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Five Ways to Support Interdisciplinary Work Before Tenure

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Five ways to support interdisciplinary work before tenure

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Abstract Academic institutions often claim to promote interdisciplinary teaching and research. Prescriptions for successfully engaging in interdisciplinary efforts, however, are usually directed at the individuals doing the work rather than the institutions evaluating them for the purpose of tenure and promotion. Where institutional recommendations do exist, they are often general in nature and lacking concrete guidance. Here, we draw on our experiences as students and faculty participating in three interdisciplinary water resource management programs in the USA to propose five practices that academic institutions can adopt to effectively support interdisciplinary work. We focus on reforms that will support pre-tenure faculty because we believe that an investment in interdisciplinary work early in one's career is both particularly challenging and seldom rewarded. Recommended reforms include (1) creating metrics that reward interdisciplinary scholarship, (2) allowing faculty to "count" teaching and advising loads in interdisciplinary programs, (3) creating a "safe fail" for interdisciplinary research proposals and projects, (4) creating appropriate academic homes for interdisciplinary programs, and (5) rethinking "advancement of the discipline" as a basis for promotion and tenure.

Keywords Interdisciplinary · Transdisciplinary · Tenure · Coupled Human Natural Systems

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Introduction

Interdisciplinary research and teaching is a critical component of effective environmental education and sustainability programs (Powell and Larsen 2013, Khagram et al. 2010). While interdisciplinary programs are increasingly common, many challenges remain for successfully engaging in interdisciplinary teaching and scholarship. Many of these challenges have been well examined (Heberlein 1988; Klein 1990; Rhoten and Parker 2004; COSEPUP 2004; Campbell 2005; Ausburg 2006; Chandramohan and Fallows 2009). Suggestions for successfully engaging in interdisciplinary efforts, however, are often both general in nature and directed at the individuals doing the work rather than the institutions evaluating them for the purpose of tenure and promotion (Rhoten and Parker 2004). University administrations are increasingly promoting interdisciplinary research and teaching but often without the structures in place to support the work by faculty.

Here, we discuss the challenges facing pre-tenure faculty who want to pursue interdisciplinary teaching and scholarship at research universities. While these recommendations are particularly helpful for early career faculty, they are applicable to all those involved in interdisciplinary programs because the suggestions are also valid for those seeking promotion to full professor, salary increases based on merit, and other forms of recognition. We emphasize institutional reforms that will support pre-tenure faculty because we believe that investment in interdisciplinary work early in one's career is both particularly challenging and seldom rewarded. This must change if we are going to effectively teach, inform, and mentor future generations of environmental leaders as well as produce the level of interdisciplinary scholarship needed to solve our pressing environmental problems. In order to meaningfully address the complex and coupled human-nature systems dynamics of the Anthropocene—global climate change, biodiversity loss, and other factors related to exponential rates of increased resource consumption—integrated research and scholarship across disciplinary boundaries will be needed to formulate societal responses (Millennium Ecosystem Assessment 2005; Liu et al. 2007; Wolinsky 2011; Biermann et al. 2012).

We suggest five specific ways institutions can support interdisciplinary work and encourage faculty to build careers that work *across* and even *beyond* rather than simply *within* traditional academic disciplines. These recommendations are based on our own experiences at three interdisciplinary water resource programs (WRPs) at research universities in the American West: University of New Mexico (UNM), University of Idaho (UI), and University of Nevada Reno. Within these programs, we represent current and past program directors, faculty, and recent graduates.[1] For the most part, faculty in these programs have primary appointments in discipline-specific departments and colleges, and our participation in WRPs is usually a combination of cross-listing courses, teaching "overloads," service responsibilities, and scholarship with and without participation in interdisciplinary grants.

While our recommendations are based on our experience in WRPs specifically, the basic concepts and ideas are generally applicable across different types of interdisciplinary efforts. These recommendations include (1) creating "impact factors" that reward co-authored scholarship and citations outside traditional disciplinary silos, (2) allowing faculty to "count" teaching and advising loads in interdisciplinary programs, (3) creating a "safe fail" for interdisciplinary research proposals and projects, (4) finding appropriate academic homes for interdisciplinary programs, and (5) rethinking "advancement of the discipline" as a basis for promotion and tenure. Each of these suggestions is now discussed in further detail.

[1] This group came together in 2013 as part of an Innovation Working Group on "Building resilience in water governance: an interdisciplinary investigation into the social-ecological system dynamics of climate change." The group was supported by the Western Tri-State Consortium EPSCoR Program and funded by National Science Foundation # NM 0814449. While many of our individual affiliations have changed since 2013, each of us was at one time affiliated with one or more of the three WRPs discussed in the article.

Develop metrics that reward citations outside traditional disciplinary silos

While the validity of quantitative metrics used to evaluate science is debated (Harnad 2004; Ioannidis et al. 2014), both in the form of journal impact factors and metrics designed to assess the impact and productivity of faculty (bibliometrics), there is little doubt that these metrics play a critical role in the evaluation of faculty for the purpose of allocating research funding, promotion and tenure, and hiring (e.g., Harnad 2008; Hirsch 2005). This role, particularly when coupled with increasing competition for limited resources, means that these metrics help define the incentive structure for academic research (Henderson et al. 2009) and therefore influence the type of research being proposed, funded, and ultimately conducted. It is therefore critical to consider the impact of these metrics in terms of how they incentivize or deter interdisciplinary research.

Current bibliometrics rely on numerous criteria, such as the number of publications, citation rate of those publications, journal impact factors, or some combination thereof. There have been attempts to quantify interdisciplinarity using these metrics (e.g., Adams et al. 2007). In general, these attempts show a positive correlation between interdisciplinarity and citation rate, indicating that interdisciplinary work is valued by the scientific community. This finding has been used to argue that interdisciplinary research does not need to be accounted for in bibliometrics (Adams et al. 2007). However, this argument fails to acknowledge the equally well-documented "punishments" of interdisciplinary research (Heberlein 1988, 9), such as the additional time, people, and effort needed to generate interdisciplinary research projects (Heberlein 1988).

Researchers are often required to evaluate the tradeoffs of participating in interdisciplinary work. The increased citation rates identified by Adams et al. (2007) seem to incentivize interdisciplinary research by increasing metric values based on citation rates; however, the challenges and perceived challenges of interdisciplinary work deter researchers from participating. Given the value of interdisciplinary research well recognized, it is incumbent upon the academic community to ensure that this tradeoff ends up being a net incentive for interdisciplinary work. Recognizing the significant and increasing role of bibliometrics in defining the incentive structure for academic research and accounting for the real and perceived deterrents to interdisciplinary research in the calculations of those metrics are critical to promote the types of

cooperative investigation required to address society's most pressing questions.

We propose two solutions. First, institutions could employ a new weighting method for evaluating interdisciplinary publications. Traditional impact factors are still the baseline for evaluating the relevance of pre-tenure research, but additional emphasis could be placed on journal papers that involve interdisciplinary work using a weighting metric. For example, during the tenure evaluation process, each published interdisciplinary paper could be considered equivalent to 1.2 single-discipline papers. This weighting helps compensate researchers for the extra risk and effort required to contribute to interdisciplinary research without discouraging continued work in traditional academic fields. The weighting would occur during the tenure evaluation process and would not require new impact factor metrics used by publishers. Second, universities could insure that researchers receive full credit for papers where they are not first author and/or when there are multiple co-authors. In practice, most scholarship from interdisciplinary work is co-authored. This should be viewed as a strength rather than a weakness in terms of the value of each individual's contribution.

"Count" the teaching and advising of interdisciplinary students

Few interdisciplinary programs have their own faculty. They instead rely on various departments to provide instructors, offer courses, advise graduate students, and serve on various committees. In our experience, faculty members often conduct this work as an "overload," in addition to duties and responsibilities within their departments. Elsewhere, it may be treated as a course release by the home department and thus not accounted for in review of contributions to teaching. As a result, this work is often undervalued and sometimes completely overlooked. Whether and how this work is "counted" is of increasing importance for many reasons. University budgets are tight. State-funded universities such as ours are currently constrained by decreased direct support from state government and a general reluctance to increase student tuition. These and other factors are placing pressure on faculty in several ways, including pressure to bring in more external grant funding (discussed below) and to increase the number of "credit hours" generated by departments and individual faculty.

The pressure to do "more with less" places increased emphasis on faculty productivity. As is the case with most universities, our departments conduct annual reviews of faculty research, teaching, and service and then convert this information into metrics designed to track our individual productivity. In turn, these metrics are then often used to evaluate departments at the college level. Unfortunately for many of us, work associated with teaching and advising students and serving on committees outside of our department is either not "counted" in these metrics or is devalued for purposes of annual assessment. This is in part because universities are increasingly linking direct credit hours to specific academic departments. For example, if a member of the civil engineering faculty at UNM teaches a course in the WRP, the credit hours generated by the class "go to" the WRP and are not reflected in the engineering college's annual report. At the UI, the Institutional Research and Assessment office keeps track of student numbers by WRP and various departments, but, in the process of reporting, the value of WRP credits are still not taken into account.

The devaluation of this work also takes place informally. Many of our colleagues who work within traditional disciplinary boundaries simply do not recognize work that takes place outside of the department. Especially when mentoring pre-tenure faculty, they caution against investments outside of the department because they see it is a loss of focus, a waste of time, or because they seek to protect the pre-tenure faculty from the reality of undervaluation of these efforts. The experience one of us had 2 years ago during an annual review provides one example. During the evaluation process, this pre-tenure faculty member pointed out that, in addition to advising more than the average load of students within the department, s/he was also advising several students in the WRP. The department chair replied this was *voluntary* service and admonished the faculty member for taking on too much. This admonition came during the *same* week that the *same* department chair was overheard boasting about the department's role in the WRP to the college dean. Departments like to align themselves with interdisciplinary programs, but they can fail to appreciate the investments necessary to make them successful and adjust departmental loads accordingly.

Institutions can remedy this situation in three ways. First, credit hours generated by faculty members teaching and advising students outside their traditional departments should be valued and recognized. This could be accomplished during the annual assessment process for individuals and their "home" departments and colleges. Input to faculty review by leadership within the interdisciplinary program should be sought by the home department and incorporated in written documentation. Second, faculty advising and serving on interdisciplinary committees should receive the same "credit" for this work as their departmental work. Annual reviews and other faculty productivity metrics should allow this work to be considered as equally—if not more—valuable for purposes of tenure and promotion. Finally, where at all possible, teaching and advising loads should be adjusted so that faculty are rewarded (rather than penalized) for work outside the discipline.

Create a "safe fail" for interdisciplinary research proposals and projects

One of the most challenging aspects of interdisciplinary research is that it can be very time consuming. This is particularly challenging for pre-tenure faculty who feel pressure to get work published as soon as possible. Not so long ago, research proposals that simply noted the various components of how each researcher would contribute to the overall research project was sufficient for labeling work "interdisciplinary."[2] Increasingly, however, the National Science Foundation (NSF) and other grant-making entities are demanding a more integrated and synergistic approach. For example, NSF's Dynamics of Coupled Natural Human Systems program (CNH) requires a high level of synergistic integration between fields of research in the social and natural sciences. Figure 1 is the NSF's depiction of how this research ideally takes place. CNH projects must include (1) the dynamics within one or more natural systems, (2) the dynamics within one or more human systems, (3) the processes through which the natural systems affect the human systems, and (4) the processes through which the human systems affect the natural systems (National Science Foundation 2014). A course in interdisciplinary methods taught by several of our authors instructs students that successful integration across disciplines requires that they develop disciplinary adequacy within the disciplines involved secondary to their own (see Cosens et al. 2011). Although disciplinary adequacy does not equate to expertise, at a minimum, it requires expenditure of sufficient time to develop and understanding of disciplinary terminology, methods, viewpoint, and major questions addressed (Repko 2011).

This type of research requires much more than each member of the project team simply providing his or her "section" of the proposal. They must reach across traditional investigative boundaries and demonstrate both (1) how they will learn from each other and (2) how they will draw conclusions based on integrated knowledge. This can be particularly challenging for CNH systems work because the types of research going on can be grounded not only in different disciplines but also on different assumptions about how knowledge is produced. The work is often not only interdisciplinary but also inter-*epistemological*.[3]

It takes an enormous amount of time to write a successful interdisciplinary research proposal in a field that is extremely competitive. In 2014, the NSF awarded $9.47 million for research on coupled natural and human systems—funding only 11 proposals. The CHN systems program currently funds approximately 8% of the proposals they receive in a given year. In our experience, a successful proposal must be submitted several times before funded. For example, the UI water resources team was recently awarded a five-year grant by the NSF's Integrative Graduate Education and Research Traineeship (IGERT) Program. The project will support 24 doctoral students who will work in interdisciplinary teams and conduct research related to climate change adaptation and water governance in the Columbia River Basin.[4] The Idaho team had to submit their IGERT proposal to NSF several times over the course of 6 years, requiring a significant investment of time and resources by the faculty directly and indirectly involved.[5] The Idaho example demonstrates the ways in which interdisciplinary proposals are both high risk and high reward. They take a lot of time and energy, but, once funded, a CHN or IGERT research program can result a tremendous amount of high impact research and scholarship.

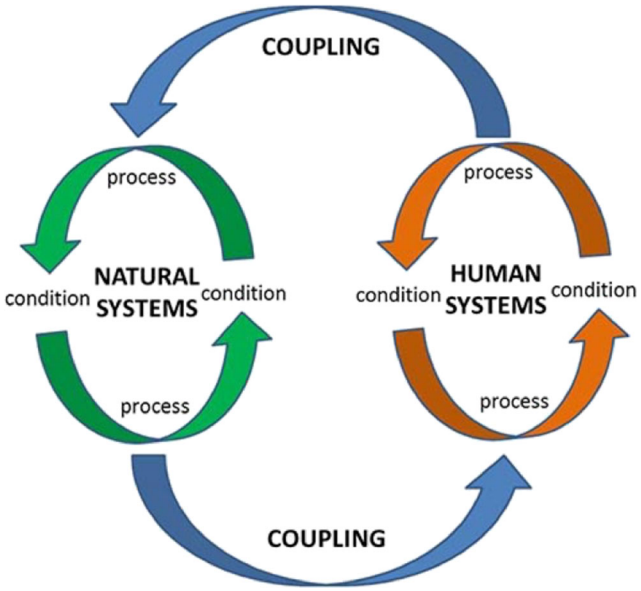

Fig. 1 NSF's figure demonstrating the integration of human and natural systems research.

Precisely because of the time-consuming and high-risk nature of the projects involved, many young scholars are cautious about engaging in interdisciplinary work pre-tenure (Rhoten and Parker 2004). But the possible rewards, not only for the individual and his or her institution but for society as a

[2] This type for work is now more commonly referred to as *multi*-disciplinary (Khagram et al. 2010).

[3] Work in natural science and engineering fields is positivistic and embraces the scientific method as a means of generating knowledge. Conversely, much of the work in the social sciences (with the notable exceptions of economics, most of law, and much of political science) has a critical theoretical orientation, viewing knowledge as historically situated, socially constructed and infused with assumptions about power and control.

[4] Learn more about how to apply at http://www.uidaho.edu/cogs/envs-wr/academics/water-resources/igert-program.

[5] Idaho submitted pre-proposals to NSF in 2006, 2007, 2008, 2009, and 2010. In 2011 and 2012, NSF did away with the pre-proposal round, and Idaho submitted full proposals. The version submitted in 2012 was funded, starting 2013.

whole, create a counter-argument for making the investment early on and establishing working relationships that can last throughout one's professional career. Institutions can encourage pre-tenure faculty to build interdisciplinary working relationships and submit collaborative research proposals by finding ways to reward the effort required, even if it does not immediately result in a funded proposal. This "safe fail" approach will assure young faculty that, even if proposals are not immediately funded, the time and effort taken to develop them is rewarded. The following are a few suggestions to make this possible.

First, allow unfunded proposals to "count" in the work productivity assessment discussed in recommendation 2. While they would obviously not deserve the same weight as a funded proposal, the effort should count. Second, funded proposals could be given an enhanced productivity metric. Each successfully funded proposal could be evaluated using a weighting metric that is based on the academic diversity of the PIs. A simple method might be to add an additional 10 % to the grant amount for each additional academic department represented in the proposal. For example, if an interdisciplinary team composed of pre-tenure faculty from three departments is awarded a $1 million grant, the award would be evaluated during the tenure process as if it was a $1.2 million grant ($1 million plus $200,000 for two additional academic departments). The total monetary award would not change, of course, but pre-tenure faculty could take credit for a slightly higher amount to reward their interdisciplinary efforts while at the same time rewarding their department for support of the effort.

Finally, in many cases, the proposals developed for interdisciplinary water resources work have the potential for high, immediate impact and include a strong community component. This work should be counted as "service" as well as research. It is not uncommon for pre-tenure faculty to donate their time attending stakeholder meetings, policy discussions, and educational field trips in order to build community trust and communicate the importance of their research. For example, in New Mexico, several of us have conducted research addressing the ecological and institutional challenges of water resource management, including a recent proposal to build a controversial water storage project on the Gila River in southern New Mexico. This work incorporates the involvement and coordination of state agencies and stakeholders that have a strong interest in the health of New Mexico's water resources and aquatic ecosystems. Similarly, researchers at the UI have been involved in and even facilitated stakeholder meetings associated with review of the Columbia River treaty between the USA and Canada with countless hours involved in preparation and meetings. Although not explicitly included in project scopes and budgets, these interactions with the water resource community are vitally important for the success of the projects. Service credit should be given to pre-tenure faculty for similar projects that depend on close coordination with grassroots organizations and other stakeholders.

Construct and support academic homes for interdisciplinary programs

Where an interdisciplinary program is located within the university—both physically and in terms of the institutional hierarchy—is critically important to its success. Many universities struggle with where to put interdisciplinary programs. The WRP at UNM is one example. When it was first created as a professional Masters degree program in 1991, it was placed in University College. The University College at UNM is actually an undergraduate college designed to assist students as they prepare to declare a major. The decision to place the WRP in this unlikely location was based on the idea that it would be good "neutral territory," given that the faculty administering the program are located at three different colleges: Arts and Sciences, Community and Regional Planning, and Engineering. During budget cuts in 2008, the University College was no longer an amenable home, and after much machination, the program ended up in Graduate Studies. This current situation is also not ideal. Graduate Studies is the central graduate academic administrative unit for graduate programs at UNM; it generally does not confer its own degrees and is not an *academic* home. As a result, the WRP remains an island, administratively isolated from academic programs on campus conducting relevant teaching and research. The WRP's successes and struggles are not a direct concern for any of the academic departments and colleges on campus. The search for "neutral territory" has resulted in a situation in which the WRP is rarely championed on campus and has a hard time competing for increasingly scarce resources.

At UI, the WRP was launched in 2007 and was first administered in the College of Graduate Studies, where three existing interdisciplinary programs (environmental science, bioinformatics and computational biology, neuroscience) were also housed. The College of Graduate Studies was a neutral home for these programs, and two others added later, until the Provost and other college deans became concerned that communication across campus was lacking and that the rest of the university continued to be organized predominantly in a silo structure, i.e., colleges and departments. In addition, the location suffered from the same issue raised with UNM: it was housed in a college that, other than the interdisciplinary programs, did not confer degrees and was not the academic home for any of the faculty in the program. The Provost and college deans then constructed a University-wide Program (UWP) Board reporting structure, also referred to as the Council of Deans. Interdisciplinary programs (now referred to as UWPs) was assigned a coordinating dean, on a rotational basis. The new structure was designed to provide

communication across the multiple colleges in which interdisciplinary program faculty were housed. The benefits given as justification for new approach included: (1) increased communication and appropriate representation; (2) designated leadership for day-to-day responsibilities and assignment of representative college resources in service to the UWP; (3) clarified process protocol and pathways for reporting, coordination among academic programs for delivery, and support systems; (4) coordination of development activities; (5) integrated evaluation and appropriate acknowledgment for interdisciplinary endeavors; and (6) development of position description, tenure and promotion standards, and annual performance evaluation in coordination with home departments.

A rigorous evaluation and assessment process was supposed to be implemented for the new structure. While the coordinating deans were good about facilitating several administrative functions previously provided by the College of Graduate Studies, few of the promised benefits materialized, and an evaluation process was never put in place. Some increases in communication were credited to the new structure, and, for those faculty in colleges in which the dean took the structure seriously, considerable increase in recognition of contribution to the university occurred. In general, however, it was a failed attempt for better coordination and support. In 2012, changes at the administrative level resulted in another shift, and UWPs were permanently moved to a single college for administrative purposes. The accounting system for student numbers was subsequently revised, with the result being that UWPs appear less successful and certain colleges more successful than often warranted. Communication and coordination regarding the activities of faculty associated with UWP's to their home departments has declined despite protests from participating students and faculty. At the moment, the future of the WRP and other UWPs at the UI is uncertain.

Universities need to provide institutional structures for interdisciplinary programs that incentivize an investment in their success. While this does not necessarily require a stand-alone college or an independent faculty, it does mean that there must be institutional support for the substance of the program and a process for rewarding other academic units on campus for their participation. Solutions will necessarily differ from place to place. On some campuses, a separate college or school may provide the necessary focus, but this can also lead to unnecessary isolation of the program from other work on campus. Cross campus programs that draw from many colleges and departments have the ability to involve more faculty, but these attempts fail if the upper administration does not make it a priority and provide the necessary incentives and resources. This could be accomplished by providing increased research overhead allocations to departments and colleges that invest in interdisciplinary programs, as well as communication and evaluation structures that are effective and transparent.

The key is to find an institutional structure that invests the university in the program's success and provides the necessary support. Direct involvement by the Provost's office, with a program director reporting directly to the Provost, can invest the university in interdisciplinary success, with the Provost leading the cross-college communication through her/his interaction with deans. In the end, hard choices need to be made. In the environmental arena generally (and in water resources specifically), interdisciplinary research and education are the future. However, attempts bridge to that future during lean budgetary times by simply asking faculty to fulfill both their disciplinary requirements as well as contribute to these new, cutting edge fields will see quality of teaching, research, recruiting and retention decline.

Rethink "advancement of discipline" as basis for promotion and tenure

For any pre-tenure member of a faculty, the standards and expectations for promotion and tenure are of paramount concern. While most faculty feel some anxiety around tenure and promotion decisions, those involved in interdisciplinary work invariably have heightened concerns. These concerns include whether colleagues will understand and value their scholarly contributions and whether the standards and processes used to evaluate them contain the necessary flexibility to recognize research and scholarship that may differ from the norm. Another concern relates to the selection of external reviewers for tenure packages, i.e., will reviewers from a specific discipline appropriately assess and value work outside their area of expertise? Table 1 summarizes the standards for promotion and tenure at our universities. While there is some variation, both Idaho and New Mexico have specific references to advancing a *discipline* as part of the criteria for promotion and tenure.

This is not uncommon. Value at a research university is generally placed on scaling the peaks of one's discipline—investigating some new, uncharted territory. Interdisciplinary research also charts new territory but this is often accomplished by coming down off the peaks of any given discipline and finding an unexplored valley filled with complex interactions, multiple knowledges, and differing assumptions and values. Many of the disciplines currently informing important interdisciplinary research are "mature" in the sense that it is increasingly difficult to find new territory. For example, one co-author was recently at a water resources workshop that included many of the top hydrologists in academia. The hydrologists were talking among themselves about the need to identify the next "big question" for their field. After overhearing this, our co-author thought: "I have more big questions than I can handle!" Continuing the mountain metaphor, some disciplines have reached their angle of repose—the steepest angle they can reach without additional support. In this way, interdisciplinary work can enhance individual disciplines by

Table 1 Promotion and tenure standards based on faculty handbooks (emphasis added)

Promotion and tenure	University of New Mexico	University of Idaho	University of Nevada Reno
Associate Professor	(a) Individuals who have attained high standards in teaching and who have made *significant contributions to their disciplines* may be considered for this faculty rank. They shall also have developed expertise and interest in the general problems of university education and their social implications and have shown the ability to make constructive judgments and decisions. It is expected that the professor will continue to develop and mature with regard to teaching, scholarly work, and the other qualities that contributed to earlier appointments.	Tenure is granted only to faculty members who demonstrate that they *have made and will continue to make significant contributions in their disciplines* through effective performance in the responsibility areas.	The recommendation for awarding tenure to academic faculty may include but not be limited to specific review of the faculty member's teaching effectiveness and scholarship record, along with the following criteria: (1) a record of effectiveness as a university teacher, including the ability to communicate effectively with students; (2) demonstrated teaching competence in a classroom and laboratory; (3) definite interest in advising students; (4) skill in handling classroom and campus routines; (5) evidence of continued professional growth through study, membership in professional organizations, and creative or research activity; (6) demonstrated ability to work in harmony with colleagues in the best interests of the university and the people it serves; (7) service on college and university committees; (8) a record of creative or research activity resulting in publication of comparable productivity; (9) reputation among colleagues for stability, integrity, and capacity for further significant intellectual and professional achievement; (10) indication of respect and esteem of colleagues and students; (11) recognition and respect for participation and service in worthy community, state, or nationwide
Professor	(b) Appointment or promotion to Professor represents a judgment on the part of the department, college/school, and university that the individual has made *significant, nationally recognized scholarly or creative contributions to his or her field* and an expectation that the individual will continue to do so.	A. General. Promotion to a rank requires the faculty member to meet the requirements for that rank. Responsibility for the effective functioning of promotion procedures rests with faculty and administrators. Decisions are based on thorough and uniform evaluation of the faculty member's performance in relation to the expectations as listed in his/her position description. Performance of university administrative duties as a unit administrator is not a consideration in promotion. B. Bases of Evaluation. Promotion in rank is granted only when there is reasonable assurance, based on performance, that the faculty member will continue to meet the standards for promotion.	Same as above.

Relevant criteria in italics

broadening the base of knowledge that informs them and allowing them to move forward in new way.

The pressing environmental research and policy challenges of our time require collaborative, integrated research and scholarship across disciplinary boundaries in order to formulate meaningful societal responses (Millennium Ecosystem Assessment 2005; Liu et al. 2007). To accomplish this, faculty should be encouraged to take on interdisciplinary challenges early on, laying the groundwork for a successful, long-term career in such endeavors. Tenure and promotion standards can support this by eliminating the need to advance any one "discipline" as a reference point for scholarly achievement.

University of Nevada Reno's much broader basis for tenure provides one example of this approach. Groundbreaking achievements take many forms, and new trajectories in environment and natural resources scholarship will be in many cases interdisciplinary and in some cases *post*-disciplinary, leaving behind altogether previously structured silos for knowledge systems.

Conclusion

Interdisciplinary work is increasingly valued at research universities, but academic institutions can do a better job of supporting individuals who are building careers centered on interdisciplinary teaching, research and scholarship. And while many others have written on the topic of interdisciplinary research (e.g., Heberlein 1988; COSEPUP 2004), our conclusions are complimentary and directly based on our experiences *doing* interdisciplinary scholarship and teaching. By providing five specific suggestions for academic institutions looking to better support interdisciplinary research and teaching, we hope to generate discussions across campuses and within academic professional societies and grant-making institutions. First, by finding ways to honor the impact of scholarship outside traditional disciplinary silos, young faculty will be encouraged to seek a broader audience for their work and place it in appropriate venues. Second, the value of interdisciplinary work on campus is often overlooked. Where it is recognized, it can be viewed as voluntary, "extra" work that is not central to the faculty member's role at the university. By ensuring that time and effort spent teaching, advising, and mentoring students in interdisciplinary programs are recognized and valued, pre-tenure faculty can become active participants, focusing on the needs to be met rather than the metrics used for workload productivity. Third, by creating a "safe fail" for interdisciplinary research proposals and projects, institutions can acknowledge the particularly challenging aspects of this work and encourage it early in one's career. Fourth, the placement of interdisciplinary programs within an academic institution is critical to its success. By providing academic homes that are invested in their accomplishments, programs such as ours can flourish and create opportunities for faculty and students. Finally, it is time to reexamine the expectation that faculty must advance one specific discipline in order to receive tenure and promotion.

We hope that discussions generated by this article will result in actual changes that will destabilize the common assumption that interdisciplinary work is something to pursue *after* tenure, once advancement of a specific discipline is accomplished. By implementing specific reforms that protect faculty from disciplinary-bound expectations and support the high-risk/high-reward nature of interdisciplinary work, research and teaching can more effectively address and respond to the environmental challenges facing our rapidly changing world.

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