

A Plan for Transition of the Biodiversity Institute, and Capturing the Full Potential of UW Research and Outreach Capability

Draft

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Executive Summary - The opportunity for a renewed effort in transdisciplinary biodiversity research effort, and an outreach effort grounded in it, is keen. The research resources at the University of Wyoming to support such an effort are considerable. Yet the Biodiversity Institute (BI), a component of the biodiversity enterprise at UW and with a focus on education, outreach, and the broad impacts of research, is facing fiscal challenges. It is on a path to closure by the end of this calendar year that must be managed now. This plan provides an approach to managing the present challenges while putting UW on a path to become establish a new class of research activity that will serve outreach, serve as the basis for conservation practices, inform policy decisions, and enable assessment of environmental, economic, and social impacts of influences on the biosphere.

This plan begins with a description of the background of the importance of biodiversity research, education, and outreach, considering Wyoming's unique character and its citizen's relationships to the state's ecosystems. The origins and vision for the Bob and Carol Berry Conservation Center for biodiversity research, education, and outreach are highlighted.

Recommendations for maintaining the highest priority BI services are (1) leveraging BI practices to benefit STEM education and outreach across UW, and joining forces with the Science Initiative; (2) maintaining administrative support for the Program in Ecology; (3) continuing support of the Museum of Vertebrates and its curation; and (4) developing a capacity to create "Broader Impacts" plans for research proposals. Resources for these will be found by reallocation within the existing approved UW budget. These will be reduced compared to what is now required to support the BI, requiring some adjustments in level of effort. Still, synergies with Science Initiative and other education and outreach programs can mitigate some of this loss. To retain cohesiveness of BI activities, they should be housed at the Berry Center building. Per Regulation 2-13, efforts are being made to identify positions for which the BI staff are qualified, both within the realm of biodiversity and, where necessary, outside of it.

In Section III, urged is faculty developing a proposal for a new biodiversity center of excellence, to be sited within the Berry Center and charged to create a first-of-a-kind, experimentally validated predictive capability of complex biological systems. Tentatively named the Berry Biodiversity Center of Excellence (BBCE) for purposes of this report, it will lever Wyoming's as a natural laboratory. With a scope and plan to be developed by a faculty Task Force-led planning process, the BBCE's public face will be the Berry Conservation Center. Its reach will have a broad reach to all schools and colleges.

A proposal for this Center of Excellence will emphasize identifying scientific grand challenges and achieving stability through partnerships. Financial stability may be achievable through capture of a wide range of grant support from state and federal agencies, as well as donor contributions. A centerpiece will be developing a predictive capability that enables UW to be a national go-to resource in research-based conservation and issues such as land reclamation, water use, infectious diseases, economic impacts, and forest fire management. The Center will strengthen UW's cross-disciplinary research culture as well as the culture and practices of engaging external sponsors. BBCE research will form the basis for a vigorous education and outreach enterprise in biodiversity science that serves the state's citizens, drawing on the BI's practices as well as the best from other existing and planned STEM education and outreach activities. Financial support for this planning will be treated as an investment, contingent on the promise of success in growing externally supported research and outreach activities.

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Section I: Overview of the challenges, and opportunities revealed

The expiration of funds for the Biodiversity Institute (BI) during extraordinary fiscal times at the University of Wyoming has prompted an examination of the implications of its imminent closure, both from a personnel perspective as well as regarding its most valued practices. This examination has informed the near-term priorities for the transition of BI functions, observations and recommendations regarding the culture and practices surrounding research support at UW and STEM education and outreach, and a proposal for developing a sustainable, impactful program in biodiversity research integrated at all relevant scales that will inform conservation efforts for the state and the nation and serve as a foundation for future education and outreach activities. Described here is a plan that

- preserves administration of the Program in Ecology, the strongest elements of outreach, and provides support for the development of a broader impacts capacity to strengthen research proposals;
- proposes a path to strengthen research and outreach excellence by pursuing a first-of-a-kind capability in biodiversity science that addresses the field's grand challenges and enables new kinds of predictive capability. At the heart would be a new organization run from the Berry Conservation Center, referred to here as the Berry Biodiversity Center of Excellence (BBCE).

I.a Observations and recommendations from this assessment

The examination prompted by the BI's circumstances have revealed much. The process has included conversations with stakeholders in biodiversity research, education, and outreach across the campus.

I.a.1 Recognitions and gratitude

- *Deep thanks for their generosity, and recognizing the vision of Bob and Carol Berry* - Conspicuous is the need to recognize the extraordinary generosity and impact of the Berry's. The generosity of Bob and Carol Berry in providing resources through the Wolf Creek Foundation has been singularly important in elevating the profile and impact of biodiversity research, education, and outreach performed at UW. They have strengthened the foundation of a bright future for biodiversity research, education, and outreach, despite the present challenges with the BI. Their contributions that led to the construction of the Bob and Carol Berry Biodiversity Conservation Center, an endowed chair in biodiversity science, and the operations of the BI are among the most generous in the history of UW.
- *Deep thanks to the BI staff for their contributions through service* - Also necessary is to acknowledging the contributions of the founding director, Carlos Martinez del Rio, the interim director Gary Beauvais, and the entire BI staff over the years. Public comments have attested to the impact and devotion of the BI staff and associated faculty; through their efforts, many have experienced aspects of the special, complex nature of Wyoming in a manner previously unknown to them, often working side-

by-side with researchers in the field on leading questions of the day. UW is deeply grateful for their service.

I.a.2 The unique nature of biodiversity research in Wyoming, and its alignment with UW interests and obligations

- *The deep value of the field experience in biodiversity science* – The unique potential of biodiversity research in Wyoming recognizes the power and potential of Wyoming as a stage where faculty, staff, and citizens are imbedded in the study of the complex interactions in nature that drive the evolution of flora and fauna. Levering the intimacy between student of the natural world – be they K-12 or college and university students, faculty, or other citizens – is an essential component of any biodiversity research enterprise. It is the intent going forward that the Berry Conservation Center continue to promote the practice of nurturing this kind of relationship through enabling a vision that is aligned with the intent of the donors in funding the construction of the building that hosts labs, graduate offices and public educational space, and in supporting the Biodiversity Institute. This will take place in concert with functions preserved in this transition with programs and research within the Science Initiative, and by effective coordination with the vast array of biodiversity-related research across campus that is driven by a new vision for a center of research excellence. Field research of this sort promotes an important kind of understanding of the world and one’s place in it that can be obtained in no other way.
- *The Bob and Carol Berry Conservation Center as a public stage for biodiversity* – Related to the point above, the Bob and Carol Berry Conservation Center has served as a compelling and effective public stage for biodiversity-related education and outreach. It is an attractive setting that is much more than an administrative or classroom center. As such, any plan for biodiversity research and outreach should not only respect this intent of the donor. Continuing its use in this way is fully aligned with the strategic vision for research and outreach in biodiversity. This is reinforced in this plan in at three ways. First, it is proposed that the functions of the BI to be continued in the near-term as expressed in this plan will still be executed in the Berry Center. Second, by virtue of proximity, it is envisioned that the Berry Center be used in conjunction with the Science Initiative building and its programs, both for research and as a public stage for biodiversity activities. Third, the Berry Center will serve as both the administrative home and public space associated with a proposed center of biodiversity excellence, described in this document in Section III.d.
- *Serving Wyoming* – As the Land Grant university serving the state, the University of Wyoming has an obligation to serve all of its citizens. As their interests are intimately connected to energy and the energy industry, there is considerable investment in research and research infrastructure at UW in energy science that is world-leading, exciting, and vital. The same land that makes this research so important also gives rise to the extraordinary resource that is Wyoming’s biodiversity. The dynamics and beauty of its ecological systems infuses the minds and spirits of its citizens. It is of vital economic interest as well. Understanding and providing a means to educate and involve its citizens regarding both classes of resources, and their interface, is a UW obligation and opportunity. As this transition of the Biodiversity Institute is managed, UW is committing to a vision for advancing a biodiversity enterprise that meets the needs of its citizens through world-leading biodiversity systems research. This work must inform conservation efforts, address questions of immediate concern to policy including land and water use practices, and serve as a strong foundation for education and outreach.

I.a.3 Recommendations

Three high level sets of recommendations follow and are detailed in the subsequent sections.:

Recommendation I: Maintain the highest impact aspects of the Biodiversity Institute programs and practices, learning from and strengthening them

This includes reallocating resources within the approved UW budget, and from indirect cost recovery revenue, as appropriate, to continue to support at full or reduced levels the following:

- *Lever the BI's practices and programs to benefit STEM education and outreach across UW*
- *Maintain administrative support for the Program in Ecology*
- *Continue support of the Vertebrate Museum and its curation and lever with the Science Initiative*
- *Develop a capacity to create "Broader Impacts" plans for research proposals applicable to all disciplines that demand it*

Details follow in this document. It is recommended that the first three of these activities continue to be housed in the Berry Conservation Center; the fourth may be located in the Office of Research and Economic Development. The recommendations also include making a university commitment to assess and coordinate the various STEM education and outreach activities across the campus, enabling best practices to be shared and developed for biodiversity and other STEM outreach activities. This would be done while recognizing the unique character of STEM outreach as it pertains to biodiversity. For biodiversity, an immediate opportunity is in coordinating present outreach and education efforts with the Science Initiative programs. Being considered long term is standing up a STEM education and outreach center.

Recommendation II: Develop a plan to create a Berry Biodiversity Center of Excellence (tentatively named BBCE) to inform conservation efforts, and enable rapid responses to biodiversity matters of statewide and national economic and societal import. A highly multidisciplinary effort, BBCE's administration will be centered at the Berry Conservation Center Building

This will build on the alignment between the research vision for UW and the research vision of the donors. The vision for it is strongly multidisciplinary, centered on STEM fields and extending to economic analysis and the humanities. Central to the research vision for UW is developing programs and practices that assert leadership in grand, multidisciplinary challenges, and developing into a strength biodiversity research integrated at all relevant scales. Also, it is this Administration's understanding that central to the vision of the donors for both the Berry Conservation Center and the BI was to stimulate a vigorous research enterprise in biodiversity that would form the foundation of conservation efforts that are informed by scientific understanding. These visions have much in common.

This envisioned plan honors this intent of the Berry's, and is well aligned with the strategic interests of the university. Recommended here is the following:

One aim is to develop a biodiversity research enterprise that will pursue grand challenges in biodiversity research, and yield a first-of-a-kind, experimentally validated predictive capability for the evolution of ecological systems to serve conservation efforts by informing policy and practice relevant to flora and fauna. Tentatively called the Berry Biodiversity Center of Excellence (BBCE), the Berry Conservation

Center will serve as its hub. BBCE will have the potential to inform conservation efforts and policy decisions in a tremendously wide range of matters including and beyond species protection efforts, water systems management, ecosystem restoration and reclamation practices, invasive species management, forest fire control, climate impacts on water supply, wildlife migrations, and animal disease management. BBCE's plans and activities will be informed by an external advisory committee.

A driver in the planning will be identifying the requirements for building sustainable programs within BBCE that attract research dollars from external state and federal sources, including the National Science Foundation, as well as private sources. BBCE will serve as a stable foundation for biodiversity education and outreach efforts.

Recommendation III: Address vulnerabilities to UW revealed in the BI's circumstances

These vulnerabilities include:

The risk of an overreliance regarding a single donor to support any enterprise at UW - The immediate need to close the BI is prompted by a failure to diversify funding.

Absence of coordination of STEM education and outreach activities at UW – Revealed in this assessment is the absence of coordination or sharing of lessons learned in STEM education and outreach activities at UW. For the BI, recognizing that each field of research has unique aspects that drive differences in approach, opportunities reside in working with the Science Initiative programs, the Trustees College of Education and Tier 1 Engineering initiatives, and other activities. UW should commit to developing a plan for a more coherent approach to STEM education and outreach where each benefits from the lessons and approaches of others. More detailed comments on this challenge follow.

The need to strengthen the culture and expectations regarding grant capture to support research at UW vs. relying on donor or state resources to support such research. This need extends well beyond the biodiversity enterprise. In addition to the obvious benefit of gathering additional resources and relaxing reliance on state funds, engaging vigorously in the national competitive research scene does a service to UW faculty and students by ensuring that the UW research enterprise is highly nationally relevant. A successful BBCE enterprise can help stimulate this cultural change.

Confusion regarding the relation between the BI, the Berry Center Building, and biodiversity research at UW – Revealed in the present circumstance is widespread confusion of the nature of these three items and their relationship. The Bob and Carol Berry Conservation Center building is not closing. It is host to a wide range of biodiversity-related research and programmatic activities that are well aligned with the wishes of the donors who enabled its construction, Bob and Carol Berry. Far from closing; the opportunity to strengthen its presence in biodiversity research must be captured, as described in the vision for BBCE, and in concert with the Science Initiative. While noting that the BI is a minority occupant of the Berry Center building, and the Berry Center's activities are only a small component of the vast biodiversity research programs across campus, this building has been a prominent and effective public stage for biodiversity activities and education, and a compelling, attractive venue for convening educators and citizens. The Berry Center will continue to house many of the BI's present activities and will retain its purpose as a public focal point, and its role in both research and education will be strengthened through partnership with the Science Initiative.

Section II. The near-term challenges: identifying BI strengths, and an approach for continuity

II.a The Bob and Carol Berry Conservation Center

In 2011, the Robert and Carol Berry Biodiversity Conservation Center, or Berry Center, opened on the UW campus. Enabled by generous donations from the Berry's through the Wolf Creek Charitable Foundation, and with matching funds from the Wyoming State Legislature, the Berry Center was designed to promote research in biodiversity science, provide service to the university and the state through research labs and the Wyoming Natural Diversity Database (WYNDD), and facilitate people's engagement in and understanding of the natural world.

The purpose of the Berry Center is not brought in question by the circumstances that surround the BI; in fact, the opportunity to strength this facility's role in biodiversity activities exists, enabled in part by its close proximity to the Science Initiative facility. At present, the Berry Center is host to much biodiversity-related work, including: UW's Stable Isotope Facility, a center for world-leading research that engages UW students, postdocs, and faculty; administrative support and students participating in

UW's Program in Ecology (PiE), the most productive interdisciplinary graduate program at UW as measured by the number of graduates receiving PhDs; and the Museum of Vertebrates, which is rapidly emerging as a research force in its own right through modern analysis techniques and networking with other museums in the Rocky Mountain region and nationally. This museum is host to a biological record of vertebrates dating back more than a century, and therefore is a strong complement to UW's Rocky Mountain Herbarium. In addition, the creation of the Berry Center led to the formation of the Biodiversity Institute, and is the BI's

home. This was enabled by redirecting unused building funds as well as further donations from Bob and Carol Berry.

II.b The Biodiversity Institute

The BI was formed as a participant within the Berry Center in September 2012, with Dr. Carlos Martinez del Rio as the founding director. The mission statement of the BI as expressed in its recent five year report is:

“The mission of the Biodiversity Institute is to foster the understanding, appreciation and conservation of biological diversity through innovative research, education, and outreach, and by engaging a broad audience in the scientific process.

“The Biodiversity Institute works with scientists, resource managers, educators, and the public to further the understanding and conservation of biodiversity. We seek to provide a unique service to Wyoming and beyond by facilitating collaborative research projects, synthesizing and disseminating research, distributing grants, and providing educational, outreach, and citizen science programs for students and the public.”

The outreach and education activities’ impact and productivity is notable. As stated in its most recent five-year report, between 2012 and 2017, the BI produced 190 outreach events that engaged over 14,000 people, conducted 17 citizen science projects engaging over 1000 people in field data collection and analysis, and produced and distributed 19 books, field guides, and other biodiversity publications. In education, the BI conducted 17 events for K-6 students and 71 events for middle- and high school students, engaging over 5000 K-12 students overall. The BI also facilitates research and strengthens certain research proposals through its “Broader Impacts” work, discussed below, involvement of some faculty in its activities, its use of donor funds to issue and research grants, and through its curation of the Museum of Vertebrates.

II.c Transition Goal: Leveraging the BI’s Strengths in Outreach, Education, and Research

The University of Wyoming’s high level strategic goals include those that will benefit from practices developed and programs executed by the BI. A leading strength of the BI has been its outreach and STEM education programs; testimony from citizens around the state speak to this strength. A priority of UW, as expressed in the strategic plan “Breaking Through,” is that of increasing the effectiveness of community engagement throughout the state. BI education and outreach practices can serve as an effective catalyst for this.

In addition, the state has demonstrated its commitment to UW in joining top tier institutions through its initiatives, namely, the Trustees Education, Science, and Tier 1 Engineering initiatives. The BI’s research activities, including its citizen-based research efforts as well as field, laboratory, and museum-based research, have the potential of joining forces with the Science Initiative facilities and programs and other research assets. Properly organized and managed, these have the potential to help enable UW to be rightly recognized as a national powerhouse in biodiversity science.

II.d Procedure Followed, and Determining Priorities for this Plan

Although the BI is not an academic program, it has components involving academic personnel, and the protocols of UW Regulation 2-13 (Academic Program Reorganization, Consolidation, Reduction and Discontinuance) are being followed in transiting the most valued functions of the BI to other units of the university, as resources allow. This document is aimed at fulfilling part of the obligation of Regulation 2-13 by providing background and context regarding the present situation, and a plan for maintaining our high priority activities in biodiversity research and outreach.

Part of Regulation 2-13 requires making reasonable efforts to find positions within UW for which the BI staff are qualified. Potential individual assignments are not described in this report. The details of UW obligations in this regard are provided in another UW regulation.

Several sources of input were considered in developing the recommendations that follow. Views on the highest priority functions that the BI exercise were obtained, and discussion took place on possibilities for transition of these functions.

- Priorities were informed by UW’s strategic plan, “Breaking Through,” discussions with stakeholders and potential stakeholders, and communications from citizens and students.
- In early August of 2018, a transition group was formed of stakeholders and potential stakeholders on campus. Membership of the group include
 - interim director of the BI
 - dean of Arts and Sciences
 - faculty with partial appointments to the BI
 - dean of the Haub School
 - chair of the Department of Botany
 - leader of the emergent Office of Engagement and Outreach (OEO)
 - leadership of ORED

Input obtained through the group discussions helped develop a shared understanding of BI functions and impacts, resource requirements, and of related activities on the UW campus as well.

- Input was also received through letters written to the VP for Research and Economic Development and the President of UW, primarily regarding BI positive impact on citizens of Wyoming through its Citizen Science program, as well as benefits of the BI to students in the Program in Ecology (PiE), especially regarding “Broader Impacts” statements often required for research grant proposals.
- Discussions were also held by the VPRED with the following:
 - BI staff
 - director of PiE
 - dean of the College of Education
 - leadership of Academic Affairs (AA) and General Counsel regarding process as it pertains to Regulation 2-13

Conversations with those inside and outside of the BI helped develop a picture of STEM education and outreach activities on campus that put the BI activities in context and informed the recommendations here. Finally, and importantly, the priorities as identified by the BI participants and stakeholders were assessed in the context of the strategic plans of UW and ORED.

II.f Priorities of BI activities for transition

The input received, measured against strategic priorities and considering existing and emergent activities at UW, informed the following priorities for maintaining BI activities. These are:

- *Lever the BI’s practices and programs to benefit STEM education and outreach across UW*
- *Maintain administrative support for the Program in Ecology*
- *Continue support of the Museum of Vertebrates and its curation ;lever with the Science Initiative*
- *Develop a sustainable capacity to create “Broader Impacts” plans for research proposals applicable to all disciplines that demand it*

Finally, there is an overarching priority of a different sort, namely:

- *Ensure that all future activities in the Berry Conservation Center building are strongly supportive of biodiversity research, education, and outreach, meet donor intent, and are aligned with UW's strategic interests.*

II.g Details on the priorities and resource requirements

- *Lever the BI's practices and programs to benefit STEM education and outreach across UW*

Background – Leveraging the BI's education and outreach activities is aligned with the interests of UW. A particular near-term opportunity is coupling BI practices to planned Science Initiative outreach efforts.

This transition and coupling should be done in parallel with a vigorous effort, already begun and to be led by the Office of Engagement and Outreach (OEO), to survey existing UW outreach and engagement efforts in STEM fields. The overarching goal should include creating a new vision for UW's outreach efforts in STEM education, including reducing duplication as experienced on campus and by state stakeholders. With a strong, effective vision, there may be an opportunity to work with the Foundation to enduring resources for this outreach program's continuance and growth. Potential resources for such work includes engaging the county extensions and community colleges.

Level of effort: 1.0 FTE recommended. In the near term, Citizen Science and K-12 activities should be administered under a director for a Berry Biodiversity Center of Excellence (BBCE, to be described in Section III, and to be located in the Berry Conservation Center building), with ties to the Science Initiative and Colleges of Engineering and Education. Direct involvement in program development and administration, grant proposal writing, effective communication, and project management will be key skills.

Resources – Through the remainder of FY 2019, resources to support Citizen Science and K-12 outreach should come from within the existing UW budget. For FY 2020 onward, resources need to be found by the Administration through internal reallocation.

Further comments - A clear vision and plan for STEM outreach activities has the potential of attracting an enduring source of funds, preferably through an endowment. The BI practices can substantially inform that future; biodiversity-related outreach and education practices will also benefit from the experiences gained in other STEM outreach efforts on campus.

However, such a vision and plan do not exist. While the impact of the outreach work conducted by the BI's Citizen Science and K-12 education programs is significant, also revealed in discussions is concern regarding the loose confederation of STEM outreach activities on campus and potential overlap and inefficiencies within it. There is a lack of common understanding within campus of such work. This was not only revealed by internal UW discussions: it was also reflected in citizen stakeholder comments. Accordingly, there is a lack of "lessons learned" between these activities.

UW should commit to develop a coherent vision for STEM outreach by the end of FY 2020 for developing and managing effective and innovative outreach/engagement programs that include bringing biodiversity expertise and experiences to a broad range of audiences. These include

administering UW Citizen Science programs as well as creating and implementing educational programs, including curricular development, and projects for K-12 and community college audiences.

Consideration should be given to creating a new director of STEM Education and Outreach at UW. This person should be tasked to work with the Office of Engagement and Outreach director, the provost, the dean of the College of Education, and staff leading education and outreach activities from across campus should work to develop a plan for a cohesive and integrated approach to STEM outreach. The plan should include building and maintaining strong relationships within UW's STEM community to enhance existing outreach education practices and networks (e.g., public schools and youth organizations), as well as coordinating contacts with teachers, community members, and other STEM stakeholders.

The need to develop effective coordination is clear. The goals of a coherent outreach and engagement effort will include eliminating redundancy between outreach programs in STEM fields, heightening on-campus awareness of them, and maximizing their connection to cutting-edge research. In play at UW are several initiatives and activities: the Trustees Education, Tier 1 Engineering, and the Science Initiative, as well as the Wyoming State Science Fair and activities in the College of Education's Science and Mathematics Teaching Center. Together, these activities and the BI outreach work can inform each other, and can serve as a reservoir of experience from which each can draw. A survey recently begun of outreach services for public education and research participation should be completed across the university, and the emergent OEO, provost, and deans should convene appropriate university and program leadership to develop a vision and plan for outreach and public engagement that includes and extends beyond the BI mission space.

- *Administrative support for the Program in Ecology*

Background - This is UW's most impactful cross-disciplinary PhD program in terms of numbers of PhDs granted annually; its continuation is essential. At its inception in 2005, PiE was comprised of five faculty members from three different departments. It has grown substantially, and now includes 51 students, 52 alumni, 42 faculty, and 15 affiliates.

Level of effort - 1.0 FTE recommended. The full set of duties for a new position for PiE administration will include those to be determined by the associate vice provost for graduate education.

Resources - The remainder of PiE administration costs should be borne by the existing UW budget. In FY 2020 onward, resources need to be identified by the Administration through internal reallocation.

Administrative home - PiE administration should be conducted under the umbrella of the Office of Graduate Education, recognizing the strong ties PiE will have with the Berry Center Building. The job description will likely include additional duties beyond PiE administration.

- *Continue support of Museum of Vertebrates and its curation; lever with the Science Initiative*

Background - This is rapidly becoming a vibrant research tool as it rises in profile nationally. A strong research-oriented vertebrate museum can be a strong component of a nationally leading effort in biodiversity systems science, in concert with modern-day DNA analysis techniques, the Stable Isotope Facility in the Berry Center, the Rocky Mountain Herbarium, and a biodiversity effort that leverages the Science Initiative. The BI has long provided operational funds to the Museum of Vertebrates. This faculty responsible for curation is a member of the Zoology and Physiology Department. Maintaining the museum will support the vision of the Berry Conservation Center activities becoming a strong complement to the SI.

Level of effort – \$35 - 40k annually is required for consumables and maintenance. Museum curation support is provided through an existing faculty line in the Zoology and Physiology Department. See the budget breakout in the next section.

Resources - The \$35-40k per year supports consumables and maintenance activities required for curation, and the research activities of undergraduate and graduate students. Faculty activity required is supported by a state-funded faculty; it is not a burden on the 40k. For FY 2019, resources need to be found within the existing UW budget. For FY 2020 onward, resources need to be found by the Administration through internal reallocation.

A breakout of the resources requirements for the vertebrate museum follows:

Maintenance ~\$10,000

Service contracts on freezers, specimen case compactor system, etc.

Supplies ~\$3000-\$6000

Consumables for field work, prepping, storage, etc.

Field work ~\$8000-\$10,000

Permits, vehicle rentals, lodging, food, etc.

Personnel ~\$14,000

Paying student workers, graduate student summer stipends, etc.

Total: ~ \$35,000-\$40,000

Administrative home - It is recommended that support for the Vertebrate Museum curation be administered through the Zoology and Physiology Department.

- *Develop a sustainable capacity to create “Broader Impacts” plans for research proposals applicable to all disciplines that demand it*

Background - A strong theme revealed to ORED last year in a series of listening sessions with faculty is the institutional need to develop a UW-supported approach to assisting faculty in developing plans for research that has an impact that is broader than the primary research itself. This is a long-term goal for UW and ORED. BI outreach programs have provided resources for developing these plans. Coupling with Science Initiative programs will be pursued.

A business model will be developed, and resources identified within the ORED.

Level of Effort –0.25 FTE recommended near term, to grow to 1 FTE as a self-sustainable funding model is developed

Resources – A self-sustaining business model needs to be developed for this capacity. ORED will provide 0.25 FTE support in the near term to develop such a model and further explore this priority, developing a strategy going forward this fiscal year.

Administrative home: This broader impacts development will be administered by the Office of Research and Economic Development. The goal is to develop an approach that is of value to all of research at UW.

Section III: Transdisciplinary Research, and planning for a Berry Biodiversity Center of Excellence (BBCE)

III.a Transdisciplinary research, and the potential of biodiversity research and outreach at UW

Many leading scholars, scientific organizations including the National Science Foundation and the National Institutes of Health, academic leaders, and scientific advisors recognize that in the next half century, research institutions of higher learning must be nimble and able to respond to issues of regional, national, and global importance that are strongly multi- or transdisciplinary in nature. Indeed, if UW is to position itself to be a research leader that is sought to address such problems, it must identify the grand transdisciplinary challenges it is best suited to confront, and develop practices and a research culture that enables rapid response.

Biodiversity science is one such grand challenge. It is ideally suited for pursuit by UW by virtue of the unique nature of Wyoming and its capacity to serve as a research laboratory. It is a “grand multiscale challenge,” worthy of targeted, intense research in and across many disciplines. The emergent science of *complex systems*, of the connections and interactions between fundamental elements and how they give rise to phenomena that would not be predicted through study of an individual element of the system, itself represents an emergent component of biodiversity science that is critical for prediction.

A statement provided by UW faculty, provided as feedback in developing this plan, conveys the breadth and scope of biodiversity research at UW:

“Biodiversity studies at UW entail a focus ranging from the microbes of Wyoming’s soils, to the mammals and birds that roam across the state, to the fish and invertebrates swimming in alpine lakes and streams. They also include interactions between plants, microbes, and herbivores in our mountains and plains, and the ecosystem processes that facilitate these interactions. UW also has substantial strength in the study of biodiversity beyond Wyoming’s borders in some of the world’s most biodiverse places, from the tropical rainforests of Central America, to East Africa’s savannas and great lakes.”

More broadly, the transdisciplinary challenge that is biodiversity is remarkably rich and complex, and represents a grand challenge for the sciences. Again, from UW faculty:

“The UN Environment Program defines biodiversity as, ‘... the variety of life on Earth, it includes all organisms, species, and populations; the genetic variation among these; and their complex assemblages of communities and ecosystems. It also refers to the interrelatedness of genes, species, and ecosystems and their interactions with the environment.’ As such, studying biodiversity spans spatial, temporal and hierarchical scales, and its study inherently involves interdisciplinary work, linking research at the cellular, organismal, community, and ecosystem levels... [G]enerally we **seek to understand the processes and factors contributing to biodiversity across varying spatial, temporal, and hierarchical scales**. These studies range from focus on genes to focus on whole communities, and range from interactions at a single-organism level to considering continent-wide and global patterns in biodiversity.”

The transdisciplinary challenge and opportunity of biodiversity extends well beyond the STEM fields. The dynamics of the flora, fauna, and water have impacts on the economy and species conservation efforts that are vast. UW faculty have demonstrated that Wyoming can be a tremendous vehicle for establishing the science girding conservation and responsible land and water use that can inform policy nationally and globally. UW has the infrastructure to smartly engage in interfacing biodiversity research in informing policy based on this research. And, as Wyoming's resides deep in the consciousness of its and the country's citizens, the dynamics and destiny of the flora and fauna as revealed by biodiversity research have bearing on the arts and humanities as well. Also, understanding economic impacts related to changes in biodiversity require continued informed assessment.

The potential for UW taking its biodiversity research, education, and outreach was deeply explored about eight years ago, and this opportunity was expressed in a detailed report issued in 2011, *A Biodiversity Initiative for the University of Wyoming* ("Frost Report"). Indicators of the promise of using Wyoming as a laboratory for this class of research and a platform for related education and outreach is found in the statements of outside experts. For example, in the report is a view attributed to Peter Raven, from the Missouri Botanical Garden. There the report stated that "UW can take advantage of its unique setting, biology, and culture, and create a model that can be adopted elsewhere. Dr. Raven sees an opportunity for UW to create a university-wide interdisciplinary initiative, and to develop a unique curriculum in biodiversity studies that produces

graduates prepared to deal with the world as it is." He also indicated that "UW can lead in developing a vision of nature and society in the interior West for the coming decades." Note also the perspective of Goergina Mace, of Imperial College, London. The Frost Report cites her views as including the idea that "UW has a huge opportunity to bring the physical, biological, and social sciences together, and to train students at all levels to communicate across disciplinary boundaries. Professor Mace suggests that UW could be unique by developing a deep, specific focus on biodiversity science and conservation. She knows of no university, anywhere in the world, that is doing this at an institutional level."

This report informed a new vision for the BI. Discussions with many faculty reveal that, despite many strengths of UW's

The Science Initiative and other programmatic elements of biodiversity research at UW - Consider that microbes in the soil (presently the subject of a new NSF EPSCoR grant being executed at UW, funded at \$20M over five years) interact with the flora (the subject of study of UW's Rocky Mountain Herbarium and UW's botanists, including research at the Stable Isotope Facility in the Berry Center) and fauna (the subject of study of UW's migration research enterprise and other students and members of the faculty of the Department of Zoology and Physiology), which themselves are governed by the behavior of Wyoming's water systems and associated biology (as studied by UW's earth systems biologists in the recently completed EPSCoR program). And, a vital component of understanding organismal behavior is the science of cellular biology (as pursued by UW's molecular biologists, among others).

Cells, microbes, and earth systems biology form major pillars of biodiversity science and are the basis for how much of the research will be organized in the new Science Initiative building. The SI thus provides an opportunity for amplification for future research, education, and outreach efforts that will be performed across the street in the Bob and Carol Berry Conservation Center.

academic programs and the success of the BI, especially in outreach, the support required to realize the vision expressed in the Frost Report was never provided. That said, it is the expressed view of this Administration that there is much in hand in terms of facility resources, faculty excellence, and pride among faculty, staff, citizens, community colleges, and Wyoming's government and industry to realize much of this potential.

III.b Developing a plan for a Berry Biodiversity Center of Excellence (BBCE)

An Berry Biodiversity Center of Excellence (BBCE) can serve as an organizational structure in which a nationally leading effort in biodiversity research, integrated at all relevant scales and capable of responding to questions of regional, national, and global import, can reside. It can be informed by the analysis expressed in the Frost Report. It is recommended that it be designed with the following overarching vision elements and goals in mind:

- BBCE should draw upon the wide array of resources active or available to support transdisciplinary biodiversity research at UW, including
 - All Colleges and Schools, and their departments and programs that foster elements of biodiversity science through its outstanding faculty
 - Computing and data science, including partnership with NCAR, ARCC, the Data Science Initiative, WyNDD, and WyGIS
 - Analytical core facilities, including the Stable Isotope Facility, Center for Advanced Scientific Imaging, the Jenkins Microscopy Facility, and more
 - Science Initiative building and programs, including its life sciences research labs, research greenhouses, animal care facility, active learning classrooms, and the Wyoming Research Scholars programs
 - Natural history collections, including the Rocky Mountain Herbarium, Museum of Vertebrates, Insect Museum, and Geological Museum
 - Field research facilities, including the AMK Ranch and Glacier Lakes Ecosystem Experiments Site
 - Berry Biodiversity Conservation Center, including its research labs, core facilities, public spaces, outreach and education facilities, and administrative offices
- Developing the plan for the BBCE will be driven by a faculty Task Force
- BBCE will develop a business model that does not rely on internal UW funds provided by the state. It will derive most of its resources from successful grant capture from state and federal agencies, private industry, and private donor contributions
- A mature BBCE will engage with an external advisory committee for its execution and planning
- BBCE will draw upon the best practices in STEM education and outreach that reside in the Biodiversity Institute, the Science Initiative, the NSF EPSCoR and NIH INBRE programs, the Education Initiative, Tier 1 Engineering, and other such activities at UW
- A goal of BBCE will be to develop practices that enable rapid coordinated responses to time-sensitive challenges in biodiversity science that have economic and societal impact. Responding to needs on a contracted project basis will likely be one kind of research activity. Examples include species conservation, forest fire management, land reclamation practices, and water use. This will require a culture of cooperation across departments that is reinforced by performance incentives at UW. It will also require effective partnership with other institutions

- BBCE shall recognize that understanding impacts of biodiversity on the total well-being of citizens requires participation with the arts and humanities faculty, as well as the STEM fields and economics
- A goal of BBCE will be developing the capability of assessing economic and societal impacts of potential influences on the biosphere. Participation will be required of non-STEM entities including the emergent Center for Business and Economic Analysis (CBEA) of the Institute for Innovation and Entrepreneurship, the humanities, and HPAIRI
- As UW leads, a successful BBCE will act on the recognition of requiring successful partnerships with Wyoming's community colleges, other universities, and national labs in order to succeed

The path to developing an outline for a plan for BBCE begins with identifying and supporting a near-term leader. This leads to a final priority for this report:

- **Priority** – *Support 30% of a faculty member's time through FY 2020 to lead the development of a plan for a Berry Biodiversity Center of Excellence.*

The resources to support a director of BBCE will be found through indirect cost recovery. These resources for his or her salary and benefits will join those also provided by additional indirect revenue to serve as an investment for planning and positioning of BBCE to succeed in calls for proposals and are ultimately aimed at developing a successful research and outreach enterprise through a self-sustaining business model. The Berry Conservation Center will serve as the administrative center and leadership home of BBCE.

This leader will convene a Task Force that includes UW faculty as well as Foundation participation. That group will develop a plan that includes an impactful, exciting vision for research leading to a predictive capability in biodiversity science, as well as in education, outreach, and developing plans for broader impacts. One model for the group to consider is that of the Task Force convened to help stand up the Office of Engagement and Outreach. A successful plan will identify the grand challenges of the field and identify opportunities for statewide, national, and global impact. It will assess depth of grant potential, and develop requirements for best practices in ensuring effective broader impacts programs. It will also assess the potential of external donor base development for both research and outreach, including strategies for raising income through grant capture and donor support to combine with UW resources to enable pursuing targeted faculty hires that will allow fulfillment of an ambitious plan.

III.c An example of the potential of grant capture for BBCE: NSF's Science and Technology Centers

Among the many opportunities for grant capture that will be enabled, establishing BBCE will position UW to compete for a class of National Science Foundation grants that is among NSF's most prestigious, a Science and Technology Center (STC). With grant income of about \$30M over five years, receiving an STC grant requires successful competition with the country's leading research universities. This requires considerable preparation and demonstration of institutional commitment, including a commitment to strong partnership.

There have been three classes of STCs, the first in 2010, the second in 2013, and the most recent in 2016. It is generally believed that the next call for proposals for STC's may be coming soon. About ten

STC's are presently supported in multidisciplinary areas ranging from the science and technology of intelligence, to the behavior of cellular systems, to energy efficient electronics.

The American Association for the Advancement of Science (AAAS) reported in 2011 on NSF's STC program (<https://www.aaas.org/news/aaas-report-national-science-foundation-centers-support-transformative-research-provide>). In the AAAS report, the following was stated:

“The [NSF Science & Technology Centers Integrative Partnerships](#) program supports universities, national laboratories, industrial organizations, and others that join together to create new multidisciplinary research centers. From nanobiotechnology to microbial oceanography, the AAAS report concludes, the centers successfully pursue innovative basic science while promoting its applications to larger societal issues.”

That is, a proposal for a Center that proposes to advance fundamental scientific understanding that drives major economic and societal issues, one that leans on partnerships across institutions, will be of interest to the National Science Foundation. UW has the capacity to organize and lead such an effort, and research in biodiversity and its impacts can be organized to justify such a compelling Center proposal. Moreover, the AAAS report said:

“‘The centers ‘foster collaboration between faculty with an orientation toward basic science and those interested in more applied and clinical research, and as such enable a true integration of science and technology,’ said Edward Derrick, a co-author of the AAAS report and acting director of AAAS Science and Policy Programs. In interviews and surveys conducted for the report, Derrick noted, ‘the participants praised the outcomes as enriching to their research and subsequent careers.’”

This statement by the AAAS describes the STC program as nurturing an institutional need of any university that aspires to be relevant in this century in addressing problems of great societal import. UW would serve itself well by championing research enterprises that promote inter-departmental cooperation, as well as means of bridging between basic and applied research. In this case of biodiversity, this includes mapping out compelling approaches to enable rapid responses to state and national challenges for which biodiversity is at the core.

Promoting a culture of institutional partnership is in UW's interest, to ensure its faculty and students are in the midst of a vibrant exchange of ideas, and have access to the world's leading research facilities, and have a seat at the table of decision makers. Present-day STC's are consortia, comprised of partnerships between high performing universities and national labs. Developing a successful STC proposal and then executing it would provide a means for developing new partnerships for UW, and strengthening existing ones.

Section IV: Additional Items

IV.a Proposed budget

Budget elements for the functions to support near-term BI-related activities are shown below.

Biodiversity-related Function	Level of Support (approximate)	Comments
PiE administration support and other duties	~\$65k, salary and benefits	1.0 FTE. Supported through reallocation of UW budget
Education and Outreach coordinator	~\$85k, salary and benefits	1.0 FTE. Supported through reallocation of UW budget
Museum of Vertebrates expenses	\$40k	Materials and consumables. Supported through reallocation of UW budget
Broader Impacts development	~\$25k, salary and benefits	25% FTE, supported through Indirect Cost Recovery. Total support from ICR and contract income likely to grow with a mature business model
Director of BBCE in Berry Conservation Center	~\$60k, salary and benefits	0.3 FTE, estimated from 30% A&S professor salary and benefits. Supported through Indirect Cost Recovery. Likely to grow as plan develops and is implemented
BBCE research program development support	To be determined in planning	Indirect Cost Recovery revenue
Operations and Expenses, BBCE in Berry Conservation Center	~\$35k	Supported through reallocation of UW budget

IV.b Determining space utilization in the Bob and Carol Berry Conservation Center

All activities in the BI are well aligned with the interests of biodiversity research and outreach. Proposed here is that a plan be presented to the UW Facilities Council on recommended use in March. It is expected that the Director of BBCE, the coordinator for PiE education, and the person who assumes the Education and Outreach position described in this document will stay in this Berry Conservation Center. A strong consideration for future space utilization will be to promote complementarity with the Science Initiative facility, which will be constructed across the street from the Berry Center. The aim will be to make this pair as effective a combination in serving the interests of biodiversity research, education, and outreach as possible.

IV.c Proposed follow-up

A follow-up report will be made to the Trustees next summer on space use in the Berry Center, an update on plans for STEM education and outreach, and developing a Broader Impacts capacity on campus. A report will also be given on the progress in planning for an Impactful Biodiversity Research and Analysis Center of Excellence.