Growing Transdisciplinary Roots in the Peruvian Amazon: Lessons from the Field

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Abstract: *Although promising advances in transdisciplinary scholarship have been made over the past several decades, the successful integration of disciplinary perspectives has yet to be realized. One avenue for fostering transdisciplinarity is experiential education at the graduate level where scholars are brought together in applied research contexts to solve complex problems. As graduate students in an applied conservation science program, we describe an experiential learning program that facilitated the development of research proposals and created transformative experiences. In this program we engaged in a field course in the Tambopata National Reserve and Bahuaja Sonene National Park in the Department of Madre de Dios, Peru, which was designed to teach us how to effectively engage with and learn from our peers. As a critical reflection on this course, we present five keys to transdisciplinary scholarship that were instrumental for interfacing with scholars and practitioners from diverse disciplinary backgrounds: 1) develop a common language, 2) cultivate connections with your peers, 3) assert your worth, 4) know the assumptions of your field, and 5) recognize ideological differences. Each key to integration facilitated the process of integrating different forms of knowledge and learning about how to most effectively translate environmental policies into practice.*

Key words: *Graduate training program, experiential education, biodiversity conservation, transdisciplinarity, Peru*

1. Introduction

Environmental conservation is an inherently transdisciplinary endeavor that requires the integration of multiple disciplines to solve complex problems (Kinzig 2001). However, research and practice in this area has been criticized owing to insufficient connections to the real world. Applied graduate education is fertile ground for addressing this concern (Courter 2012). Graduate training programs that encourage students to conduct research inclusive of the on-the-ground challenges of conservation while combining multiple disciplinary perspectives will help to close this so-called "research-implementation gap" (Knight 2006; Knight 2008). Numerous graduate education programs have been developed and implemented with the intent of addressing this issue (Welch-Devine *et al.* 2014; Clark *et al.* 2011; Fitzgerald & Stronza 2009). However, little has been said concerning the realities of how training programs rise to this challenge and succeed (or fail) to instill transdisciplinary values in student participants. There are numerous obstacles to learning the theory, methods, and norms of one's own discipline, as well as the tools needed to undertake inter/multi/transdisciplinary conservation research and practice. As graduate students in an applied conservation science program supported by the National Science Foundation's Integrative Graduate Education and Research Traineeship (IGERT) that addresses this charge, we critically reflect on our experiences participating in a field course in the Peruvian Amazon. This course was designed to cultivate transdisciplinary skills and provide hands on experiences in applied conservation research and practice. Lang et al. (2011, p 26-27) define transdisciplinarity as a "…reflexive, integrative, method-driven scientific principle aiming at the solution or transition of societal problems and concurrently related scientific problems by differentiating and integrating knowledge from various scientific and societal bodies of knowledge". Transdisciplinary research, therefore, is differentiated from other forms of collaborative science in that it is problem focused and seeks to integrate multiple bodies of knowledge to produce new theories and methods of inquiry. In this paper we aim to inform the pedagogy of conservation science and hope that future scholars and practitioners can learn from our experiences to anticipate the challenges associated with undertaking transdisciplinary scholarship in environmental conservation.

The field course was an experiential education program that built knowledge, skill sets, and values through interaction with program facilitators, conservation practitioners, and the on-site experience (AEE 2009). That is, learning emerged from the experience itself, and the lessons we share in this paper are attributable to our immersion in the realities of environmental management in the Peruvian Amazon. The cornerstone of the course was the development of research proposals addressing pressing issues of conservation concern in the region. We use our experiences creating these proposals as a basis for sharing what we found to be five keys to the successful integration of scholarly perspectives:

1. *develop a common language,*
2. *cultivate connections with your peers,*
3. *assert your worth,*
4. *know the assumptions of your field, and*
5. *recognize your ideological differences.*

We highlight the invaluable role of experiential educational opportunities like the IGERT field course for creating spaces where students design conservation research and implement these practices. Many of the skills that we have identified are only developed through direct experience and engagement with colleagues.

We begin with a brief description of the course structure and describe some of the tenets of the program that led us to arrive at our five keys to integration. Next, we describe the five keys, provide methods to promote them, and discuss potential barriers to doing so. Although some of the examples that we provide are specific to the IGERT program's Amazon field course, it is our belief that the lessons we have learned and outlined in this paper transcend the individual context and carry relevance for similar experiential education programs and inter/multi/trans-disciplinary research endeavors.

2. Course Background and Research Proposals

The field course revolved around the development of research proposals that addressed various aspects of biodiversity loss through a transdisciplinary lens. To write these proposals, students were split into three teams that reflected the social and natural sci-

entific expertise of the participants in the program. In total, 13 students (11 Ph.D. and 2 Master's) and four faculty instructors hailing from the United States, Canada, and France participated in the course. Graduate students self-identified with a variety of academic disciplines including anthropology, ecology, biology, social psychology, and geography, among others. Our three teams were tasked with collecting physical, ecological, cultural, and economic information surrounding three areas of biodiversity conservation concern in the Madre de Dios region of Peru where the course took place (Figure 1). Our projects focused on the following topics:

1. water resources, aquatic ecology, and fisheries management;
2. wildlife use, ecology, and management; and
3. forestry, forest ecology, and the management of non-timber forest products.

These three broad categories, and their associated anthropogenic drivers of change, covered the bulk of biodiversity concerns in the region. In addition to the development of research proposals, we participated in a variety of field experiences. These included a conservation symposium hosted by local stakeholders and resource professionals, village home-stays with native communities, and visits to local markets, ecotourism projects, and research centers that broadened our perspectives on the nature and scope of conservation needs in the region. These experiences were the foundation upon which the content of our research proposals were based.

In the sections to follow, we provide brief descriptions of the transdisciplinary work that was completed by each of the groups, and offer potential applications of our findings for applied biodiversity conservation. These descriptions are not meant to

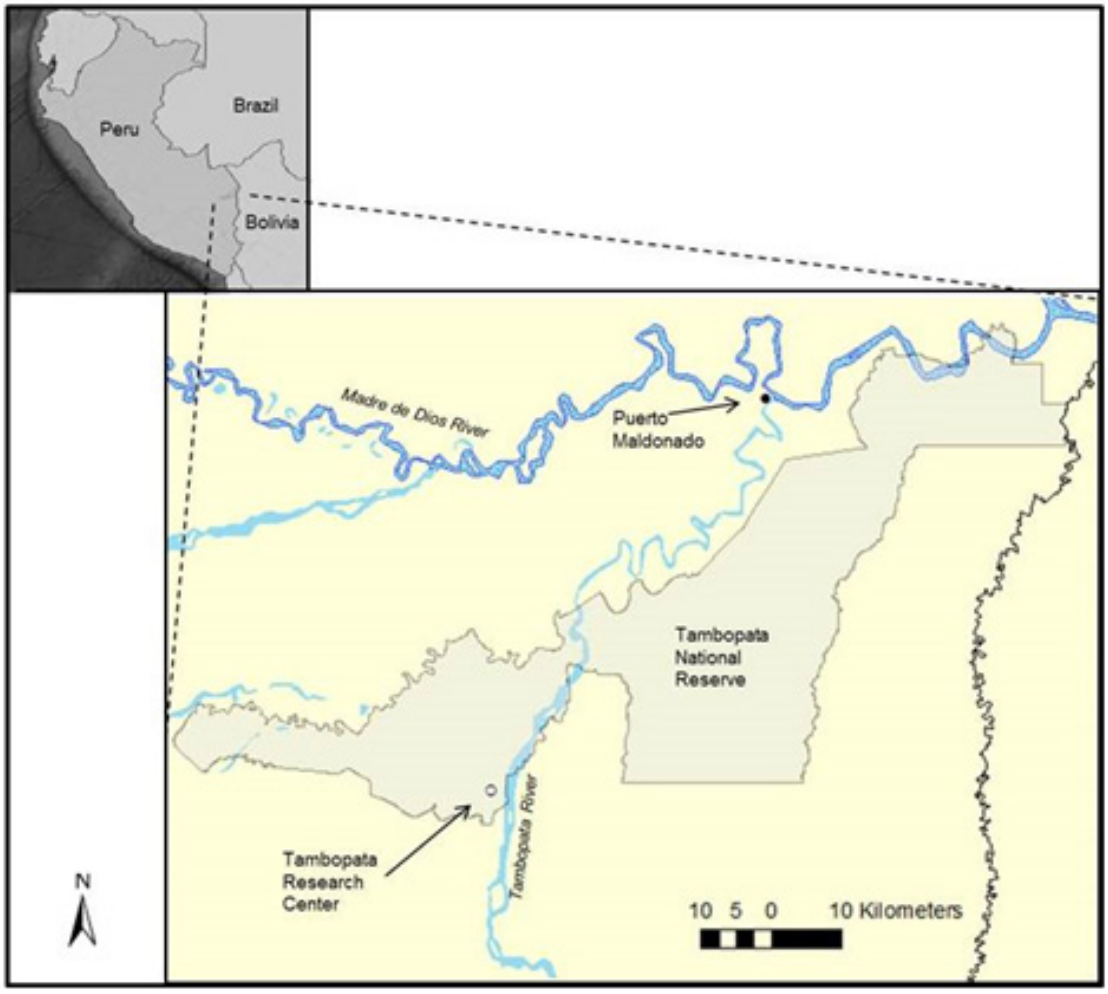

Figure 1. *Location of Amazon Field School in Southeastern Peru, Tambopata National Reserve, and Tambopata Research Station where the majority of course activities occurred.*

be exhaustive, but to serve as an example of the type of work conducted and provide background on the lessons that we gleaned from the experience. This approach was adopted to maintain relevance within a broader discussion on graduate education and inter/multi/trans-disciplinary scholarship (Fitzgerald and Stronza, 2009).

Water Resources, Aquatic Ecology, and Fisheries Management

The team that focused on water resources, aquatic ecology and fisheries management lived with a family that practiced subsistence fishing along the Tambopata River. These students engaged in a dialogue with the host family, other community members, and fish merchants that regularly attended a market in Puerto Maldonado. This team's proposal examined stakeholder perceptions of mercury contamination, the impacts of gold mining on local livelihood strategies, and consequences for aquatic biodiversity and fisheries management (Figure 2.). Many of the fishers and merchants encountered held beliefs about the potential health risks of contaminated river fish that were incongruent with scientific recommendations for consumption. Although fish taken from parts of the river may have presented human health risks, mercury contamination was not a deterrent to consumption nor, in many cases, were the fish believed to be contaminated. The preliminary results that informed this proposal presented an opportunity for policy and outreach to minimize human exposure to harmful contaminants and diversify local livelihood strategies that depended on fisheries resources.

Figure 2. *Fish sampling in a tributary along the Tambopata River. Photo credit Kelsey Neam.*

Wildlife Use, Ecology, and Management

The group that focused on wildlife resources spent time with a local shaman and his family. After discussions with the shaman and local community members (Figure 3), the team recognized a gendered component to the demand for wildlife in this particular community. The proposal they developed sought to integrate measures of relative wildlife abundance and the diverse values held by men and women concerning wildlife in the local environment. The group proposed to engage with community members in the collection of relative abundance estimates through hunting surveys and camera trap data collected by members of the community. Preliminary data from dialogues with local families, hunters, and community leaders revealed that this project would likely find that men and woman valued the consumption of wildlife in different ways. These social dynamics may in turn drive patterns of relative abundance in the larger matrix of forest habitat. Thus, this proposal indicated that targeted wildlife policy intending to curb consumptive use of wildlife resources would need to be tailored to the diverse values and activities of both men and women in the local community.

Figure 3. *Student interview with a local family examining beliefs about wildlife resources. Photo credit Kelsey Neam*

Forestry, Forest Ecology and the Management of Non-Timber Forest Products

The third group stayed at an ethnobotanical center where they interacted with a shaman, spent time surveying the forest with local guides, and engaged in informal conversation about the process of managing forests and non-timber products such as charcoal, palm fruits, and Brazil nuts (Figure 4). While immersed in this experience, the group designed a study to better understand how traditional

ecological knowledge and values ascribed to forest resources could be harnessed to reveal the diverse meanings of the region. In-depth techniques (e.g., participant observations, semi-structured interviews) and geospatial modeling would be used to reflect not only the perspectives of communities and tourists across spatial scales, but also illustrate the location and condition of forest resources that people in the region experienced on a daily basis. From the field

Figure 4. *Forest resources team discussing research proposal with course facilitators and local guides. Photo credit Kelsey Neam.*

notes and observations made, this group hypothesized that the products derived from forests would carry different levels of importance for different stakeholders and relate to the biophysical resources examined in their study. Ultimately, this proposal wed perspectives from the biological and social sciences to inform decisions about the management of forest ecosystems and human livelihoods.

3. Keys to Integration

The preliminary findings and research questions that stemmed from these three experiences were products of a long process of learning rooted in experiential education and preparation that began well before the initiation of the field school. Although ultimately successful, each of the three groups faced numerous challenges along the way. Many of these challenges are common to any group attempting to engage in collaborative transdisciplinary research. In overcoming these challenges, we identified five keys to successful integration of scholarly perspectives. These keys ultimately enhanced our understandings of conservation policy and practice and improved the quality of the transdisciplinary scholarship in which we were engaged. In the section to follow we describe these five keys in detail, highlight methods for promoting them, and outline several associated problems that might be encountered. The keys that we highlight here are the product of both the formal educational structures of the graduate training program in which we were enrolled and the experience of conducting transdisciplinary research. Graduate training programs in inter/multi/transdisciplinary environmental conservation can take notice of the keys that we highlight and work toward developing curricula that promote these competencies.

Key #1: Develop a Common Language

Jargon and conflicting meanings associated with the vocabulary of various academic disciplines can impede collaboration unless concerted efforts are made to define concepts throughout the research process (Bracken & Oughton 2006). We found, for example, that an "instrument" to a social psychologist is a survey questionnaire, whereas this tool for a biologist takes on a different form entirely. Referring to the development of disciplinary specific constructs, methods, and language, Pellmar and Eisenberg (2000) state that these distinctions represent "…a form of professional socialization that serves as an important part of the training experience". However, differentiated practices and language can pose significant barriers for the practice of transdisciplinary research (Pellmar & Eisenberg 2000; Brakcken & Oughton 2006). Thus, it is imperative for collaborators from different disciplines to communicate clearly in order to effectively design and conduct transdisciplinary research. The integration of disciplines will necessarily spawn new concepts, so having a common language from which to begin this dialogue is critical. Scholars engaging in transdisciplinary research should attempt to agree upon the definitions of concepts integral to the questions at hand during the formulation of specific hypotheses and methods that will be used to test them. Failing to do so may result in unnecessary confusion and conflict within a group, confusion concerning the nature of the inquiry, and potentially invalid findings.

Our experiences reaffirmed a common belief that various social and natural science disciplines are associated with different social worlds that establish distinct lexicons and in turn behaviors. Anthropologists and ecologists, for instance, are guided by different publishing protocols and expectations from granting agencies that shape the research process (Campbell 2005). In our course, time was set

aside to discuss different standards in our respective fields, such as taking ethnographic and biological field notes, which in turn reflected our different ways of observing and interacting with the world. The development of a common vocabulary during the field course was a catalyst for communication and productive conversations that extended into our everyday practices. We contend that effective communication about similarities and differences enables collaborative work and serves as a precursor to developing a common language.

Methods to Promote

One way in which we were able to facilitate the development of a common language was through shared group discussions of journal articles. Prior to leaving for the field, we participated in weekly journal clubs where both disciplinary and interdisciplinary articles relevant to the course were read and discussed. This practice extended into the field course. Reading and discussing common literature increased our knowledge of the conservation issues in the region and provided a chance to work through issues of disciplinary terminology in a low stress environment. Scholars, students, and practitioners should take the time to discuss these differences to foster a shared set of definitions for shared concepts and methods. Some scholars have even advocated for the development of contracts in collaborative research (Primack *et al.* 2014). This document could not only define the specific roles, expectations, and work plan for group members, but also create space to develop a common understanding of the ideas, concepts, and methods that will be the focus of research.

Potential Barriers

Although the practice of journal club discussions increased our common vocabulary, a number of barriers became apparent when we began to write our group proposals. For example, stylistic differences between disciplines led to conflict within the groups. While some of us favored terse, declarative writing, others were more open to descriptive narratives. When left implicit in conversation, these differences led to unproductive editing battles that divided group members. More than just communicating with each other, our transdisciplinary teams were forced to agree on a common written style for publication and dissemination of results, which would have important implications for the hiring, and tenure and review processes in our respective professional worlds. The choices we made through collaboration also affected the audiences we targeted with our written products, thus setting the course for the reach of our findings (Goring *et al.* 2014). The decisions made to settle these concerns had differential outcomes for scholars in different fields of study (Wagner *et al.* 2011). Consequently, some individuals had stronger opinions about how findings should be communicated. Defining clear expectations for research products, definitions of theoretical concepts, practical problems to be solved, and methods that will be used at the beginning of the process will help to reduce these potential barriers.

Key #2: Cultivate Connections with Your Peers

The trust and understanding needed to establish relationships that foster successful transdisciplinary projects are built through common experience. An appreciation for the knowledge and skills of peers is best accomplished through sustained interaction; however, these opportunities are not easily obtained. Collaboration among scientists with dissimilar backgrounds can be rendered unsuccessful unless relationships are formed and common understandings reached on both personal and professional levels. Establishing at least partial comprehension of the strategies used in different fields is critical for managing ambiguity and anticipating how individuals with different expertise can tackle a research problem. As articulated by Daily and Ehrlrich (1999), collegiality and respect are essential elements of transdisciplinarity. In our experiences, connections with our peers created space for listening to and considering opposing viewpoints in a constructive manner. Differences were thus recognized and reflected upon throughout the collaborative research process.

Methods to Promote

We were able to foster relationships with our peers through shared extracurricular activities. Our groups made it a priority to spend time with each other outside of the work setting through various activities ranging from bird watching at daybreak to fishing at twilight, and searching for herpetofauna after dark. Despite long days in the field, it was important for us to find time

Potential Barriers:

It can be difficult to find activities that appeal to all members of a group, but this might be an unavoid-

able limitation. For example, sub-groups may form based on certain people's common interests. Conversely, the importance of solitude can also become apparent given the copious

Key #3: Assert Your Worth

Successful transdisciplinary research occurs when members of a collaborative team transform, rather than surrender their perspectives. Often times researchers engaged in collaborative projects contribute their methodological expertise and simply end up doing service to another discipline or individual that dominates the discourse. The integration of disciplines throughout all phases of the research process is at the heart of transdisciplinarity and distinguishes this research approach from multi- and interdisciplinary studies (Tress *et al.* 2005; Margles *et al.* 2010). We found that each individual engaged in a collaborative conversation needed to be assertive to ensure their perspective was heard and considered throughout the planning and research process. Synergy among disciplinary perspectives occurred through high degrees of integration and yielded new understandings that would not have otherwise been possible. Therefore, it is important that all voices are heard and ideas considered when developing concepts for integrated research.

Methods to Promote

Group reflections were one way that our project teams ensured that all perspectives were taken into consideration. Simply taking a moment to stop and reflect on what has been done, how it has been done, and how satisfied group members are with the research and writing process was a powerful method for exposing elements of dissatisfaction. These group reflections should be done throughout the duration of a trip and/or research project to serve as a checkpoint for making sure that the group is on their desired trajectory. It is critical to have a discussion leader who can be objective and engaging in order to prevent potential intergroup conflict, yet still facilitate discussion.

Potential Barriers

We found that although it was important to make sure that all voice were heard, at a certain point, it became counterproductive to consider the array of opinions expressed by group members. Also, it was difficult to assess the validity of any one individual's claim that their opinions were not being represented, or that another group member's ideas are over-represented. These are problems common to any group activity, but become particularly important when integration across disciplines is the desired outcome.

Key #4. Know the Assumptions of Your Field

Every academic discipline is predicated on a litany of assumptions, epistemologies, and ontologies. A strong understanding of these foundations allows for clear communication and concept formulation when engaging in transdisciplinary research. Prior to undertaking transdisciplinary research, it would behoove any group of scholars to negotiate their ideas and build a common understanding of the research problem, agenda for the research in question, and methodological plan for answering research questions. Granted, it is difficult to do this when scholars from different fields have varied expectations concerning research products, methods of knowledge production, implications of findings for practice, and desired benefits from the research process. In negotiating these agendas, scholars will need to be cognizant of potential potholes that stem from conflicting assumptions of their academic fields of study. Doing so will lay the groundwork for navigating institutional barriers that may impede collaboration.

Knowing and anticipating the assumptions of different disciplines allows researchers to maximize their academic and/or practical contributions to conservation. The transdisciplinary research process creates space to test the validity of theories and concepts, as well as the assumptions of contrasting ideas resulting in refined understandings of the explanatory power and potential applications of conservation models (Kinzig 2001; Wilson 1998). Evaluating the utility and potential application of theory is only possible if individuals maintain a strong disciplinary foundation. During our experiential learning program, we found that disciplinary knowledge was a prerequisite to productive conversations about research directions and our ability to effectively decide on the most relevant and innovative path forward. The importance of disciplinary assumptions in any inter/multi/transdisciplinary graduate training program should be emphasized.

Methods to Promote

The process of identifying collaborators and developing a dynamic team of scholars is replete with chal-

lenges. Not only must each individual be well versed in the assumptions of their respective fields, different personalities and interests need to come together in a complementary fashion. We believe that each collaborator must maintain personal accountability for grasping and understanding the fundamentals of their discipline, while also understanding key tenets from the philosophy of science. In our experience, individuals in our group had different levels of expertise ranging including Masters and Ph.D. level scientists at different stages in their education. We explored these similarities and differences through a number of mechanisms. For example, informal interviews with conservation stakeholders presented an opportunity to listen to the questions posed by various members of the group. This activity spawned discussions about the variety of methods and theories stemming from the disciplinary backgrounds of participants represented in the conversation, and how they could be applied to solve the problem in question. Similarly, group journal discussions were an area where methodological critiques spawned discussions that led to a better understanding of diverse perspectives and ultimately new research questions.

Potential Barriers

Many institutional structures still reflect the traditional "disciplinary stovepipes" in which an individual with a clearly defined area of expertise is well received (van Riper *et al.* 2012). Scholars from different universities or research institutions face varying levels of acceptance of transdisciplinary research projects from their respective departments, schools, colleges, and institutes. These differences present incentive structures for participation that manifest themselves in the negotiation of a common research agenda. Although many organizations such as the National Science Foundation along with foundations such as Templeton, Heinz, and the Doris Duke Foundation encourage transdisciplinary models of thinking, much progress has yet to be made. In our experience, when scholars have a strong understanding of their discipline's assumptions, they are better able to identify the root causes of conflicts that stem from differences in these assumptions, and effectively develop a research agenda that reflects the needs of those involved. For examples, institutional standards will likely drive different opinions and create potential barriers to collaboration. With a clear plan of action that addresses issues such as sources of funding, consultancy options, criteria for promotion, and publication outlets, successful collaboration will be more likely to ensue. Knowing how disciplines define success will make the research process more fluid and productive.

In the context of graduate education, students are in the process of becoming experts in their respective fields. Many do not necessarily know the norms of their disciplines in terms of publishing, language, seminal works, or methods, which may lead groups of students engaged in transdisciplinary scholarship down unproductive paths. Faculty oversight is thus critical in the early stages of idea formation. Also, students being trained in emerging transdisciplines run the risk of being spread too thin when they attempt to enter the academic job market.

Key #5. Recognize Ideological Differences

As highlighted in Key #4 there is quite a bit of heterogeneity in the manner in which academic disciplines produce knowledge (Monteiro & Keating 2009). For example, many disciplines diverge on the topic of bias. Objectivity is fundamental to the natural sciences, yet anthropologists may see their own bias as an unavoidable part of the research process, and in many ways integral to the use of the researcher as the tool for data collection. The most successful transdicplines that have emerged are quite similar in epistemological and ontological orientations. Ecology and economics, for example, share a similar post-positivist outlook (generally) leading to the successful creation of the discipline of ecological economics (Daly & Farley 2011; Gowdy & Carbonell 1999). Fundamental ideological differences are not as easily overcome, and in some cases may never be.

Although it is important to understand the assumptions of one's field (Key #4), being entrenched in a single discipline's ideas throughout a graduate program may lead to strong opinions and potential conflict among group members when they attempt to work together. Many academic disagreements can be seen as merely failures of communication (Key #1), while others are the product of more deeply held convictions regarding the nature of knowledge and mechanisms for its production. Knowledge formation was not viewed similarly among the scholars in our group, and many of our experiences challenged us to honor the validity of different forms of scientific and traditional knowledge. We found it was

important to recognize these differences, establish a working set of ideas about how disciplines fundamentally diverge on topics such as bias, and maintain an open mind to unveil what can be learned about ideologies that lie in contrast to one's field of study.

Methods to Promote

As part of the field course we participated in a symposium featuring lectures from conservation professionals working in the region. In addition to exposing students to the wide range of issues in Madre de Dios, the breadth of experience of the presenters helped to hammer home the true scope of localized problems and diversity of stakeholder interests. One ideological difference apparent in our group came to light when hearing from local stakeholders. Beyond our course, the broader conservation community has been divided by proponents of the so-called "new conservation" where economic development has been embraced as a means to achieve "win-win" solutions (Kareiva & Marvier 2012). Divisions of this nature were apparent in our group when discussing development options as solutions to natural resource and conservation problems. Therefore, normative questions concerning the way something ought to be done can present a challenge for researchers beyond differences associated with one's disciplinary orientation.

Potential Barriers

Not all groups of people (or disciplines) can work together effectively. Forcing transdisciplinary work is not something that should be done. Sometimes ideological and interpersonal differences are too strong to be overcome or be successfully integrated by the parties involved. Although it may seem attractive to undertake transdisciplinary scholarship, it is not always the most appropriate research approach. This should be recognized early on in the research process or the work will suffer. Intergroup conflict that results from a failure to transcend ideological differences will lead to poor effort, poor communication, and poor scholarship. We encountered this barrier and warn that it is a possibility for any group engaging in training that cuts across disciplinary boundaries.

4. Discussion

Although graduate training in environmental conservation has evolved to address many of the competencies required for students to successfully conduct inter/multi/transdisciplinary research, some competencies are best developed through experience in the field. The five keys that we describe above are the result of our field experiences and reflect the skills that we developed outside of formal educational structures that were facilitated by an organized program. The five keys that we identified, *1) develop a common language, 2) cultivate connections with your peers, 3) assert your worth, 4) know the assumptions of your field, and 5) recognize your ideological differences,* are relevant for both students and faculty involved in graduate education, and scholars conducting transdisciplinary research alike. The value in these five keys is that they transcend the context of an individual research or conservation project and provide a blueprint for the successful integration of scholarly perspectives. If researchers and practitioners take the time to develop the skills that we describe, they will be better equipped to successfully negotiate the challenges associated with collaborative transdisciplinary research and practice. Those that fail to develop these skills, and recognize these challenges, may fail to accomplish their goals, run the risk of producing invalid research findings, and face more difficulty than is necessary along the way. Among the lessons that we have gleaned from our experiences in the field are several methods to address the challenges of transdisciplinary research and several barriers that might present themselves in attempting to do so. For example, we suggest that those engaged in transdisciplinary research take the time to get to know their colleagues outside of the research context in order to develop the social capital that is needed to do collaborative science (Key #2). In the context of our program this was accomplished through nature based recreation. Graduate curricula and transdisciplinary research projects should set aside time for these types of experiences. Also, we contend that a common language is needed to conduct collaborative transdisciplinary science. We sought to develop a common language through journal club discussions before and during our field experience. Graduate programs that are training students in transdisciplinary research should facilitate opportunities to involve students in discussions like these outside of the formal classroom environment.

We suggest that graduate programs training students in transdisciplinary environmental science use each of the keys (1-5) as guides for the development of informal training and field based experiences that

parallel formal educational programs. The methods to promote and potential barriers that we identify for each of the five keys are not exhaustive, but rather a reflection of our experiences. Others may find more appropriate methods to negotiate these challenges in their individual research and training context and encounter barriers that we did not. Several benefits will emerge from engagement in the types of exercises and experiences that we advocate for here. First, scholars will better anticipate how different fields of study have developed normative practices, equipping them with strategies for preventing misunderstandings. That is, insights on potential potholes from differences in how disciplines solve problems could be informative. Secondly, students and scholars will better appreciate the potential contributions of colleagues from diverse backgrounds. Ultimately, these exercises will help students more effectively deliver conservation theory into practice and better prepare themselves to tackle the complex environmental problems of the 21st century.

5. Conclusion

As graduate students in a integrative conservation science program we have built an appreciation for research that bridges disciplinary boundaries. However, our eyes were not fully opened to the demand for transdisciplinarity until witnessing first-hand the complexities of environmental problems faced in the Madre de Dios region of Peru. Having the opportunity to conduct research alongside colleagues with different perspectives on science and conservation has indisputably improved our ability to communicate and collaborate across disciplinary boundaries. For the future work of conservation scientists to be put into meaningful practice, training must be cast in a transdisciplinary light, tied to curricula that engage graduate students in experiential education (Bustam *et al.* 2009), and paint more complete pictures than can be accomplished by any one discipline alone (Kinzig 2001). The academic exchange that occurred within our diverse group inspired confidence that scientists from very different disciplines could work together to achieve common conservation objectives. However, this was not an easy proposition. The disciplinary training we received in our respective graduate programs has provided a relatively stable foundation for individual scholarship, yet we found stronger support and a broader understanding of conservation issues in the intertwined, transdisciplinary root systems that we grew in the Peruvian Amazon. The pedagogical framework of the field course enabled us to collaborate on critical resource management issues and link research to practice. The collective experiences we have documented in this paper were formative in illustrating the need for transdisciplinary approaches to conservation, complement our ongoing research programs, and serve as a spring-board for future research endeavors.

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