montana University System and is considered to be an integral part of every component of this strategic plan.*

*The first goal reinforces what has always been the core mission of public higher education – to provide access to a quality postsecondary education for our citizens. In light of trends during the past decade, access requires affordability and this does mean, in part, increased state support. It also means the university system needs to do a better job of reaching remote, disadvantaged, and nontraditional students; using technology to deliver education; and working more closely with K-12 education to make the transition to college seamless. The second goal recognizes the two critical roles that a university system must play, for both traditional industries and the “new economy,” in an increasingly global marketplace. It must train a skilled workforce for the types of jobs that exist, or will exist, in the economy. It is also a principle source of research and technology that fuel the innovation vital for any successful company to grow. The third and final goal gives a high priority to stewardship of the resources we have been provided to help attain these goals. How well the Montana University System manages costs, allocates resources, and tracks this accountability with hard data is critical for improving credibility and keeping higher education accessible for all our citizens.*

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The Systems Ecology graduate program is fully commensurate with and embraces the goals and concepts articulated in the BoR Goals and objectives given above. Specifically it focuses on Goal 1, to increase the educational attainment of Montanans and Goal 2, assist in the expansion and improvement of the state's economy. It does this by providing another pathway to graduate education targeted at a set of critical issues for Montana; a focus on understanding, maintaining, and restoring Montana environments, producing graduates who will lead Montana companies, universities and federal, state and tribal agencies in the broad area of ecosystem science, and enhancing ecological research programs in Montana. The Systems Ecology graduate program also will form a strategic and long term component in the Montana University System Science and Technology Strategic Plan (*Montana Science Serving Montana Citizens* - January 2009), in the science focus area of Environmental and Ecosystem Science. This plan was written by the Montana University System Science and Technology Advisory Committee (MUSSTAC) and is available for review on the MUS website [see <http://mus.edu/board/meetings/2011/Aug2011/MUSSTACbrochure.pdf>]. A fundamental component of the MUS Science and Technology Strategic Plan is increased levels of collaboration and interdisciplinary research and education between UM and MSU.

Systems Ecology fills a national call as well as fulfilling strategic state and regional needs. We live in an increasingly connected world where human mediated transformations can reverberate locally to globally in ways that redefine everyday life. It is fundamentally important that the University develop academics and professionals that think critically about these connections and pursue rigorous scientific inquiry into the processes of how ecological systems function across multiple spatial and temporal scales. Systems ecology is a discipline concerning the information needed to understand and direct complex transformative processes, like climate or economic change, as clearly articulated in recent reports by The Intergovernment Panel on Climate Change ([www.ipcc.ch](http://www.ipcc.ch)), the Millennium Ecosystem Assessment ([www.MAweb.org](http://www.MAweb.org)) and Heinz Center Report on the State of the Nation's Ecosystems ([www.heinzctr.org/ecosystems](http://www.heinzctr.org/ecosystems)). A systems ecology approach increasingly depends on efficient analysis and computational tools that allow for greater and more insightful synthesis and visualization of processes and responses that influence well-being of ecosystems and humans. This type of synthesis requires cross-disciplinary thinking because the problems and questions transcend traditional disciplinary boundaries. Indeed, two recent reports from influential members of the USA ecological community to NSF have stressed the need for greater interdisciplinary synthesis in ecology through expanded use of long term ecological research sites and establishment of regional synthesis centers (Robertson and Collins 2007; Carpenter et al., 2009). The main objectives in the Systems Ecology Program are to:

1. create knowledge about linkages between natural and cultural attributes in benchmark ecosystems (e.g., the Crown of the Continent and Greater Yellowstone ecosystems);
2. enhance the learning experience for graduate students interested in broad questions in ecology, particularly at landscape spatial scales;
3. develop the professional capacity of these students; and
4. use the knowledge generated through this program to inform policy, broadly defined, for Montana, the Northern Rocky Mountain Region and the Nation.

#### **B. How will students and any other affected constituencies be served by the proposed program?**

Systems ecology is, in part, the examination of how ecosystems function as determined by the components of the ecosystem and how those components cycle, retain, or exchange energy and

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nutrients. The discipline typically involves the application of models that track processes such as the flow of energy and materials and predict the responses of systems to perturbations that range from fires to climate change to species extinctions. Systems ecology is a powerful theoretical approach that can simultaneously examine a system from the level of individuals all the way up to the level of ecosystem or regional dynamics. It is an especially valuable approach for investigating large and complicated systems that do not lend themselves to experiments, and even when observations of the entire system are impractical. In these settings, the best approach to help formalize understanding of how the system functions and to provide insight into probable trends and outcomes is to assemble a system model that pieces together all components. A Systems Ecology graduate program that formally organizes faculty and graduate students provides a common framework for resolving understanding of complex interactions surrounding ecological and human problems. The training and the graduate certifications of the Systems Ecology program will enhance broad understanding among future professionals that will be entrusted with managing the State's and the region's rich traditions of environmental stewardship.

Montana possesses broad, sweeping landscapes and large riverscapes; yet like much of the world, it is at an ecological crossroad. Faced with changing climate, water- and land-use demands, changes in disturbance regimes (e.g., wildland fire, flood and draught frequencies, and insect epidemics), and urban development on the edges of its forests and grasslands, Montana must be prepared intellectually and practically to understand and manage the complex relationships between natural and human systems. Ensuring sustainability of Montana's land and water, as well as economy, is an urgency shared by scientists, land-use managers, and policy makers. Society benefits from a multitude of resources and processes that are supplied by the natural and managed ecosystems of Montana. For example, Montana serves as a major "water tower" for the continent with rivers draining to the Pacific (Columbia), Atlantic (Missouri/Mississippi) and Arctic (Saskatchewan). Montana's traditional economies have depended on crops, forage, wood, and mineral extraction, but these are being supplanted by new amenity-based communities with different demands for ecosystem goods and services. Yet, in spite of its expansive landscapes and extensive wild lands, the state's natural and managed ecosystems are at risk from large-scale changes in climate and social and economic forces.

The training received by Systems Ecology graduate students will result in the development of professionals well prepared for a very competitive job market. Faculty at UM that will be the primary participants and employ a systems ecology approach have successfully mentored students proven to be successful in the acquisition of jobs in academics, as well as private- or public-sector organizations that focus on ecological processes or problems at large spatial scales. Graduation from a formalized Systems Ecology Program will make these students even more competitive and emphasize the role that UM plays in developing this expertise.

#### **C. What is the anticipated demand for the program? How was this determined?**

The graduate program should reach a steady state over the course of the next 2-4 years. We expect Systems Ecology tenure-line faculty to have 2-4 graduate students at any one time and research faculty to have 1-2 students. This is in line with the long term level of graduate support of the current faculty engaged in systems ecology research (as a discipline) at UM. With the recent faculty recruitments, we anticipate a graduate student enrollment in the Systems Ecology Graduate Program to be between 30-35 students, but as the program grows in faculty strength and participation (over 20 faculty from across the UM campus have been routinely participating in the SE program development

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meetings) this number may increase to 40-50. Systems Ecology will adopt the existing FLBS program of tracking graduate student careers following graduation, and this will be complemented with annual reports to the Systems Ecology Advisory Committee concerning metrics of progress and performance of current graduate students (e.g., completion statistics, distribution of times to degree, percentage of students that successfully pass program requirement deadlines in a timely fashion). The Systems Ecology program will develop specific metrics of success and be evaluated by internal and external evaluators as part of the *Strategic Plan for The University of Montana titled UM 2020: Building a University for the Global Century*. (This process is explained in greater detail in the Assessment section below.)

Some recent employment activities are indicative of what might happen with this new program. For example, recent opportunities have ranged from academics at Montana universities (e.g., Dr. Geoff Poole, Assistant Professor at MSU, Dr. Michelle Anderson, Assistant Professor at UM Western) and regional universities (e.g., Dr. Colden Baxter, Associate Professor at Idaho State University), to state and federal agencies (e.g., Joel Tohtz, MDFWP) to NGOs and consulting firms (Sarah O'Neal, The Nature Conservancy). While these example UM graduates did not receive their degrees from Systems Ecology as a graduate program, they all were educated as systems ecologists and later recruited, at least partly, based on their broad interdisciplinary training.

Systems Ecology, as a graduate program and as a discipline is important to the State of Montana and indeed the region and the nation. Systems Ecology graduates will be needed to address problems that directly affect the economy of the state and therefore will directly impact both the demand for professionals with training in systems ecology and demand by students for the degree program. The GDP of Montana is approximately \$35B per year. A significant portion of this economic activity (>35%) is connected in various ways to the Montana environment, including forestry, agriculture, energy production and transmission, and tourism, especially eco-tourism. Maintaining a sustainable economy, while also maintaining a uniquely Montana way of life with protection of ecosystem goods and services, is one of the compelling challenges of the 21st century. This graduate program, the interdisciplinary science approach upon which it is founded, and the training of graduate students that will be the future's teachers, academics, researchers, agency executives, corporate managers and scientists, and practitioners of ecological restoration, will have a profound effect on the state's and region's economy and on the maintenance of Montana's environmental heritage. Currently half of all PhD graduates from Montana's System of Higher Education stay in Montana after graduation. This proportion is even higher for natural resource graduates given the state's abundant resources and critical needs. As employment fields, such as wildland and ecological restoration, expand and as ecological science is enhanced in Montana, more jobs will be created to capture the talents of Montana graduates from a Systems Ecology program.

#### 4. Institutional and System Fit

##### A. What is the connection between the proposed program and existing programs at the institution?

Systems Ecology will add opportunity and capacity to the overall UM graduate program. It will offer a distinct pathway to education and employment for Montanans desiring to meet the challenges of a changing Montana landscape and work in the sectors of our economy that influence, and are influenced by, our diverse ecosystems and the health of those ecosystems. UM does not currently have a defined graduate program focused on a systems analysis of ecosystem processes (natural and

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cultural); although there are faculty members in various departments across the campus that conduct research that is commensurate with a systems analysis approach. Scaling biophysical systems is a key learning issue in the proposed program because while some systems ecology problems are examined at very small scales (e.g., a particular rock in a river or a single tree in mixed forests) other systems problems require use of global scale models that are used to understand and predict influences of disturbances, such as climate change, on plants and animals, or crops and other human systems within a landscape context. The proposed program is fundamentally expansive and integrative. It requires knowledge and appreciation of the strong interaction between biology, chemistry, physics and geology as linked ecological processes. The conceptual theme of scaling processes from small to large landscape scales pervades the research of the faculty of the proposed program. Thus, the proposed program builds from the long-term research thrust of interdisciplinary faculty members at UM and adds a novel integrative focus within the framework of a specific graduate program that provides greater opportunity for graduate students seeking broad training in processes that conserve and enhance ecosystem goods and services essential to human well being. Because the focus of this graduate program is fundamentally about understanding the interrelationship of diverse natural processes across expansive spatial scales, and explicitly integrating basic science into management and policy outcomes, the proposed program is entirely appropriate as an Intercollegiate Graduate Program.

The structure of the Systems Ecology Program will be intercollegiate within UM between the College of Arts and Sciences and the College of Forestry and Conservation. Many of the UM faculty and their students that will participate in this Program are already engaged in research topics commensurate with systems ecology, as a discipline. Faculty will typically support students financially through research assistantships (RAs) and intellectually by advising them in the generation and development of novel research questions. The course work for the program is expansive, in that we have identified over 30 extant UG 400-level and G 500-level courses of three or more credits each that would be appropriate for graduate students to select from in their program of study. In addition, the Systems Ecology faculty at Flathead Lake Biological Station will add four 3-credit courses to this suite as part of their existing tenure lines at no increase in financial cost to the university. The strong role played by FLBS in the program leverages the long-term strategic plan of UM to capitalize on the infrastructure investments made by the MUS in FLBS.

**B. Will approval of the proposed program require changes to any existing programs at the institution? If so, please describe.**

As an Intercollegiate graduate program, Systems Ecology has been thoroughly explored across multiple departments and colleges at The University of Montana. There is no conflict with or changes needed to any existing programs at the institution.

**C. Describe what differentiates this program from other, closely related programs at the institution (if appropriate).**

Systems ecology differs from ecology in both emphasis and approach. Where ecology is the scientific study of the distributions, abundances, and relations among organisms and their interactions with the environment, systems ecology emphasizes the integration of physical, chemical, and biological approaches to scientific inquiry of ecosystem structure and function and the social/cultural context in which these processes occur. As a result, systems ecology addresses large spatial scales and the role of

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processes, such as nutrient cycling, bioenergetics, and habitat connectivity in explaining the ecological character of ecosystems. The proposed program also differs from many existing approaches in ecology through its primary emphasis on large-scale patterns and processes and the fundamental integration of human activities into natural landscapes. The proposed program is complementary to other graduate programs existing within and between departments at UM (e.g., Wildlife Biology, Organismal Biology and Ecology) and with the Ecology and Ecosystem Science intercollegiate graduate program at MSU–Bozeman. However, the Systems Ecology Program at UM will neither be a duplication of, nor be a direct competitor with, other programs at UM or the EES Program at MSU. Rather, the synergies between programs underscore the growing need across the nation for interdisciplinary science, the enhanced productivity that an intercollegiate program affords within an institution and the value that the Systems Ecology Program will make to an already growing collaboration among the allied faculty within the Montana University System and throughout the region.

The objectives of the proposed graduate program are to: 1) prepare students for productive careers in large-scale ecological research and management, and 2) to train students to answer novel research questions about ecological patterns and processes by integrating physical, chemical, and biological sciences. Research questions may be focused on basic issues (e.g., nutrient spiraling in rivers, connectivity and gene flow of bull trout) or applied problems (e.g., nutrients as pollution to rivers, societal valuation of salmonids) or at the interface between them. Students will be taught to understand and integrate diverse processes that affect ecological systems, from an array of physical, chemical and biological factors (e.g., processes of wave energy on lake shores and wetlands, bioenergetics of organism physiology and metabolism, species interactions, externalities of exotic species invasions, effects of climate change on regional hydrologic patterns, and growing human impacts). Beyond a rigorous training in these processes, students will be exposed to the use of models that allow exploration of the effects of many interacting processes on ecosystem patterns and environmental change across multiple spatial and temporal scales.

#### **D. How does the proposed program serve to advance the strategic goals of the institution?**

UM has an established record as a national leader in environmental and natural resource education and science. With undergraduate and graduate programs in areas such as, forestry, field ecology, organismal biology and ecology, wildlife biology, geosciences, conservation, toxicology, environmental law, tourism and outdoor recreation, environmental studies, mountain studies, and watershed science, the addition of a graduate program in Systems Ecology is consistent with UM's identity as a major university emphasizing the environment. Systems Ecology would provide a unique ecological science and education complement to the broad environment and natural resources portfolio of UM.

Coherent with this, a unique benefit of a Systems Ecology graduate program will be that it will foster further development of the undergraduate Field Ecology program in the College of Arts and Sciences department Division of Biological Sciences (DBS), further demonstrating the fit with UM. The Systems Ecology faculty will assume primary responsibility for fully enrolling the Field Ecology undergraduate option in DBS. The teaching plan for this recently approved (Board of Regents 2007) option in DBS is for each of the tenure-line faculty members involved in the Field Ecology curriculum, which is centered at FLBS, to also teach a graduate course in the Systems Ecology graduate program.

The Systems Ecology program will enhance inter-university collaborations and research initiatives, strengthening UM programming while enhancing Montana and regional collaboration and synergy in

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ecological science. Systems ecology oriented ecological research clearly appeals to a broad range of scientists in our region and beyond. There already are strong research relationships and collaborations among environmental and ecosystem sciences faculty at UM [working in systems ecology as a discipline], and Ecology and Environmental Sciences faculty at MSU. For example, beginning 2009 the UM - MSU collaboration titled "COLLABORATIVE RESEARCH: Cyberinfrastructure for a Virtual Observatory and Ecological Informatics System (VOEIS)" involves 7-8 faculty from each university working on a \$3M NSF interdisciplinary grant. In another example, a recent (May 2011) Research Coordination Network proposal to NSF, involved over 70 ecologists, geographers, earth scientists and economists and human ecologists from UM, MSU, University of Idaho, Idaho State University, University of Wyoming and a variety of Federal, State and Tribal entities, in the development and participation in the proposal. The strong sense of inter-university collaboration is further seen in the MUS Science and Technology Strategic Plan (January 2009) and the role of ecosystem sciences in the Montana NSF-EPSCoR program. The MUS is making a significant long-term commitment to emphasizing the importance of regional ecosystems and developing research infrastructure at UM and MSU.

The Systems Ecology program builds on several important complementary and ongoing strengths among faculty and graduate students focused on landscape scale interrelationship between natural and cultural sciences at UM:

1. It integrates academic and research strengths among systems ecology faculty across the Missoula campus;
2. It strengthens research and graduate training collaboration between the Mountain campus in Missoula and the Lake campus of Flathead Lake Biological Station;
3. It enhances existing graduate course offerings by adding four critically important new courses (Advanced Ecosystem Ecology, Integrated Systems Ecology, Advanced Physical Limnology and Advanced Biological Limnology) not offered by title or subject matter elsewhere in the MUS;
4. It is a highly interdisciplinary program that emphasizes both basic and applied science approaches to ecological problems important to Montana and Montanans;
5. It capitalizes on the research and graduate training momentum of both the UM campus and Flathead Lake Biological Station in systems ecology that is recognized nationally and internationally; and

It builds on existing faculty, thus maximizing productivity within a framework of existing resources, including development of the above graduate offerings.

**E. Describe the relationship between the proposed program and any similar programs within the Montana University System. In cases of substantial duplication, explain the need for the proposed program at an additional institution. Describe any efforts that were made to collaborate with these similar programs; and if no efforts were made, explain why. If articulation or transfer agreements have been developed for the substantially duplicated programs, please include the agreement(s) as part of the documentation.**

The Commissioner of Higher Education Office proposed (October 2010) to the National Science Foundation EPSCoR program the development of a Montana University System statewide institute, the Montana Consortium for Environmental Research and Education (a \$24M proposal over 5 years). The proposal was funded in full by NSF beginning in Fall 2011. The Systems Ecology graduate program, as proposed here, has been specifically designed to intersect with the Ecology and Environmental

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Sciences graduate program at MSU with a fundamental goal to develop a unified graduate program in Systems Ecology and EES such that the graduate students can seamlessly acquire the broadest possible coursework and programmatic development available across the MUS. Linking large scale and wide ranging research activity to meaningful academics clearly is a significant part of the future for UM. Systems Ecology provides a substantive new step into that future. This will be facilitated through the Institute and the funding by the NSF-EPSCoR program.

This is envisioned to include:

- joint seminars,
- faculty serving on graduate committees across SE and EES,
- graduate coursework that is offered jointly across the two campuses (and the MUS) through web-casting and other web-based multi-media, and
- collaborative faculty and graduate student research coming out of joint SE and EES interdisciplinary research grants.

The Institute, through the EPSCoR funding, will also provide specific funding to bring UM-SE faculty and graduate students together with MSU-EES faculty and graduate students into interdisciplinary research working groups that will have jointly submitted research proposals as fundamental outcomes. It is the intention of the Institute developers, the NSF-EPSCoR goals, and the Systems Ecology graduate program proposed here along with the EES graduate program at MSU, to fully develop an innovative and fully collaborative research and education program in the ecosystem sciences. In short, the existing EES graduate program at MSU is that institution's mechanism of relating faculty and graduate students to the EPSCoR funded MUS-level Institute while the Systems Ecology program proposed here is UM's mechanism of relating faculty and graduate students to the Institute and its overall objectives.

The Systems Ecology program, as proposed here, is neither program duplication nor directly competitive with the Ecology and Environmental Science (EES) graduate program at MSU. The SE program focuses on understanding and adapting to ecological complexity that necessarily includes structural and behavioral complexity of human systems examined at multiple spatial and temporal scales. The EES program at MSU focus "provides the opportunity for motivated students to integrate our world-class faculty research programs in diverse aspects of ecology and environmental sciences, within the unparalleled natural laboratory that is the Greater Yellowstone Ecosystem." Thus, these two graduate programs, as envisioned here, have many aspects that will be complementary and will enhance the interdisciplinary research capacity between UM and complementarily focused faculty at MSU, as well as other programs among other universities in the MUS and in the region.

Systems Ecology is an Interdisciplinary Graduate Program that has broad interest across the UM-Missoula campus among faculty and graduate students that seek a means of unifying their existing collaborations and strengthening the degree program offered to the graduate students. Many faculty have expressed a strong interest because they believe that interdisciplinary collaborations are necessary to address large-scale ecological problems and will enhance their capacity to retain the top-tier Montana students, as well as, attract the best students from around the nation. The faculty listed here (Table 1) are the UM-Missoula faculty that have committed to participating in the Systems Ecology Graduate Program. This list is not exhaustive, and we expect additional faculty will participate as the program fully develops. Also listed are faculty at MSU-Bozeman and at Montana Tech who

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regularly collaborate with these UM faculty on large-scale research grants in the broad subject of systems ecology, and in many cases have existing grants that are currently being funded.

**Table 1. University of Montana faculty with commitment to, or expressed strong interest in, the Systems Ecology Graduate Program.**

MSU-Bozeman and Montana Tech faculty listed have strong collaborations and research ties to the Systems Ecology faculty listed herein. (This is not an exhaustive list of every potential faculty member at UM who may join the SE graduate program as participating faculty, nor is it exhaustive of the MSU or MT Tech faculty that have collaborations with UM faculty in the focus area; however, it does illustrate the strong interdisciplinary interest in Systems Ecology.)

UM-Missoula	College/Dept	Research Interest
Joel Berger	CAS/DBS/OBE	Large Mammal Ecology
Len Broberg	CAS/EVST	Environmental Law and Policy
Ragan Callaway	CAS/DBS/OBE	Plant Ecology
Cory Cleveland	CFC/DECS	Terrestrial Biogeochemistry
Robert Crabtree	CFC/DECS	Terr. Ecology and Remote Sensing
Solomon Dobrowski	CFC/DFM	Landscape Ecology
Lisa Eby	CFC/DECS	Fish Ecology
Bonnie Ellis	CAS/DBS/FLBS	Lake Limnology
James Gannon	CAS/DBS/IMB	Microbial Ecology
Sarah Halvorson	CAS/Geography	Environment-Society Relations
Richard Hauer	CAS/DBS/FLBS	Stream and Wetland Limnology
William Holben	CAS/DBS/IMB	Microbial Ecology
John Kimball	CAS/DBS/FLBS	Climate and Landscape Modeling
Anna Klene	CAS/Geography	Arctic and Alpine Climatology
Mark Lorang	CAS/DBS/FLBS	Physical Limnology
Gordon Luikart	CAS/DBS/FLBS	Genomics and Conservation Biology
Laurie Marczak	CFC/DECS	Freshwater Invertebrate Ecology
Steve Running	CFC/DECS	Climate Modeling
Jack Stanford	CAS/DBS/FLBS	Ecosystems
Maury Valett	CAS/DBS/FLBS	Freshwater Biogeochemistry
Andrew Wilcox	CAS/Geosciences	Fluvial Geomorphology
William Woessner	CAS/Geosciences	Hydrology

MSU-Bozeman faculty with close research collaborations		
Jack Brookshire	CA/LRES	Biogeochemistry
Wyatt Cross	CLS/DE	Foodwebs and Nutrient Cycling
Daniel Goodman	CLS/DE	Population Dynamics
Andrew Hansen	CLS/DE	Landscape and Spatial Ecology
Lucy Marshall	CA/LRES	Watershed Analysis
Brian McGlynn	CA/LRES	Watershed Hydrology
Geoff Poole	CA/LRES	Landscape Ecology

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Dave Roberts	CLS/DE	Vegetation Population Dynamics
Cathy Whitlock	CLS/DES	Fire Ecology and Paleo-ecology

<b>Montana Tech faculty with close research collaborations</b>		
Chris Gammons	Geol/Eng	Aquatic Chemistry
Steve Parker	Chemistry	Aquatic Chemistry

## 5. Program Details

- A. Provide a detailed description of the proposed curriculum. Where possible, present the information in the form intended to appear in the catalog or other publications. NOTE: In the case of two-year degree programs and certificates of applied science, the curriculum should include enough detail to determine if the characteristics set out in Regents' Policy 301.12 have been met.**

### MS

Master's students must complete a committee-approved program of study composed of at least 30 semester credits of graduate-level coursework and successfully write and defend a thesis. As many as 10 credits may be thesis (BIOL 599), and at least 10 credits of the non-thesis coursework must be at the 500 level or above. Master's students must complete their program of study within five years.

Every Systems Ecology MS student must also complete a condensed core program in systems ecology. Additional courses will be selected in consultation with the graduate committee to support the research program and student's career goals. The condensed core program will consist of the following elements:

- Fundamentals of Ecosystem Ecology (new 500-level graduate course including physical, biological, and social perspectives [see course description below])
- Integrated Systems Ecology (new 500-level graduate course [see course description below])
- Annual participation in the Systems Ecology Seminar series
- A Systems Ecology oriented thesis

In addition to the core program, each Systems Ecology MS student will select, under the supervision and advice of their graduate committee, relevant course work from a broad suite of graduate courses. (See Table 2 below).

### PhD

Basic requirements are a minimum of 60 semester credits beyond a bachelor's degree. As many as 20 credits may be dissertation, (e.g., BIOL 699). The other 40 credits may include coursework, graduate seminars, or independent research (e.g., BIOL 596). Up to 30 credits can be from a master's degree as approved by the student's committee and accepted by the Graduate School. PhD students must also successfully complete comprehensive exams (written and oral) and a successful defense of a dissertation of original research. PhD Students must complete their program of study within seven years.

Systems Ecology PhD students must complete the PhD level core program as an integral part of their program of study, as well as additional courses that support their research program and career goals. The PhD level core program will consist of the following elements:

- Fundamentals of Ecosystem Ecology (new 500-level graduate course including physical,

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- biological, and social perspectives [see course description below])
- Integrated Systems Ecology (new 500-level graduate course [see course description below])
- A graduate level research methods course relevant to the student's research problem (drawn from existing courses)
- An ecological modeling course relevant to the student's research problem (drawn from existing courses)
- Annual participation in Systems Ecology Seminar series
- Comprehensive Exams (written and oral) focused on the student's program of study and research
- Systems Ecology oriented dissertation

In addition to this core program, PhD students will select, under the supervision of their graduate committees, relevant elective course work from a broad suite of graduate courses offered within the College of Arts and Sciences and the College of Forestry and Conservation in geosciences, chemistry, ecology, natural resource sciences, environmental social sciences, and other areas particularly relevant to their research problem and their career goals. As an additional benefit arising from The Systems Ecology Graduate Program, the current broad suite of graduate ecology courses at UM will be diversified by addition of the four courses primarily sponsored through the education and research resources of the Flathead Lake Biological Station. Two of these new courses are proposed as the core courses in the Systems Ecology Program and two would be electives for students primarily interested in lake or running water limnology. These courses are: Advanced Ecosystem Ecology (Core Course), Integrated Systems Ecology (Core Course), Advanced Physical Limnology (Elective) and Advanced Biological Limnology (Elective). Each of these is a 500-level graduate course described below on the attached Course Forms and listed in the following Table 2.

Numerous recent proposals to NSF, USFWS, USGS and other federal agencies, include a significant collaboration component between the systems ecology at UM and environmental and ecosystem sciences at MSU. Commensurate with this goal of shared research and broader relationships between the universities, these courses will be webcast to MSU and Montana Tech [and other MUS campuses], where graduate students may find these courses to be important additions to their graduate program of study.

**Table 2. Systems Ecology Graduate Program - Graduate Courses**

**Core Courses (Required):**

- G 532 Advanced Ecosystems Ecology 3cr (proposed - see course description below)
- G 534 Integrated Systems Ecology 3cr (proposed - see course description below)
- G 531 Systems Ecology Seminar 1cr

**Core Courses 400-level (Elective)**

- UG 407 Global Biogeochemical Cycles
- UG 408 Advanced Fisheries
- UG 415 Field Methods in Fisheries Biology and Management
- UG 432 The Human Role in Environmental Change
- UG 433 Cultural Ecology
- UG 440 Environmental Economics

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- UG 442 Aquatic Chemistry
- UG 451 Landscape Ecology
- UG 452 Conservation Ecology
- UG 453 Lake Ecology
- UG 454 Stream Ecology
- UG 455 Riparian Ecology and Management
- UG 458 Ecology of Forests and Grasslands
- UG 459 Alpine Ecology
- UG 460 Process Geomorphology
- UG 475 Sociology of Environment and Development
- UG 480 Conservation Genetics
- UG 488 Snow, Ice and Climate
- UG 492 Seminars in Ecology and Resource Management

#### **Core Courses 500-level (Elective)**

- G 503 GIS: Methods and Applications I
- G 504 GIS: Methods and Applications II
- G 513 Community Ecology
- G 519 Fire Ecology
- G 536 Advanced Physical Limnology 3cr (proposed - see course description below)
- G 538 Advanced Biological Limnology 3cr (proposed - see course description below)
- G 540 Research Design
- G 541 Environmental Chemistry
- G 545 Advanced Topics in Microbial Ecology
- G 546 Experimental Microbial Ecology
- G 551 Digital Image Processing
- G 560 Fluvial Geomorphology
- G 563 Advanced Topics in Habitat Ecology
- G 565 Advanced Problems in Restoration Ecology
- G 570 Advanced Geochemistry
- G 572 Advanced Hydrogeology
- G 570 Political Ecology
- G 573 Applied Groundwater Modeling
- G 586 Snow Hydrology

#### **Additional Elective Courses at the discretion of the Graduate Advisory Committee**

##### **Courses at MSU as electives for the UM Systems Ecology graduate program**

- BIOL 505 Environmental Analysis
- BIOL 509 Introduction to Practical Modeling
- BIOL 513 Terrestrial Ecology of the Plains and Prairie
- BIOL 520 Animal Biodiversity in the Greater Yellowstone Ecosystem
- BIOL 524 Frontiers in Landscape Ecology

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#### **Courses at Montana Tech as electives for the UM Systems Ecology graduate program**

- CHMY 506 Environmental Chemistry
- CHMY 542 Fate & Transport of Organics in the Environment
- GEOE 520 Advanced Hydrogeology
- GEOE 522 Groundwater Monitoring
- GEOE 523 Groundwater Monitoring Laboratory

It is our intention to work closely and collaboratively with MSU administration and faculty, as well as Montana Tech, to develop the Systems Ecology graduate program and course work such that students can take Systems Ecology and EES courses seamlessly between the campuses. The Institute that will be developed through the NSF-EPSCoR funding will provide Administrative support for both the UM Systems Ecology program and the MSU Ecology and Environmental Sciences program. This includes funded joint seminars and Research Assistantships (RAs) for graduate students. This spirit of collaboration already exists among faculty at UM, MSU and Montana Tech that are functioning broadly within the scope of systems ecology as a discipline. This is also a stated goal of the NSF-EPSCoR proposal discussed in greater detail above that was submitted by the Commissioner of Higher Education Office and development of the Montana Consortium for Environmental Research and Education (MtCERE), (the current name for the MUS-wide Institute that is described herein , although will likely be named something else).

#### **B. Describe the planned implementation of the proposed program, including estimates of numbers of students at each stage.**

Systems Ecology will be an Intercollegiate Graduate Program between the College of Arts and Sciences and the College of Forestry and Conservation administered through the Division of Biological Sciences. Systems Ecology curricula, like other graduate program curricula, will be governed by the faculty participating in the program. Given the intercollegiate nature of the program, a Systems Ecology Program Advisory Committee, consisting of the Dean of the College of Arts and Sciences, the Associate Dean of DBS, the Dean of the College of Forestry and Conservation, the Program Director of Systems Ecology, the Director of FLBS and the Department Chairs of each participating department will be formed. The Advisory Committee will meet at least annually to review program accomplishments and set strategic goals.

We expect a high degree of association with other departmentally-specific graduate programs at UM (e.g., Geosciences, Organismal Biology and Ecology) and with colleagues at MSU, Montana Tech, Montana-based federal agencies, and universities outside the MUS. The day-to-day operations will have strong similarities to other intercollegiate graduate programs at UM. Indeed, the Systems Ecology administrative structure will be similar to that used by the Wildlife Biology Program and the Biochemistry Program at UM. Foundational to the proposal is the goal of greater collaboration among systems ecology faculty at UM and greater integration of FLBS-based faculty into the academic and graduate student mentoring structure of the university. A set of Graduate Student Guidelines for the program have been developed that are coherent with UM Graduate School standards and practices.

The Systems Ecology Program will require an administrative structure and effort on the part of a Program Director. The Program Director will serve for renewable 3-year terms and be drawn from the senior faculty with a tenure home in DBS, the unit having responsibility for administration of the

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program. The responsibilities of the Program Director will be as follows:

- Coordinate with participating unit administrators regarding mutual needs and goals.
- Oversee development of new Systems Ecology courses and coordinate with relevant unit administrators in assigning faculty members to teach these courses.
- Represent the needs of the Systems Ecology Program to the Dean of the College of Arts and Science and the Dean of the College of Forestry and Conservation.
- Work with the faculty in the Systems Ecology Program to develop and maintain the highest quality systems ecology curricula at all levels.
- Publicize the program to grow the number of students at all levels.
- Work with the Associate Dean of DBS and the Director of FLBS to grow and fully develop the Field Ecology option undergraduate program.
- Ensure that effective mechanisms for advising of students at both the graduate and undergraduate level are developed and maintained.
- Ensure that the program lends expertise to the mentoring of junior Systems Ecology Program faculty in collaboration with their respective academic unit administrators.

There are approximately 10-14 graduate students at UM that will transfer into the Systems Ecology graduate program as soon as it is approved. These students have expressed intense interest in the program and the interdisciplinary structure that it affords that is not available within the departmental constructs of graduate education currently available. We anticipate strong recruitment over the next 4-5 years with excellent funding support through the NSF-EPSCoR program.

## 6. Resources

### A. Will additional faculty resources be required to implement this program? If yes, please describe the need and indicate the plan for meeting this need.

Faculty members participating in the program are already extant at UM and are the primary faculty that teach the listed elective courses given in Table 2 (above). The four new 500-level graduate offerings of the Systems Ecology program (also see attached Course Forms) are being developed by FLBS-based faculty as part of their instructional assignments. Three of these faculty members have recently joined the UM faculty at FLBS and their instructional assignments have yet to be fully filled out. Thus, there is opportunity to assign them courses within this program and to adjust their instructional loads in concert with assignments of long-term FLBS faculty members. These recently added faculty were recruited with one-time-only UM Foundation or EPSCoR funding as 0.5 FTE academic and 0.5FTE research faculty. It will be necessary for UM to assume their 0.5 FTE academic support after the initial recruitment funding comes to an end. However, these positions and funding for them are included in the long term funding plans developed by the Provost that include reallocation of funds to be made at the appropriate time. Thus, the Systems Ecology graduate program, proposed here, uniquely benefits from a) its administrative coherency with the EPSCoR program, and b) the otherwise long term research commitment at FLBS that brings the FLBS faculty into a stronger and more complimentary posture with the whole of UM.

Finally, the Systems Ecology program will add a new program and require some new administrative oversight by the Associate Dean of DBS in cooperation with the Dean of the College of Arts and Sciences and the Dean of the College of Forestry and Conservation. These administrators are prepared

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to add these responsibilities in recognition of the added value and enthusiastically support the development of the Systems Ecology graduate program. Likewise, the Systems Ecology faculty is ready to fully implement this program immediately following Board of Regents approval.

**B. Are other, additional resources required to ensure the success of the proposed program? If yes, please describe the need and indicate the plan for meeting this need.**

No start-up funding is required or requested for the proposed Systems Ecology graduate program. Funding of the Systems Ecology administration and support staff will initially come from the recently funded NSF-EPSCoR project (\$24M/5yr, which was written jointly by UM Systems Ecology faculty and MSU - EES faculty). Systems Ecology is the primary means by which UM will participate in the MUS-proposed MtCERE. Thus, the Systems Ecology administrative costs will be completely covered by the EPSCoR program through NSF funding for the next 5 years, minimum. After that period the Systems Ecology program will be financially self-supporting through faculty and student participation and through the planned sustainability planning by the Provost and the Deans of CAS and CFC.

## 7. Assessment

### How will the success of the program be measured?

The goal of the Systems Ecology graduate program for assessment is to evaluate the proposed program through constructive analysis and feedback and to chart and maintain an effective course of programmatic and strategic graduate student development. This will be accomplished through both internal and external evaluation of both the Institute and the Systems Ecology graduate program. Internal evaluation will be conducted by the Administrative Advisory Committee (described above in Section 5.B). This evaluation and assessment will occur annually. The external evaluation and assessment will occur as a part of the NSF-EPSCoR project, which has a highly developed assessment procedure that is funded by the NSF program. The Assessment will be both formative and summative and will involve a combination of quantitative and qualitative data collection and analysis processes. Specifically, it will include:

1. Ongoing tracking of performance metrics;
2. Guidance by an external advisory board;
3. Review by external scientific boards; and
4. Formative feedback on the processes employed by EPSCoR to achieve its goals to determine if the most effective methods are being used.

We will report annually to the national NSF EPSCoR Office and the Montana University System Science and Technology Advisory Committee on the outcomes and the recommendations from each of these assessments.

The Systems Ecology administrative staff will track activities using a database designed specifically for the purpose of collecting data on participants, graduate student success and progress, and funding outcomes. The external evaluator will assist in the specification and content of this system. Data gathered on metrics specific to key aspects of the program will be updated monthly with complete accessibility. We will use performance indicators based on the STAR METRICS (Science and Technology in America's Reinvestment – Measuring the Effects of Research on Innovation, Competitiveness, and Science) model used to track outcomes of federal funding and provide accountability. This national effort to standardize and assess program impact will allow us to focus efforts on measureable outcomes that can be documented and traced through the Systems Ecology graduate program.

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#### 8. Process Leading to Submission

**Describe the process of developing and approving the proposed program. Indicate, where appropriate, involvement by faculty, students, community members, potential employers, accrediting agencies, etc.**

Discussions for development of a Systems Ecology graduate program were initiated among the FLBS-based faculty in 2006. In January 2008, the FLBS Director, in concert with the FLBS-based faculty submitted the 5-year Biological Station Strategic Plan to Provost Engstrom, Dean Fetz of CAS, Associate Dean Janson of DBS and the faculty of DBS. The FLBS Strategic Plan called for the development of a campus and field station graduate program to be developed with FLBS-based faculty being united with campus faculty across an interdisciplinary program. Initial meetings continued during 2008 among the faculty at FLBS and Provost Royce Engstrom and Associate Provost Perry Brown. The 2007-10 EPSCoR award provided funding for the addition of one 0.5 FTE tenure-line Landscape Ecologist at FLBS. This position was nationally recruited and filled by John Kimball in fall 2008. In January 2009, the Walton Family Foundation provided seed funding to recruit two additional 0.5 FTE tenure-line faculty at FLBS. These faculty positions were approved by UM President George Dennison and Provost Engstrom and nationally recruited in the fall of 2009. Maury Valett filled the Aquatic Biogeochemistry position in January 2010 and Gordon Luikart filled the Conservation Ecologist/Genetics position in February 2010. On July 23-24, 2009, Provost Engstrom, Assoc Provost Brown, Dean Comer of CAS, and VPR Dwyer met with FLBS-based faculty at the Biological Station. The substance, direction and administration of the Systems Ecology program was the central theme of the meeting. It was at this meeting that the Systems Ecology Program received endorsement to move forward with development of a proposal.

In late August 2009, a draft proposal for the establishment of a Systems Ecology program was distributed to DBS faculty. Faculty in the Organismal Biology and Ecology and Integrative Microbiology and Biochemistry graduate programs reviewed the proposal independently. On September 9, 2009 the OBE faculty voted unanimously in favor of supporting the development of the Systems Ecology program. The IMB faculty followed suit with similar unanimous support on September 16, 2009. This was followed by an all-DBS faculty meeting on September 30, 2009 concluding with a unanimous vote supporting the development of the Systems Ecology program. In January 2010, Professor Richard Hauer was elected by the extant faculty developing the Systems Ecology program as Program Director. He will serve as the initial Director of the graduate program upon its BoR approval. Hauer, along with other developers of the Program, consulted extensively with Associate Dean Janson of DBS to assure continuity between DBS Administration and the proposed Systems Ecology program. Associate Dean Janson reviewed successive versions of the proposal and made many very helpful suggestions and changes.

Early in this process, we consulted other programs at UM that have faculty engaged in various forms of an approach to ecology and thus may have graduate student mentoring, as well as professional research interest in the development of the Systems Ecology program. We consulted extensively with William Woessner, Regent's Professor, then Chair of the Department of Geosciences, Steve Running, Regents Professor in CFC, Sarah Halvorson, Chair of the Department of Geography, Dan Pletscher, Director of the Wildlife Biology Program, and John Maron, Director of Organismal Biology and Ecology. In discussions with Pletscher, we discussed both the Systems Ecology program and insight into building a program which bridges between existing units, as does the Wildlife Biology Program. We maintained ongoing dialog with Associate Provost and Dean Perry Brown (now Provost). The nature of the conversations has been to foster a true sense of collaboration and development of the Systems Ecology graduate program as an Intercollegiate Program between CAS and CFC with broad support and participation across the UM

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campus.

During this developmental process, we (Provost Brown and future Program Director Hauer) met in mid-March 2010 in Bozeman with colleagues and administrative counterparts at MSU to assure maximum opportunities for collaboration and minimize duplication or competitive imperatives. MSU Associate Provost of the Graduate School Carl Fox, along with the chair of the Department of Ecology Dave Roberts, and the recent past chair of the Department of Land Resources and Environmental Science Bruce Maxwell (sitting in for chair Tracy Sterling who was traveling), agreed that the proposed Systems Ecology program at UM, as proposed, would serve as a means of increased interdisciplinary collaboration with the MSU program Ecology and Environmental Sciences. The Systems Ecology graduate program as described above was approved by the University of Montana Graduate Council and the Faculty Senate in December 2011.

In October 2010, the MUS Commissioner of Higher Education Office submitted to NSF-EPSCoR Program a 5yr, \$24M proposal that would form the basis for systems ecology, as a discipline, to be the focal area for the Research Infrastructure Improvement grant. This proposal was endorsed by the Montana University System Science and Technology Advisory Committee Steering Committee, Chaired by Associate Commissioner Sylvia Moore with additional members consisting of the UM Provost, the UM Vice President for Research, the MSU Provost and the MSU Vice President for Research. The MUS Commissioner's Office received notification June 1, 2011 that this grant is to be funded with a start date in the fall 2011.

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This proposal was also reviewed and approved by the following College Deans and Faculty Governance:

Christopher Comer, Dean, **College of Arts and Sciences**

Date: 11/11/2010

James Burchfield, Dean, **College of Forestry and Conservation**

Date: 10/22/2010

Bonnie Allen, Dean of **Libraries**

Date: 12/2/2010

The proposal was reviewed and approved by the Graduate Council of the Faculty Senate at The University of Montana

Date: : 12/9/2010

[No outside consultants were employed for the development of this proposal.]