Graduate students navigating social-ecological research: Insights from the Long Term Ecological Research Network

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Abstract

Research partnering scientists and stakeholders improves the capacity for sustainable environmental decision-making. Consequently, interdisciplinary collaborative research capable of capturing the feedback between biophysical and social systems is required. Graduate student research programs that cross disciplinary boundaries are less straightforward than traditional disciplinary graduate programs, making the pathway to degree completion difficult to navigate regarding funding, pedagogy, research design and development, communication, and culture/attitude. Although insights into interdisciplinary research have been discussed elsewhere, they often come from the perspectives of more senior scientists. We provide graduate student perspectives from the Long Term Ecological Research Network on interdisciplinary degree paths. Through case studies and interviews, we find that communication, culture, and attitude are integral to the experience of a student pursuing social-ecological research. Sharing insights about successful graduate student approaches to social-ecological research can facilitate dialogue between students, advisors, committee members, and institutions to train scientists well versed in addressing complex issues.

Key words: Coupled human natural systems; Interdisciplinary; Multi-disciplinary; Trans-disciplinary; Training
In a Nutshell

- Many environmental problems require scientists trained in both ecological and social sciences, yet studies on the lived experiences of graduate students engaged in such research remain limited. We provide insights into graduate student social-ecological research from students in the Long Term Ecological Research Network.

- The pathway to degree completion has the potential to be less linear for students pursuing social-ecological research compared to single disciplinary research. Communication, a collaborative culture, and an enterprising attitude were key factors to success.

- These insights will provide guidance to students, advisors, and institutions interested in training students to address complex policy relevant issues.
Introduction

Large-scale and pressing problems (e.g. climate change, feeding a burgeoning global population) challenge today’s human population. Scientists are being called on to examine these issues, both to better understand the causes and consequences of change and to offer suggestions for policy makers and practitioners (Groffman et al. 2010). Addressing these complex topics requires scientists to ask questions integrating the social and ecological sciences (Ewel 2001; Diaz et al. 2011; Romero and Agrawal 2011; Kueffer et al. 2012). Such research often demands a collaborative team of scientists, including individuals with the ability to integrate across disciplinary and cultural differences (Bammer 2005; Haapasaari et al. 2012).

The increasing prevalence and demand for social-ecological research is evident in scientific funding sources and organizations. Recent solicitations for social-ecological programs from the National Science Foundation (NSF) include the Water Sustainability and Climate program, an area of interest in Science, Engineering, and Education for Sustainability, and the implementation of an International Network of Research on Coupled Human and Natural Systems (www.chansnet.org). Novel research institutions (e.g. U.S. National Socio-Environmental Synthesis Center and Sweden’s Stockholm Resilience Centre) focus specifically on social-ecological research. Organizations traditionally focused on ecology have initiatives to incorporate social research (Grimm and Redman 2004; Musacchio and Wu 2004).

This paper draws upon the experiences of members of one such institution: the NSF-funded Long-Term Ecological Research (LTER) Network. Established in 1980 to encourage ecological research spanning broad temporal and spatial scales (Callahan 1984), the LTER Network is in the implementation phase of a 10-year plan to integrate social and ecological research, the Integrated Science for Society and Environment (ISSE) initiative (U.S. Long Term
Ecological Research Network 2007; Collins et al. 2011). The ISSE initiative defines a social-ecological approach as one that, “…conceptualizes ecosystems as environments driven by complex human and non-human associations, where biophysical and societal elements dynamically and adaptively interact” (Berkes and Folke 1998; Redman et al. 2004).

Implicit in the calls for increased social-ecological scholarship is the need for new scientists to be equipped with the skills required to conduct integrative, collaborative, problem-oriented research (Bammer 2005; Sibbel 2009; Cheruvelil et al. In Review). However, a comprehensive definition of a social-ecological researcher has not yet emerged, and training for social-ecological researchers can take many, often nonlinear, routes (Romolini et al. 2013).

Given the nascence of the field, the mentoring and institutions needed to support this research may not be as defined as in other areas of study, and standards for interdisciplinary degrees may not be well established (Wiek et al. 2011; Cox 2012). Further, approaches to social-ecological research may vary along a continuum from multi-disciplinary to trans-disciplinary (Panel 1). These multiple pathways can be difficult to navigate for a researcher approaching social-ecological research for the first time.

The purpose of this paper is to better understand the process of becoming a social-ecological researcher through the eyes of a graduate student. Through interviews and case studies with graduate students in the LTER Network, we conceptualize the different pathways by which graduate students approach social-ecological research and highlight key components that respondents identified as contributing to successful social-ecological research. The graduate student perspective is important since these developing researchers become the next generation of principal investigators. Yet literature on the lived experiences of graduate students engaged in multi-disciplinary to trans-disciplinary science remains scant (c.f. Graybill et al. 2006; Morse et
As our team is comprised of current or recent LTER graduate students, the authors themselves provide a perspective that is rare, even novel, in this area of research. We describe how the insights from LTER graduate students can be useful for several audiences interested in social-ecological research (e.g. potential students, current students, early career scientists, and mentors and institutions providing support for graduate research).

Insights from the LTER Network

We draw upon the experiences of four LTER-affiliated graduate students who have conducted social-ecological research. We examine how students approach social-ecological research and identify factors associated with “successful” social-ecological research projects.

Our reflections are timely because they occur halfway through the implementation of the ISSE initiative for promoting social-ecological research within the LTER Network (U.S. Long Term Ecological Research Network 2007; Collins et al. 2011). They also follow up on Colón-Rivera et al.’s (2013) discussion of how higher education institutions can improve the capacity of students in science technology, engineering and math (STEM) disciplines to meet the needs of the Ecological Society of America’s Earth Stewardship Initiative, and its focus on enhancing human well-being (Power and Chapin 2009).

We collected information about student experiences using interview and case study methods. Two of the interviews described in this paper were conducted in 2010 as part of an earlier study that included ten interviews examining graduate student social-ecological research (Romolini et al. 2013, Panel 2). Of the ten interviews conducted in 2010, only two respondents clearly self-identified as having successful social-ecological research projects. These two respondents were part of NSF’s Interdisciplinary Graduate Education Research and Training (IGERT) program, so to show a greater diversity in programs, two additional case studies were
compiled in 2012 from respondents who were not in IGERT programs and were from an interdisciplinary or disciplinary department. All sources were current graduate students but one, who was a former student whose degree was completed three years prior to the interview. The case study format asked similar questions to the semi-structured interviews from 2010, justifying our use of the two data sources together. We felt that the data from these two interviews and two case studies were sufficient because responses became redundant after collecting the second case study in 2012.

The experiences described here come from students who self-identified as having completed successful social-ecological research projects (Panel 2). We recognize that approaches to social-ecological research (Panel 1) and definitions of success vary among students. There is also variation in how students conceptualize and practice social-ecological research (Romolini et al. 2013). Our case studies provide a first look into the lived experiences of graduate students, but there are likely experiences that we do not document here.

We conducted content analysis of the interviews and case studies, identifying 1) common themes in pathways of graduate student research and 2) factors often associated with successful graduate student social-ecological research at three levels: student, faculty, (i.e. advisor, committee members), and institution (i.e. department, graduate program, university, and network). All insights into successful social-ecological research presented for these three levels of organization come from the perspective of a graduate student or recent PhD graduate.

Pathways of graduate research

Content analysis of all ten interviews and two case studies revealed that the pathway a graduate student takes from starting a degree program to graduating varies depending on the choice to pursue traditional disciplinary research compared to social-ecological research (Figure
1). While the pathways presented in Figure 1 represent archetypal disciplinary or social-ecological tracks, graduate students may transition to a social-ecological approach at many points during their graduate studies, and there is apt to be much variation among graduate students in either pathway. The support required by each student will be unique and reflect the student’s background, research questions, and study approach.

Graduate students rely upon different relationships with faculty mentors, committee members, and networks to design their research and to connect to their study system and, if relevant, stakeholders. The complex supportive network for new areas of expertise, such as social-ecological research, is likely to rely more intensively on multiple faculty members and supplemental networks (e.g. stakeholders and outside institutions) (Qureshi 2000). Cultivating diverse relationships may be especially important for the social-ecological student to facilitate interdisciplinary connections, spur creativity, and retain flexibility in research approaches.

In the archetypal disciplinary degree path (Figure 1), the student relies heavily on the faculty mentor to support research question development, coursework design, and temporal planning (Golde and Gallagher 1999). The advisor acts as the main contact point with the student - filtering committee input and directing coursework choices. In social-ecological graduate research, the relative roles of advisors and committee members may shift, especially if the primary advisor has a disciplinary background. Intellectual support for portions of the student’s research may rely more heavily upon committee members, depending upon the background training of the graduate student, development of the research question, and methodological approaches. Faculty members on the academic committee of a social-ecological student require flexibility and willingness to cooperate and reach beyond disciplinary traditions, in order to advise the student across disciplinary boundaries.
Social-ecological research requires a more iterative approach than disciplinary research, which results in feedback loops illustrated in the conceptual social-ecological pathway. The diverse questions and critiques offered by a committee with different disciplinary perspectives and the student’s interactions with stakeholders may reframe and inform research questions. Such iterative feedbacks may steer the student in directions that offer greater insight and societal relevance.

In addition to the iterative process of question development involving direct committee and stakeholder input (Rhoten and Parker 2004), social-ecological research requires more coursework or independent study spread across multiple disciplines (Golde and Gallagher 1999). Social-ecological research questions often require diverse methods, which may entail additional training. Final reporting of results may also differ between graduate student pathways. For instance, if stakeholders are engaged throughout the research development and implementation of a social-ecological graduate research project, they will ideally be informed of the project’s results through outreach activities.

Given the potential for greater uncertainty and variability in the path to completing a social-ecological degree, graduate students, advisors, and institutions will benefit from insights offered by examining the characteristics of successful social-ecological graduate student research.

Factors associated with “successful” graduate student social-ecological research

We used content analysis to identify common factors of success across the four ‘successful’ interviews and case studies. There were six factors that had the most overlap, a discussion of which follows.

Funding
Students researching social-ecological topics must seek out funding opportunities specific to their project, which may be more difficult to find since they are not always broadcast to eligible applicants (Figure 2; Panel 3 Quote 1). The LTER cases suggest that access to funding opportunities requires greater adaptability by students and faculty advisors and increased institutional support for interdisciplinary research. Students in the LTER Network receive funding when they search widely across disciplines for grants, limit disciplinary jargon in proposals, integrate disciplinary approaches, address current issues of concern, and specifically seek funding from institutions known to support such research (Panel 3 Quotes 1, 2, & 3).

Faculty with experience writing interdisciplinary proposals and knowledge of student funding opportunities are particularly valuable, especially when they secure funding prior to working with a student (Panel 3 Quote 4).

**Pedagogical approach**

Social-ecological research is broader in scope than an equivalent disciplinary study. Students engaged in social-ecological research require greater flexibility in how they acquire needed expertise and in the institutional and academic support to make this possible (Figure 1). Multidisciplinary coursework is critical to exposing students to a broad range of social scientific and ecological theories and approaches needed to adequately inform their dissertation work (Panel 3 Quotes 5 & 6).

The demands of multidisciplinary coursework require a shift in expectations about the student’s disciplinary standards. Successful students spoke of faculty members who valued breadth of knowledge and engage in interdisciplinary curriculum development and felt that these faculty members were more likely to support students in identifying the right balance of specialization (Panel 3 Quote 7). Institutions can foster this pedagogical approach by establishing
interdisciplinary programs like the NSF’s flagship interdisciplinary training program IGERT, which is currently active in several LTER sites throughout the network. However, continued NSF for IGERT is uncertain, since the program did not receive a solicitation for FY 2013.

**Research design and development**

Pertinent and tangible research questions, informed by place-based knowledge and input from stakeholders, help students define their research (Panel 3 Quote 8). Students also benefit from the expert advice and training of a committee including faculty from multiple disciplines (Panel 3 Quote 8). Including people from multiple disciplines from the outset may also facilitate research development (Panel 3 Quote 9).

Faculty members who affirm the adaptable, iterative pathway that results from allowing questions to drive the research approach facilitate graduate student research (Panel 3 Quotes 9 & 10). Pre-existing, trusting relationships among faculty from multiple departments and stakeholders also assist graduate students. However, when these relationships do not already exist, students are in an ideal position to help develop them (Panel 3 Quote 10). Institutions can be supportive by providing flexibility in requirements (e.g. the structure of departments, timelines, residency, coursework, committee members, and forms of scholarly products) (Panel 3 Quote 11).

**Communication**

For students working with diverse faculty and stakeholders, regular communication is essential to designing and executing research and building understanding and trust (Panel 3 Quotes 11 & 12). Students can have substantial impacts if they share results in formats that are relevant to both the academic community and stakeholders. Though a journal publication is meaningful in the academic community, a presentation or report on findings in the stakeholder
community may have greater impact for local decision-makers (Panel 3 Quotes 13 & 14). Stable partnerships between institutions and communities facilitate student engagement with stakeholders (Panel 3 Quote 12). Institutions can also support students through activities that bring together diverse academic disciplines to communicate about disciplinary norms (Panel 3 Quote 13).

Faculty who maintain connections with other departments and are able to translate discipline-specific jargon to a broader audience have a greater capacity to help students communicate with academic colleagues (Panel 3 Quote 15). Also, as students refine the balance between the breadth and depth of their research, they benefit from discussing shifting expectations with faculty, given the potential non-linearity of their research path. Navigating through the shifting of expectations requires continuous, open communication between the student and faculty advisors (Panel 3 Quote 14).

**Networking**

Graduate students find support in both peer and professional networks (Panel 3 Quote 16). Students at one university formed their own program modeled after IGERT for graduate students who combine social and ecological research. Participating in groups like IGERT can help students learn how to collaborate with colleagues from different disciplines (Panel 3 Quote 15).

Institutions may facilitate such communities of practice, as well as conferences and workshops that are beneficial to students. For example, the authors met through the LTER Network’s All Scientists Meeting. Faculty members who make students aware of interdisciplinary networks and encourage the formation of multi-disciplinary committees support student networking (Case study 3).
Culture/Attitude

The student engaged in social-ecological research contributes to an emerging culture of scientific practice that is increasingly entrepreneurial in its funding approach, ignores disciplinary stereotypes, and demonstrates cultural sensitivity to the values and perspectives of its stakeholder community (Panel 3 Quote 17 & 18). Flexibility and good communication are invaluable skills for completing coursework requirements, working with faculty from multiple departments, and engaging with stakeholders in applied projects (Panel 3 Quote 19). Faculty contribute to this culture by recognizing differences in disciplinary standards and demonstrating a willingness to partner across disciplines to meet students’ needs (Panel 3 Quote 17 & 21). Institutions contribute to the culture by facilitating outreach with stakeholders and collaborations that are interdisciplinary from the start (Panel 3 Quote 23). Explicitly interdisciplinary graduate programs may be more likely to encourage open dialogue across disciplines and to foster a peer support network that extends beyond the student’s home department. The student interested in social-ecological research is encouraged to think carefully about program choice, for as one respondent put it, you want to be at an institution, “where your lack of experience in a discipline is not necessarily seen as a shortcoming but is seen as an opportunity for you to learn” (Case Study 3).

Conclusions

There is unprecedented opportunity for social-ecological research to benefit society by helping to inform decisions about pressing environmental problems (Whitmer et al. 2010; Groffmann et al. 2010). Social-ecological research that engages relevant stakeholders has the potential to span the divide between academic research and the general public, increasing the
relevance of research findings to environmental decisions (Overdevest et al. 2004; Pace et al. 2010).

Training social-ecological researchers to perform transformative studies presents a number of unique challenges that are not typically encountered in a traditional single disciplinary graduate program (Bammer 2005; Romolini et al. 2013). For instance, the path to graduation for social-ecological students is often less linear than the path taken by single discipline students due to the involvement of stakeholders and committee members from diverse disciplinary backgrounds (Figure 1). Given this non-linearity, it is important to encourage dialogue about what factors lead to successful training of graduate students performing social-ecological research.

The insights presented from the LTER case studies provide the unique perspective of the lived experiences of graduate students into the multiple drivers that contribute to the success of graduate social-ecological research. While some factors were more greatly discussed in a subset of the case studies and interviews, communication and culture/attitude were emphasized by all. This finding suggests that there is potential for students, advisors, and institutions to open communication, create a collaborative culture, and foster entrepreneurial attitudes to increase the likelihood of successful graduate training and research. These actions are especially important for students who may need to shift their initial expectations of graduate school given the potential non-linearity of the pathway leading to degree completion (Figure 1).

Although communication and culture/attitude were emphasized by all respondents, many of these factors overlap (e.g., good communication skills often go with ease of networking).

Figure 2 highlights strategies that students, faculty, and institutions might take to facilitate successful social-ecological graduate student research. Increased dialogue between these players
will facilitate training of social-ecological researchers and will inform pertinent environmental
decisions in collaboration with stakeholders and policy makers.

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Figure 1. The path to successfully completing graduate research can look different for those choosing social-ecological versus purely ecological or single disciplinary research. The general path remains the same for both students: required flows from one step to another, as well as links to the advisor and committee (solid lines). Complexity may be added at many points throughout the graduate student process (dotted lines) and this is more pronounced in social-ecological research. Graphic courtesy of S. Bond.

Figure 2. Six factors that were identified as key contributors to success in social-ecological research by graduate students: attitude and culture, research development, networking, communication and outreach, pedagogical approach, and funding. Within each feature there are examples of the resources and behaviors that institutions, faculty, and students might employ to build the capacity for graduate student social-ecological research. Graphic courtesy of S. Bond.
Panel 1. Defining disciplinarities

Students pursuing social-ecological projects have several available research approaches. Whether to pursue a multi-disciplinary, inter-disciplinary, or trans-disciplinary strategy will largely depend on the research questions and systems of study. We follow the definitions of disciplinarity described by Miller et al. (2008), as displayed below.

- Multi-disciplinary research: “individual researchers consider a common set of issues, but maintain disciplinary boundaries.”

- Inter-disciplinary research: “unified problem formulation, sharing of methods, and perhaps the creation of new questions.”

- Trans-disciplinary research: “transcends entrenched categories to formulate problems in new ways.”
Panel 2. Case Study Descriptions

Case Study 1:
The effects of residential land use practices and values on wildlife and landowner decision-making.

Case Study 2:
The benefits of using a social-ecological approach to improve causal understanding of trends in natural resource use and ecological monitoring data.

Case Study 3:
The role of residential values and institutional norms on ecological characteristics of private properties.

Case Study 4:
The influence of economics frameworks for decision-making on forest dynamics and protected areas.
Panel 3: Quotes from graduate student case studies within the LTER Network associated with factors associated with “successful” graduate student social-ecological research.

FUNDING

Quote 1: “The applied ecology aspect of [the respondent’s] question allowed her to easily obtain funds... Later on in her doctoral program, an NSF call for proposals through the LTER (based on a non-specific need for human aspects within the LTER) was sent out to the social science department list-servs. [The respondent], not being based in a social science department, did not receive the email, but … a human geographer… got the email and was able to forward it to her. [The respondent] received the majority of available funds through that grant, but would not have been able to do so without her carefully picked committee and her communication with them.” – Case study 2

Quote 2: “…the network has been helpful in that there are a few LTER sites that have been working on very similar projects…we’ve gotten funding through the network, the LTER Network, to have workshops at someone’s site. Everyone will come, and we can have in-person meetings for a day or two…” – Case study 3

Quote 3: “… there are a lot of diverse perspectives on this [social-ecological research] right now, which I think is a good thing. But, it makes it very hard to get it funded because depending on who’s reading the proposals, they have a lot of different perspectives on what this actually means.” – Case study 4

Quote 4: “[The respondent] ultimately chose an ecologist as her faculty advisor because he could more easily fund her expensive ecological data collection.” – Case study 2
PEDAGOGICAL APPROACH

Quote 5: “It helps to learn the methods and theories in different fields. Having people from
different fields on my committee and being friends with grad students in different fields has
helped me a lot.” – Case study 1

Quote 6: “There was a lot of communication, a lot about how to do it: how to think past
disciplinary backgrounds and ideas and integrate them.” – Case study 3

Quote 7: “…you’re scratching the surface of 4-5 different aspects…each thing that you do will
be rigorous, to the extent that…as rigorous as you can make it, but it will not be very deep.” –
Case study 4

RESEARCH DESIGN AND DEVELOPMENT

Quote 8: “I come from a biology background, so having an anthropologist on my committee and
knowing anthropology grad students has helped me a lot. It helps to learn the methods and
theories in different fields and to get through logistics like human subject approval.” – Case
study 1

Quote 9: “The sociologists and geographers were also contributing to the planning. Rather than
just doing ecology and then bringing in the social scientists on the side, create interdisciplinary
ideas and methods and think about that from the beginning. So at the end, you have a project that
is integrated throughout.” – Case study 3
Quote 10: “Initiating collaborations across disciplines is the main thing. Not just letting them come in and participate if they want but going out and seeking them out, seeking their help in collaboration.” – Case study 3

Quote 11: “This is a good place because we are small and we are by nature very interdisciplinary faculty. Departmental boundaries are not significant. We are very small and interdisciplinary….” – Case study 4

COMMUNICATION

Quote 12: “Because of the LTER site’s historic focus on research in the forest nearest the site headquarters, the surrounding community did not know much about what was done by the LTER site. Now LTER PIs and graduate students have created a program to foster dialog between the LTER site and the community.” – Case study 1

Quote 13: “At the same time that it was really good that we were constantly communicating, it was really frustrating. We have different ideas about the ways we’re supposed to go, and different disciplines do things different.” – Case study 3

Quote 14: “If you’re really interested in this question, and there are five or six different pieces of this question that you know are important, now you can either do the traditional Ph.D. and grab one of those questions and work it until it’s done, or you can say, ‘I want to know how this whole thing works, and I want to know how different parts link together, and I want to do
rigorous research but with the understanding that if I address all five of these aspects, I can only go so deep in each area.” – Case study 4

NETWORKING

Quote 15: “What the IGERT program taught me was how to take a step back and communicate with people from very different points of view intellectually and how to be able to put aside assumptions and bring them back as necessary.” – Case study 4

Quote 16: “I got involved with LTER through my advisor. My advisor, an ecologist, wrote the original grant for my project with a cultural geographer.” – Case study 3

ATTITUDE AND CULTURE

Quote 17: “…if there is a sociologist who wants to participate, they won’t be excluded.” – Case study 3

Quote 18: “Prior to starting my fieldwork, professors had advised me that landowners … would not be welcoming and that I would have to be careful about people chasing me off their property …. In my experience, landowners were overwhelmingly supportive and friendly. – Case study 1

Quote 19: “[She] would not have been able to able to complete her dissertation without confidence in her own work, commitment to working with the … community and various faculty, and persistence throughout when faced with challenges.” – Case study 2
“It’s important to be at an institution that’s not Balkanized…. The mentality is there to say, ‘we understand that you don’t have a degree in economics, and we’re not going to treat you like you’re an idiot in this class.’” – Case study 4

“… there are very few people who shut down students who are coming from different backgrounds who want to come and contribute, especially at the graduate level.” – Case study 3
Figure 1.
Figure 2.