

1 **Running head:** Graduate student social-ecological research

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

5 Research Network

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16

17 **Abstract**

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

32 **Key words:** Coupled human natural systems; Interdisciplinary; Multi-disciplinary; Trans-  
33 disciplinary; Training

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35 **In a Nutshell**

- 36 • Many environmental problems require scientists trained in both ecological and social  
37 sciences, yet studies on the lived experiences of graduate students engaged in such  
38 research remain limited. We provide insights into graduate student social-ecological  
39 research from students in the Long Term Ecological Research Network.
- 40 • The pathway to degree completion has the potential to be less linear for students pursuing  
41 social-ecological research compared to single disciplinary research. Communication, a  
42 collaborative culture, and an enterprising attitude were key factors to success.
- 43 • These insights will provide guidance to students, advisors, and institutions interested in  
44 training students to address complex policy relevant issues.

45 **Introduction**

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

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

63           This paper draws upon the experiences of members of one such institution: the NSF-  
64 funded Long-Term Ecological Research (LTER) Network. Established in 1980 to encourage  
65 ecological research spanning broad temporal and spatial scales (Callahan 1984), the LTER  
66 Network is in the implementation phase of a 10-year plan to integrate social and ecological  
67 research, the Integrated Science for Society and Environment (ISSE) initiative (U.S. Long Term

68 Ecological Research Network 2007; Collins *et al.* 2011). The ISSE initiative defines a social-  
69 ecological approach as one that, "...conceptualizes ecosystems as environments driven by  
70 complex human and non-human associations, where biophysical and societal elements  
71 dynamically and adaptively interact" (Berkes and Folke 1998; Redman *et al.* 2004).

72         Implicit in the calls for increased social-ecological scholarship is the need for new  
73 scientists to be equipped with the skills required to conduct integrative, collaborative, problem-  
74 oriented research (Bammer 2005; Sibbel 2009; Cheruvilil *et al.* *In Review*). However, a  
75 comprehensive definition of a social-ecological researcher has not yet emerged, and training for  
76 social-ecological researchers can take many, often nonlinear, routes (Romolini *et al.* 2013).  
77 Given the nascence of the field, the mentoring and institutions needed to support this research  
78 may not be as defined as in other areas of study, and standards for interdisciplinary degrees may  
79 not be well established (Wiek *et al.* 2011; Cox 2012). Further, approaches to social-ecological  
80 research may vary along a continuum from multi-disciplinary to trans-disciplinary (Panel 1).  
81 These multiple pathways can be difficult to navigate for a researcher approaching social-  
82 ecological research for the first time.

83         The purpose of this paper is to better understand the process of becoming a social-  
84 ecological researcher through the eyes of a graduate student. Through interviews and case  
85 studies with graduate students in the LTER Network, we conceptualize the different pathways by  
86 which graduate students approach social-ecological research and highlight key components that  
87 respondents identified as contributing to successful social-ecological research. The graduate  
88 student perspective is important since these developing researchers become the next generation  
89 of principal investigators. Yet literature on the lived experiences of graduate students engaged in  
90 multi-disciplinary to trans-disciplinary science remains scant (c.f. Graybill *et al.* 2006; Morse *et*

91 *al.* 2007; Colón-Rivera 2013). As our team is comprised of current or recent LTER graduate  
92 students, the authors themselves provide a perspective that is rare, even novel, in this area of  
93 research. We describe how the insights from LTER graduate students can be useful for several  
94 audiences interested in social-ecological research (e.g. potential students, current students, early  
95 career scientists, and mentors and institutions providing support for graduate research).

### 96 **Insights from the LTER Network**

97         We draw upon the experiences of four LTER-affiliated graduate students who have  
98 conducted social-ecological research. We examine how students approach social-ecological  
99 research and identify factors associated with “successful” social-ecological research projects.  
100 Our reflections are timely because they occur halfway through the implementation of the ISSE  
101 initiative for promoting social-ecological research within the LTER Network (U.S. Long Term  
102 Ecological Research Network 2007; Collins *et al.* 2011). They also follow up on Colón-Rivera *et*  
103 *al.’s* (2013) discussion of how higher education institutions can improve the capacity of students  
104 in science technology, engineering and math (STEM) disciplines to meet the needs of the  
105 Ecological Society of America’s Earth Stewardship Initiative, and its focus on enhancing human  
106 well-being (Power and Chapin 2009).

107         We collected information about student experiences using interview and case study  
108 methods. Two of the interviews described in this paper were conducted in 2010 as part of an  
109 earlier study that included ten interviews examining graduate student social-ecological research  
110 (Romolini *et al.* 2013, Panel 2). Of the ten interviews conducted in 2010, only two respondents  
111 clearly self-identified as having successful social-ecological research projects. These two  
112 respondents were part of NSF’s Interdisciplinary Graduate Education Research and Training  
113 (IGERT) program, so to show a greater diversity in programs, two additional case studies were

114 compiled in 2012 from respondents who were not in IGERT programs and were from an  
115 interdisciplinary or disciplinary department. All sources were current graduate students but one,  
116 who was a former student whose degree was completed three years prior to the interview. The  
117 case study format asked similar questions to the semi-structured interviews from 2010, justifying  
118 our use of the two data sources together. We felt that the data from these two interviews and two  
119 case studies were sufficient because responses became redundant after collecting the second case  
120 study in 2012.

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

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

### 133 **Pathways of graduate research**

134         Content analysis of all ten interviews and two case studies revealed that the pathway a  
135 graduate student takes from starting a degree program to graduating varies depending on the  
136 choice to pursue traditional disciplinary research compared to social-ecological research (Figure

137 1). While the pathways presented in Figure 1 represent archetypal disciplinary or social-  
138 ecological tracks, graduate students may transition to a social-ecological approach at many  
139 points during their graduate studies, and there is apt to be much variation among graduate  
140 students in either pathway. The support required by each student will be unique and reflect the  
141 student's background, research questions, and study approach.

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

149 In the archetypal disciplinary degree path (Figure 1), the student relies heavily on the  
150 faculty mentor to support research question development, coursework design, and temporal  
151 planning (Golde and Gallagher 1999). The advisor acts as the main contact point with the  
152 student - filtering committee input and directing coursework choices. In social-ecological  
153 graduate research, the relative roles of advisors and committee members may shift, especially if  
154 the primary advisor has a disciplinary background. Intellectual support for portions of the  
155 student's research may rely more heavily upon committee members, depending upon the  
156 background training of the graduate student, development of the research question, and  
157 methodological approaches. Faculty members on the academic committee of a social-ecological  
158 student require flexibility and willingness to cooperate and reach beyond disciplinary traditions,  
159 in order to advise the student across disciplinary boundaries.



160 Social-ecological research requires a more iterative approach than disciplinary research,  
161 which results in feedback loops illustrated in the conceptual social-ecological pathway. The  
162 diverse questions and critiques offered by a committee with different disciplinary perspectives  
163 and the student’s interactions with stakeholders may reframe and inform research questions.  
164 Such iterative feedbacks may steer the student in directions that offer greater insight and societal  
165 relevance.

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

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

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

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

#### 182 **Funding**

183           Students researching social-ecological topics must seek out funding opportunities specific  
184 to their project, which may be more difficult to find since they are not always broadcast to  
185 eligible applicants (Figure 2; Panel 3 Quote 1). The LTER cases suggest that access to funding  
186 opportunities requires greater adaptability by students and faculty advisors and increased  
187 institutional support for interdisciplinary research. Students in the LTER Network receive  
188 funding when they search widely across disciplines for grants, limit disciplinary jargon in  
189 proposals, integrate disciplinary approaches, address current issues of concern, and specifically  
190 seek funding from institutions known to support such research (Panel 3 Quotes 1, 2, & 3).  
191 Faculty with experience writing interdisciplinary proposals and knowledge of student funding  
192 opportunities are particularly valuable, especially when they secure funding prior to working  
193 with a student (Panel 3 Quote 4).

194 *Pedagogical approach*

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

201           The demands of multidisciplinary coursework require a shift in expectations about the  
202 student's disciplinary standards. Successful students spoke of faculty members who valued  
203 breadth of knowledge and engage in interdisciplinary curriculum development and felt that these  
204 faculty members were more likely to support students in identifying the right balance of  
205 specialization (Panel 3 Quote 7). Institutions can foster this pedagogical approach by establishing

206 interdisciplinary programs like the NSF's flagship interdisciplinary training program IGERT,  
207 which is currently active in several LTER sites throughout the network. However, continued  
208 NSF for IGERT is uncertain, since the program did not receive a solicitation for FY 2013.

### 209 ***Research design and development***

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

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

### 223 ***Communication***

224           For students working with diverse faculty and stakeholders, regular communication is  
225 essential to designing and executing research and building understanding and trust (Panel 3  
226 Quotes 11 & 12). Students can have substantial impacts if they share results in formats that are  
227 relevant to both the academic community and stakeholders. Though a journal publication is  
228 meaningful in the academic community, a presentation or report on findings in the stakeholder

229 community may have greater impact for local decision-makers (Panel 3 Quotes 13 &14). Stable  
230 partnerships between institutions and communities facilitate student engagement with  
231 stakeholders (Panel 3 Quote 12). Institutions can also support students through activities that  
232 bring together diverse academic disciplines to communicate about disciplinary norms (Panel 3  
233 Quote 13).

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

#### 241 *Networking*

242 Graduate students find support in both peer and professional networks (Panel 3 Quote  
243 16). Students at one university formed their own program modeled after IGERT for graduate  
244 students who combine social and ecological research. Participating in groups like IGERT can  
245 help students learn how to collaborate with colleagues from different disciplines (Panel 3 Quote  
246 15).

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

252 ***Culture/Attitude***

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

269 **Conclusions**

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

274 relevance of research findings to environmental decisions (Overdevest *et al.*2004; Pace *et*  
275 *al.*2010).

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

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

293 Although communication and culture/attitude were emphasized by all respondents, many  
294 of these factors overlap (e.g., good communication skills often go with ease of networking).  
295 Figure 2 highlights strategies that students, faculty, and institutions might take to facilitate  
296 successful social-ecological graduate student research. Increased dialogue between these players

297 will facilitate training of social-ecological researchers and will inform pertinent environmental  
298 decisions in collaboration with stakeholders and policy makers.

299 **Acknowledgements**

300 The authors developed the paper from a working group at the 2012 LTER All Scientists Meeting  
301 and received funding from the LTER Network. C. Beier, S. Carpenter, E. Cook, C. Guenther, N.  
302 Heynin, B. Provencher, and C. Semeniuk provided useful comments on the manuscript. S. Bond  
303 illustrated the figures.

304

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369



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

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

382

383 **Panel 1.** Defining disciplinarity

384 Students pursuing social-ecological projects have several available research approaches.

385 Whether to pursue a multi-disciplinary, inter-disciplinary, or trans-disciplinary strategy will

386 largely depend on the research questions and systems of study. We follow the definitions of

387 disciplinarity described by Miller *et al.* (2008), as displayed below.

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

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

392           • Trans-disciplinary research: “transcends entrenched categories to formulate  
393           problems in new ways.”

394 **Panel 2. Case Study Descriptions**

395 **Case Study 1:**

396 The effects of residential land use practices and values on wildlife and landowner decision-  
397 making.

398 **Case Study 2:**

399 The benefits of using a social-ecological approach to improve causal understanding of trends in  
400 natural resource use and ecological monitoring data.

401 **Case Study 3:**

402 The role of residential values and institutional norms on ecological characteristics of private  
403 properties.

404 **Case Study 4:**

405 The influence of economics frameworks for decision-making on forest dynamics and protected  
406 areas.

407

408

409 **Panel 3:** Quotes from graduate student case studies within the LTER Network associated with  
410 factors associated with “successful” graduate student social-ecological research.

411 **FUNDING**

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

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

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

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

430 **PEDAGOGICAL APPROACH**

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

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

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

439 **RESEARCH DESIGN AND DEVELOPMENT**

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

444

445 **Quote 9:** “The sociologists and geographers were also contributing to the planning. Rather than  
446 just doing ecology and then bringing in the social scientists on the side, create interdisciplinary  
447 ideas and methods and think about that from the beginning. So at the end, you have a project that  
448 is integrated throughout.” – Case study 3

449



450 **Quote 10:** “Initiating collaborations across disciplines is the main thing. Not just letting them  
451 come in and participate if they want but going out and seeking them out, seeking their help in  
452 collaboration.” – Case study 3

453

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

457

## 458 **COMMUNICATION**

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

463

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

467

468 **Quote 14:** “If you’re really interested in this question, and there are five or six different pieces of  
469 this question that you know are important, now you can either do the traditional Ph.D. and grab  
470 one of those questions and work it until it’s done, or you can say, ‘I want to know how this  
471 whole thing works, and I want to know how different parts link together, and I want to do

472 rigorous research but with the understanding that if I address all five of these aspects, I can only  
473 go so deep in each area.” – Case study 4

474

## 475 **NETWORKING**

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

479

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

## 482 **ATTITUDE AND CULTURE**

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

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

488 **Quote 19:** “[She] would not have been able to able to complete her dissertation without  
489 confidence in her own work, commitment to working with the ... community and various  
490 faculty, and persistence throughout when faced with challenges.” – Case study 2

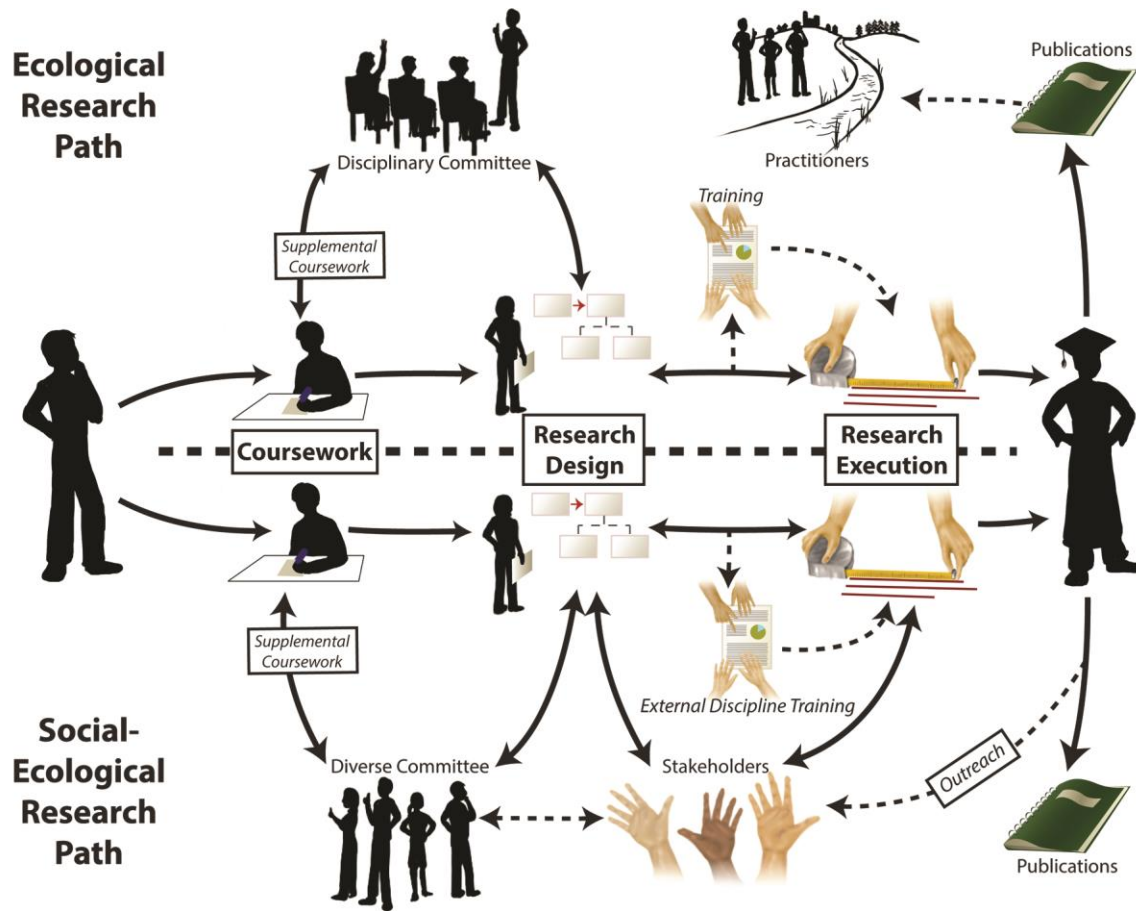
491 **Quote 20:** “It’s important to be at an institution that’s not Balkanized.... The mentality is there  
492 to say, ‘we understand that you don’t have a degree in economics, and we’re not going to treat  
493 you like you’re an idiot in this class.’” – Case study 4

494 **Quote 21:** “... there are very few people who shut down students who are coming from different  
495 backgrounds who want to come and contribute, especially at the graduate level.” – Case study 3

496

497

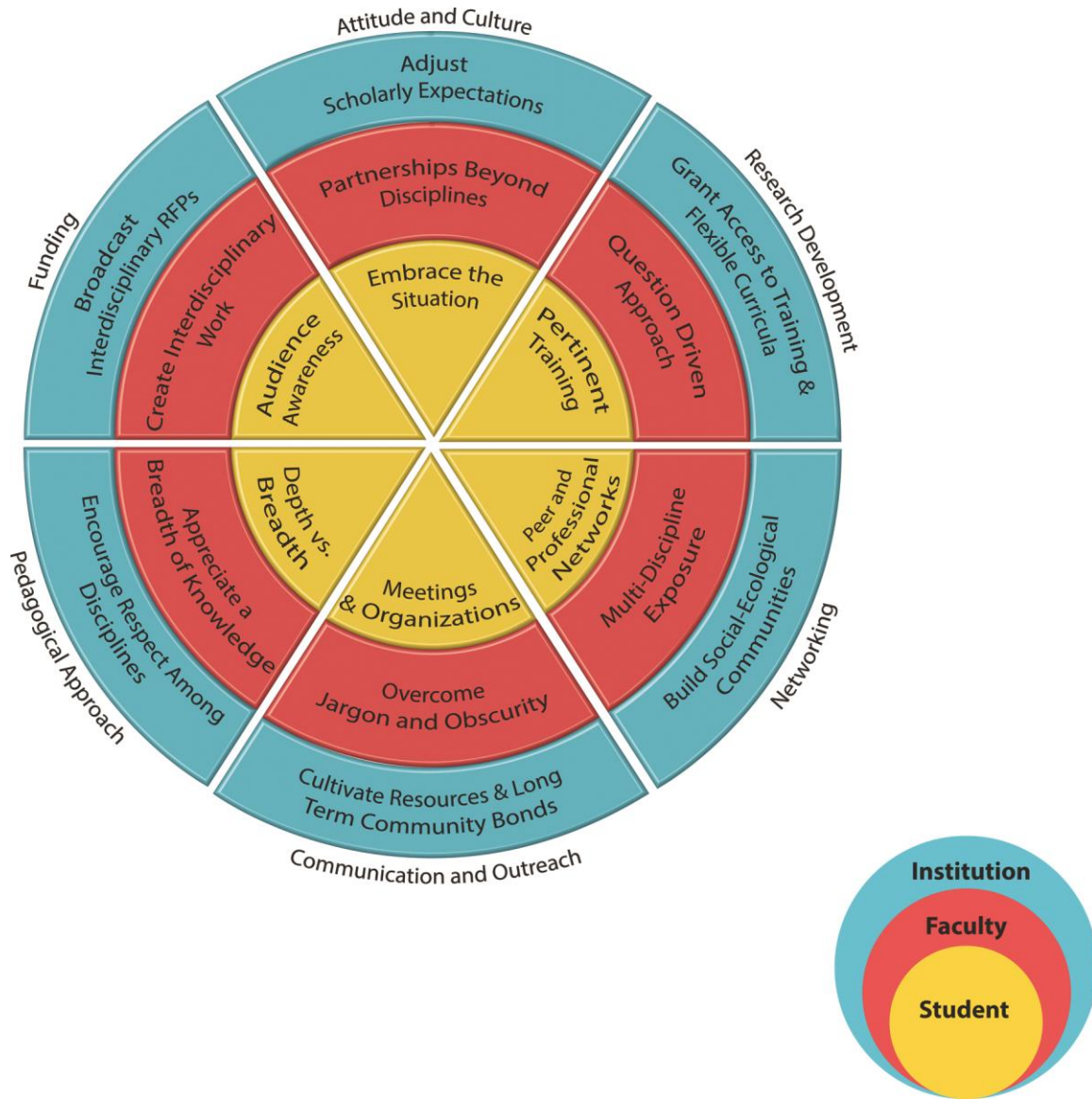
498 **Figure 1.**



499

500

501 **Figure 2.**



502