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Abby Jane Roche

University of Maine - Main, abby.roche@maine.edu

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**HOW DO WE COLLABORATE? A LOOK INTO MAINE'S SUSTAINABLE
ECOLOGICAL AQUACULTURE NETWORK (SEANET)**

By
Abby J. Roche

B.S. Northern Michigan University, 2015

A THESIS

Submitted in Partial Fulfillment of the
Requirements for the Degree of Master of the Arts
(in Communication)

The Graduate School
The University of Maine

August 2017

ADVISORY COMMITTEE:

Laura Rickard: Assistant Professor of Communication and Journalism, Advisor

Bridie McGreavy: Assistant Professor of Communication and Journalism

Laura Lindenfeld: Director, Alan Alda Center for Communicating Science
Professor, School of Journalism, Stonybrook University

Jessica Leahy: Associate Professor of Forestry and Resource Management

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An Abstract of the Thesis Presented
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There is a growing awareness that the dynamic needs of science and society are often complex and interdependent and that there is a need to work with and across diverse expertise and practices in order to create the development of new methods and to provide innovative solutions to socially relevant work. Thus, we call collaborative research efforts into action. Maine's Sustainable Ecological Aquaculture Network (SEANET) is such an endeavor, as it is a collaborative effort traversing a nexus of complex, dynamic challenges in Maine, including issues related to socio-economic shifts, climate change, and declining capture fisheries. While SEANET's plan to incorporate a collaborative approach aims to achieve an inspiring, sustainable end-goal it provides only a high-level map for how to get there, and includes few explicit directions. Following the need to better understand such an effort, this thesis considers the interdisciplinary collaboration on the team and provides both action-orientated and theoretical insights.

The following thesis is an analysis of the individuals and teams involved in this sustainability science minded project. More specifically, this research informs strategies of improvement for the SEANET team while also adding to the scholarly conversation on

interdisciplinary collaborations through the use of both quantitative methods and qualitative methods. In the first part of this study, an online survey was distributed to assess the current communication preferences and engagement needs of the team. Compiled into a technical report, this chapter is aligned with the needs of team, and the NSF strategic plan in place, to foster informed collaborative processes moving forward. The second part of this study entailed the use of interviews to better understand how team members contend with deeply normative dimensions of interdisciplinary success. This chapter provides insight into how scientists and research agencies involved in sustainability science minded interdisciplinary teams might shape research agendas and their relationship to society moving forward.

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CHAPTER 1

INTRODUCTION

Introduction

As an academic involved in a large, multi-million dollar, interdisciplinary project, I am part of an ever more common, disciplinary-spanning undertaking. These forms of interdisciplinary collaboration have grown in recent years as funding agencies, universities, and research units recognize the need to fill gaps in knowledge and to tackle complex societal problems that cannot be adequately addressed by single disciplines alone (Cummings & Kiesler, 2005; Miller et al., 2008; Reich & Reich, 2006). Maine's Sustainable Ecological Aquaculture Network (SEANET) is such an endeavor, as it is a collaborative effort traversing a nexus of complex, dynamic challenges in Maine, including issues related to socio-economic shifts, climate change, and declining capture fisheries. While SEANET's plan to incorporate a collaborative approach aims to achieve an inspiring, sustainable end-goal it provides only a high-level map for how to get there, and includes few explicit directions. Following the need to better understand such an effort, my thesis intends to study interdisciplinary collaboration and provide both action-orientated and theoretical insights.

In the spirit of creating knowledge designed to inform and support action (Lindenfeld et al., 2012; McGreavy et al., 2013), I explore interdisciplinary collaboration by taking a sustainability science research orientation, a commitment which intends to both inform strategies of improvement for the SEANET team while also adding to the scholarly conversation on interdisciplinary collaborations. Consequently, the results I share in this work are multifaceted and grounded in practice. Beginning in the second chapter, I describe work that informs how the collaborators working on the SEANET team can improve their processes for enhanced

collaborative outcomes. Compiled into a technical report, this chapter is a demonstration of sustainability science at work, as I have aligned the research with the needs of team, and the NSF strategic plan in place, to foster informed collaborative processes moving forward. The third chapter, which takes a manuscript form, reveals some of the ways collaborators on such teams are making sense of success. From this work, I both ignite and contribute to more open and informed discussions about how we gauge success within sustainability science collaborations, forming a foundation within the field that appreciates and explores the disciplinary and normative dimensions of this type of work.

In this introduction, I describe the context for my research by introducing SEANET and providing background on aquaculture development in Maine. I then summarize how this research employs the concepts of sustainability science, interdisciplinary research teams (IDRs), and a systems approach to IDR teams, and how these perspectives inform the research across the two chapters. I conclude with a summary of the questions, methods, results, and key insights from each project.

The Sustainable Ecological Aquaculture Network (SEANET)

Developed in response to the state of Maine's need to develop innovative solutions to a myriad of social-ecological system challenges posed by the state's social, economic, and environmental nexus, the Sustainable Ecological Aquaculture Network (SEANET) is a National Science Foundation-funded University of Maine initiative aimed at increasing research and development activities that will assist in the further growth of Maine's aquaculture industry. The SEANET project has a high profile not only at the University of Maine but also within the state, and if it is successful over the longer term, could potentially lend great service to the economy and work-force development of the state.

Maine's coastal communities and ecosystems are confronting challenges – including socio-economic shifts, climate change, and declining capture fisheries – that endanger many residents' long-standing economic and cultural traditions. Maine's commercial fisheries, a major economic generator within the state, are becoming depleted and dependent on direct and indirect revenues by a single species (lobsters) (SEANET, 2013, p:1). This decline, bundled with a single species dependency, leaves coastal communities in an extremely vulnerable position (SEANET, p.1). In general, aquaculture has great potential for feeding communities (Worldfish Center, 2011; Godfray et al., 2010). When looking at the state of Maine in particular, there is significant potential for sustainable growth of aquaculture in its coastal zone, and for aquaculture to expand past finfish operations. The state's abundance of coastal landscape and communities make it an ideal location to be a leader in aquaculture endeavors.

SEANET strives to generate more comprehensive, transdisciplinary, coastal marine science that is positioned at the knowledge interface of marine fisheries, ecosystems conservation and restoration, and the new paradigm of sustainable ecological aquaculture (SEA) (SEANET, p. 1). The SEANET team is comprised of approximately 60 faculty and staff, and over 20 graduate students across more than 9 academic and research institutions. There are four subgroups (referred to within the project as “themes”) that are organized around specific aspects of the project, including: (a) Ecological and Sociological Carrying Capacity, (b) Aquaculture in a Changing Ecosystem (c) Innovations in Aquaculture, and (d) Human Dimension. These themes include members from varying academic disciplines, including: marine sciences, computing and information science, aquaculture biology, engineering, food science, chemistry, economics, anthropology, and communication. As this diverse listing of disciplines demonstrates, SEANET aims to integrate varying modes of knowledge to align research with the needs of communities,

thus ensuring that science can inform decision making and lead to more sustainable practices across a range of issues related to the Maine's aquaculture industry.

Sustainability Science, IDR Teams, and Systems Approach

Sustainability Science

Through my research with and on the SEANET team, I have found myself working within the realm of sustainability science. As society faces key issues that increasingly resemble “wicked problems,” (Kreuter, Rosa, Howe, & Baldwin, 2004) or tensions within complex systems in which each solution causes new and often unforeseen consequences, a field like sustainability science with its commitment to continued pursuit of solutions to complex problems, becomes relevant and useful. For the context of this research, I define sustainability science as process of inquiry that works to engage multiple stakeholders and their varying patterns of thought, opinion, approaches, and identity in order to foster a space that propagates knowledge creation designed to inform and support action (Lindenfeld et al., 2012; McGreavy et al., 2013).

Interdisciplinary Research (IDR) Teams

Many terms exist to describe collaborative research including: multidisciplinary, interdisciplinary, and transdisciplinary. These terms distinguish between levels of working with and across diverse expertise and disciplinary assumptions. Multidisciplinary indicates an endeavor with varying academic disciplines that do not attempt integrated knowledge as they individually generate knowledge. Interdisciplinary denotes a research process that incorporates participants from unrelated disciplines to cross boundaries in order create new knowledge. Finally, transdisciplinary efforts incorporate both scientific and non-scientific knowledge bases

to engage with real world problems (Stock & Burton, 2011; (see Stock and Burton (2011) for contextual information on this terminology). This paper uses the terms “interdisciplinary” and “collaborative,” often interchangeably, when discussing the research. For the present purpose, I define interdisciplinary and collaborative research as an approach that involves a group made up of researchers from different disciplines or fields who are working together to integrate some aspect(s) of their own disciplinary approach and method in order to jointly tackle a research problem as a team.

In the context of SEANET and in studying collaborative teams in general, it is important that we recognize the interconnectedness of and differences between interdisciplinary and transdisciplinary approaches. While SEANET identifies as a transdisciplinary project, due to its commitment to draw from both academic and stakeholder knowledge bases, such as aquaculture farmers and community members, the project is also inherently interdisciplinary; that is, it has researchers working with other researchers from often disparate disciplines. Although still valuing and recognizing the importance of transdisciplinary approaches and the use of “extra-disciplinary” knowledge, due to the wide-range and breadth of actors in the SEANET grant, the present research this work only considers interactions between researchers within the academic setting.

Systems Approach to IDR

As noted above, these collaborative endeavors are made possible by the engagement of multiple stakeholders who create the processes and structures of the endeavor in their everyday interactions. For the context of this research, we take a systems approach in order to explore these processes and structures of relationships between researchers. Systems theory posits that the patterns of behavior that take place within the communication system are the elements that

define and bind the system (Folke et al., 2005; McGreavy et al., 2015) In this way, through the processes engaged in and the structures created, those involved in the system recursively create the system they are involved in. Utilizing a systems view helps scholars identify the communication processes and relationships in such interactions. Drawing from scholars and works such as Thompson (2009) and McGreavy (2015), we position interdisciplinary teams as symbiotic, interdependent, and dynamic, and recognize that interdisciplinary teams exist within a larger social system.

Chapter Summaries

As described above, this thesis takes several angles in order to conduct applied communication research. In this section, I briefly describe each chapter of the thesis, highlighting the questions, design, results, and primary conclusions to provide a map through the remainder of this thesis. In the second chapter, entitled *Collaborative Engagement and Communication Preferences: A Technical Report for Collaborative Engagement within the Sustainable Ecological Aquaculture Network (SEANET)*, I describe research taken from a survey conducted on interdisciplinary collaboration engagement on the SEANET project. As the chapter title imparts, this chapter investigates communication and engagement preferences related to those participating on the team. The survey was conducted online using Qualtrics to obtain a comprehensive sample of participants in the collaborative research network ($N = 58$; Dillman, 2009). The survey included 37 questions that used 5-point Likert scales, preference ratings, and text boxes and took approximately 20 minutes to complete. Survey questions asked participants about team decision making, communication, and motivations for engagement in collaborative research. The online survey was active in July and August 2016 and data were analyzed using SPSS (version 24).

Results are described under eight sections. The first section, “participant background information” describes participant positions, discipline, and theme. In an effort to understand SEANET members’ prior interdisciplinary experiences, the second section, “interdisciplinary experience,” presents respondents with a series of questions related to past interdisciplinary experiences, perceived interdisciplinary talent and skills within collaborative projects, and engagement in interdisciplinary actions (i.e., reading journals outside of primary field, attending conferences outside of primary field of study, etc.). The third section, “familiarity and opinion of social ecological systems (SES) framework,” asks participants about their familiarity with and perceptions of the SES framework. In order to gauge members’ collaborative experiences related to the SEANET project, the fourth section, “SEANET collaborative experience,” asks a series of questions about participants’ satisfaction in relation to their overall collaborative experience, achievement of professional goals, and institutional encouragement (e.g., encouragement from the University of Maine administration). In the fifth section, “project outcomes,” respondents were presented with a series of potential project outcomes that were selected based on the research team’s review of previous interdisciplinary surveys, and peer-reviewed literature. Respondents were asked to select all outcomes that had either experienced or expect to experience while a part of the SEANET team. The sixth section, “information access,” focused on both information about the research process and products, and access to information related generally to SEANET. In an effort to identify how SEANET members prefer to collaborate and communicate, a series of questions in the seventh section, “collaborative interactions” were asked about identification of potential collaborators, communication preferences, motivations to engage, and decision making structures. And lastly, in the eighth section, “challenges,” assessed any challenges SEANET members may have already experienced or anticipate to experience

within 3 sets of potential challenges to interdisciplinary collaboration: institutional (structure of academic institutions), epistemological (different ways of knowing or modes of thinking), and teamwork (individuals, interpersonal, or group dynamics). Respondents were asked to indicate all of the challenges they have experienced or think they might experience in the future.

In the fourth chapter, entitled *Understanding Success on Interdisciplinary Research Teams*, we examine how collaborators define success, providing evidence of how collaborators contend with deeply normative dimensions of interdisciplinary success, and providing insight into how scientists and research agencies might shape research agendas and their relationship to society moving forward. Based on semi-structured interviews with sustainability scientists from the SEANET team, this study uses participants' narrative accounts to progress our understanding of success on sustainability science teams and address the tensions arising between differing visions of success present within the current IDR literature. In so doing, we propose not simply to identify rigid formulations of success and put them into boxes; rather, we intend to create a basis for a "deeper dialogue amongst sustainability scientists" (Miller, 2013). That is, we intend study results to contribute to more open and informed discussions about how we gauge success within sustainability science collaborations, forming a foundation for appreciation and exploration of the disciplinary and normative dimensions of this work.

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CHAPTER 2
COLLABORATIVE ENGAGEMENT AND COMMUNICATION PREFERENCES: A
TECHNICAL REPORT FOR COLLABORATIVE ENGAGEMENT WITHIN
THE SUSTAINABLE ECOLOGICAL AQUACULTURE NETWORK
(SEANET) PROJECT

Introduction

Investigating various options and approaches related to collaborative research is central to the project's goal of advancing an understanding of academic research for stakeholder engagement preferences and collaborative preferences and engagement. This technical report summarizes the findings from the 2016 collaborative preferences survey, conducted by the University of Maine as part of a research project funded by UMaine's Sustainable Ecological Aquaculture Network (SEANET) National Science Foundation (NSF) award #11A-1355457 to Maine EPSCoR at the University of Maine. We had a 70% response rate ($n = 58$ respondents), representing faculty researchers, graduate students, and administrative leads who are part of the SEANET project.

This research is a first step toward improving understandings of and research on collaborative research environments. Three overarching and interrelated goals guided the survey. The first objective of the survey was to gather information on the SEANET team's collaborative and engagement preferences in order to inform strategies for improvement. Secondly, the survey aimed to determine preferences for the structure of partnerships between researchers (i.e. the level at which we collaboratively problem-solve, conduct research, and develop solutions) and the facts that impact these choices and actions. Lastly, the survey was designed and executed in order to advance and contribute to the scholarly conversation about the role of communication in collaborative research spaces that can respond more effectively to societal needs. The results obtained through our study provide important and useful data that will inform strategies

for improvement within the SEANET project, enhance communication practices between researchers, and contribute to a growing body of literature on communication practices within collaborative research teams. Further, the research provides the group with an opportunity to reflect on its collaboration practices, decision-making, and learning needs throughout the collaboration.

Study Administration & Methods

Sample

The sample was comprised of graduate students, administrative leads, and faculty researchers currently involved in the SEANET project. The SEANET team is comprised of 60 faculty, staff, and more than 20 graduate students across more than 9 academic and research institutions. There are four subgroups or “themes” that are organized around specific aspects of the project, including: (a) Ecological and Sociological Carrying Capacity, (b) Aquaculture in a Changing Ecosystem (c) Innovations in Aquaculture, and (d) Human Dimensions. These themes include members from varying academic disciplines, including: marine sciences, computing and information science, aquaculture biology, anthropology, engineering, food science, chemistry, economics, and communication.

Recruitment

In order to study collaboration on the project, participants were recruited via email. The sampling framework was a list of SEANET researchers and affiliates provided by the project’s management team. Eighty individuals were emailed over the course of two months with a link to an online survey hosted by the survey platform Qualtrics. Participants read through the informed consent disclaimer presented at the beginning of the survey, indicated they had read the information, and agreed to participate in the study. The survey was conducted online to maximize response rate among SEANET members. The survey included 37 questions that used 5-point Likert scale, preference ratings, and text boxes and took approximately 20 minutes to complete. Survey questions asked participants about team decision making,

communication, and motivations for engagement in collaborative research. The online survey was administered during July and August 2016.

Survey Development

The survey was developed from peer-reviewed literature on interdisciplinary team collaboration, communication theory, social ecological systems, and sustainability science team research. In addition, we acquired copies of other surveys targeting sustainability science teams, and we developed the questionnaire using this information (Table 1). Results are described under eight sections. The first section, “participant background information” describes participant positions, discipline, and theme. In an effort to understand SEANET members’ prior interdisciplinary experiences, the second section, “interdisciplinary experience,” presents respondents with a series of questions related to past interdisciplinary experiences, perceived interdisciplinary talent and skills within collaborative projects, and engagement in interdisciplinary actions (i.e., reading journals outside of primary field, attending conferences outside of primary field of study, etc.). The third section, “familiarity and opinion of social ecological systems (SES) framework,” asks participants about their familiarity with and perceptions of the SES framework. In order to gauge members’ collaborative experiences related to the SEANET project, the fourth section, “SEANET collaborative experience,” asks a series of questions about participants’ satisfaction in relation to their overall collaborative experience, achievement of professional goals, and institutional encouragement (e.g., encouragement from the University of Maine administration). In the fifth section, “project outcomes,” respondents were presented with a series of potential project outcomes. Respondents were asked to select all outcomes that had either experienced or expect to experience while a part of the SEANET team. The sixth section, “information access,” focused on both information about the research process and products, and access to information related generally to SEANET. In an effort to identify how SEANET members prefer to collaborate and communicate, a series of questions in the

seventh section, “collaborative interactions” were asked about identification of potential collaborators, communication preferences, motivations to engage, and decision making structures. And lastly, in the eighth section, “challenges,” assessed any challenges SEANET members may have already experienced or anticipate to experience within 3 sets of potential challenges to interdisciplinary collaboration: institutional (structure of academic institutions), epistemological (different ways of knowing or modes of thinking), and teamwork (individuals, interpersonal, or group dynamics). Respondents were asked to indicate all of the challenges they have experienced or think they might experience in the future.

Table 1: Sources of Measures

Section	Measure(s)	Source
Project outcomes	Anticipated/experienced project outcomes	SUNY Research Foundation 4E Network of Excellence Project “ <i>Understanding and Overcoming Barriers to Communication in Complex Socio-Ecological Systems: An Integrative Approach to Interdisciplinary Research, Policy Translation, and Educational Application.</i> ” Paul Hirsch, SUNY ESF
Anticipated/experienced project challenges	Epistemological challenges; institutional challenges; teamwork challenges	SUNY Research Foundation 4E Network of Excellence Project “ <i>Understanding and Overcoming Barriers to Communication in Complex Socio-Ecological Systems: An Integrative Approach to Interdisciplinary Research, Policy Translation, and Educational Application.</i> ” Paul Hirsch, SUNY ESF
Interdisciplinary experience	IDR experiences; perceived interdisciplinary talent and skills within collaborative projects; engagement in IDR actions	New England Sustainability Consortium Collaborative Preferences and Capacity Survey. Bridie McGreavy, University of Maine, Orono; Brianne Suldovsky, Portland State University.
SEANET collaborative experience	Satisfaction in relation to overall collaborative experience; achievement of professional goals; institutional encouragement	New England Sustainability Consortium Collaborative Preferences and Capacity Survey. Bridie McGreavy, University of Maine, Orono; Brianne Suldovsky, Portland State University.

Table 1: Continued.

Section	Measure(s)	Source
Collaborative interactions	Identification of potential collaborators, communication preferences, motivations to engage, and decision making structures	New England Sustainability Consortium Collaborative Preferences and Capacity Survey. Bridie McGreavy, University of Maine, Orono; Brianne Suldoovsky, Portland State University.

Data Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) Version 24 (IBM Corporation, Armonk, New York, USA). To protect anonymity and confidentiality, identifying markers such as names, titles, and addresses were removed from the data set. We calculated descriptive statistics, including: mean, median, mode, standard deviation, percentages, and frequency, along with chi-square tests, ANCOVA, and one-way ANOVA; these data are reported in the results section of the report.

Study Limitations

As with any study, there are limitations to the data collected. It is worth noting that (assuming a representative sample) surveys can provide generalizable results, but do not necessarily explain the why, how, and where related to these results. In this way, surveys lack the depth to fully explain the meaning behind responses. Follow-up qualitative research, such as through in-depth interviews, can help the researcher gain a better understanding of the results presented through this report. Follow-up interviews were conducted and are currently being coded to add to these understandings.

Study Findings

Background Information

58 SEANET members, representing approximately 70% of the SEANET team, responded to our survey. This survey specifically targeted faculty researchers, professional staff, upper administration and graduate and post-doctoral students. While professional staff and upper administration did not represent a large portion of respondents, it is important to keep in mind that the SEANET team is mainly comprised of faculty researchers and graduate students (Figure 1).

Reported Position

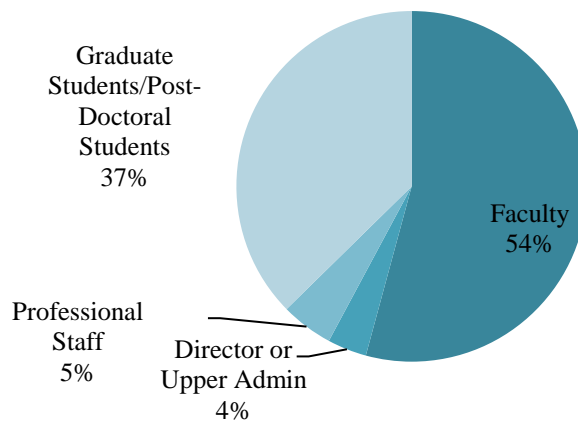


Figure 1- Please select your position within your institution.

In order to identify the number of respondents per theme, we asked respondents to indicate which theme they are a part of. Themes were adequately represented, with each theme receiving a 70% response rate or higher (See Figure 2).

Theme Response Rate

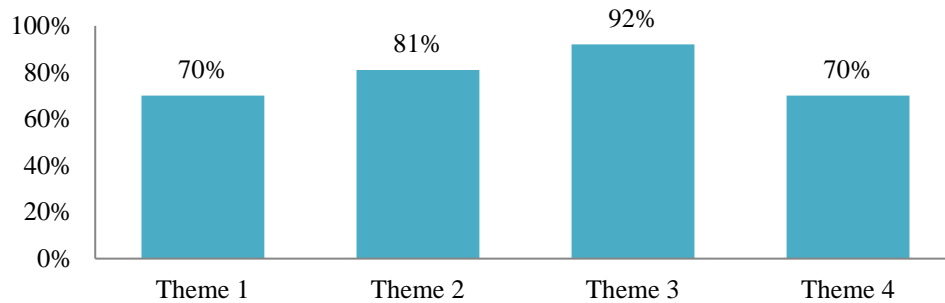


Figure 2- Please mark which theme you are a part of. (If you are a part of more than one please identify the theme you associate with most).

Interdisciplinary Experience(s)

Prior Interdisciplinary Experience(s). In an effort to understand SEANET members' prior interdisciplinary experience(s), respondents were presented with a series of questions related to past interdisciplinary experience(s), perceived interdisciplinary talent and skills within collaborative projects, and engagement in interdisciplinary actions (i.e., reading journals outside of primary field, attending conferences outside of primary field of stud, etc.). The mean scores on the first two areas and frequency counts of the last area are shown below in Figures 3 and 4.

Respondents were asked to indicate the number of interdisciplinary projects they have been a part of in the past, categories included: *SEANET is my first interdisciplinary project; 1 project; 2 projects; 3 projects; 4 or more projects.* Out of the 58 SEANET members sampled, approximately 75% had been involved in an interdisciplinary collaboration project in the past (Figure 3).

Prior Interdisciplinary Experience(s)

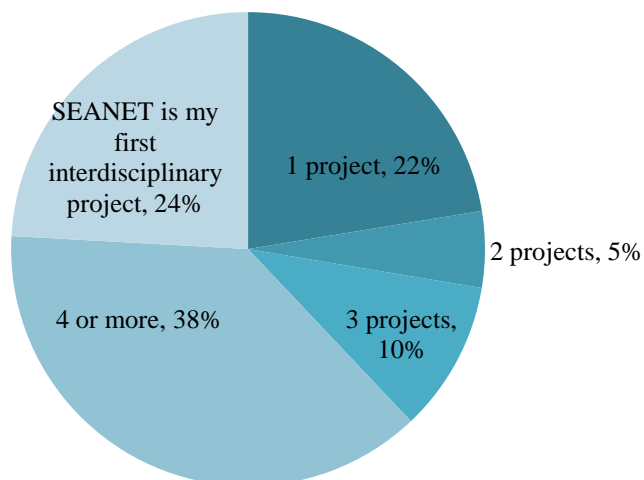


Figure 3- How many interdisciplinary collaboration projects have you been involved in before SEANET?

If participants indicated that they had been involved in previous interdisciplinary work they were asked to characterize the composition of these research teams. These options included: *“inclusive of multiple fields within my primary discipline (e.g., polymer chemistry and atmospheric chemistry)”*, *“inclusive of multiple disciplines in the natural sciences (e.g., physics and biology)”*, *“inclusive of multiple disciplines in the social sciences (e.g., sociology and political science)”*, *“inclusive of multiple disciplines across social and/or natural sciences (e.g., economics and chemistry)”*, and *“inclusive of multiple disciplines and sectors of society (e.g., economics, chemistry, federal agency, practitioner).”* Of those who had engaged in interdisciplinary collaborative research in the past, approximately 50% have worked on teams that are inclusive of multiple disciplines across social and/or natural sciences or that are inclusive of multiple disciplines and sectors of society (Figure 4).

Prior Interdisciplinary Experience(s)

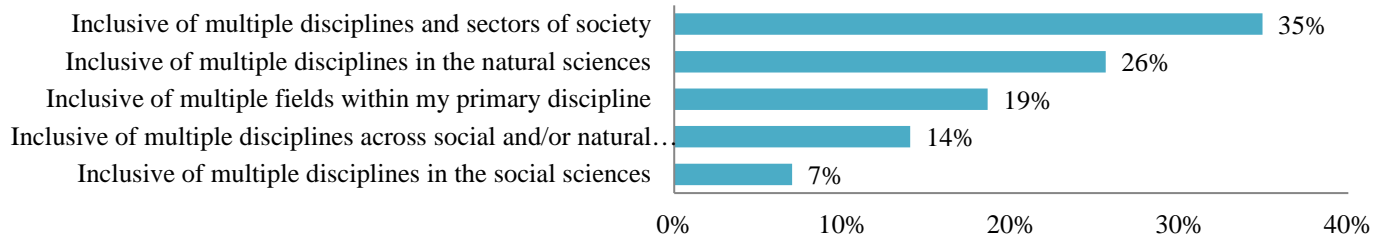


Figure 4- For the interdisciplinary research that you have typically engaged in, how would you characterize the composition of the research team? (If you've engaged in more than one type of collaborative research, please select the type you've engaged in most).

These results indicate that SEANET team has significant number of researchers who have extensive experience on interdisciplinary collaborations, with just over one-third of the team (37%) reporting being a part of four interdisciplinary collaborations or more. Furthermore, just under half (49%) of the SEANET members who have experience working on such teams have experience working across diverse expertise and practices. These results not only provide important information about the participating SEANET members and their prior experience and familiarity working across disciplines but points toward a team that has experience working with stakeholders outside of the university setting. Many researchers have experience in transdisciplinary work, which is encouraging given the project's commitment to work across disciplines and with stakeholders in order to develop new methods and provide innovative solutions to Maine's aquaculture industry.

Perceived Interdisciplinary Talents and Skills. Participants were asked to indicate how much they disagree or agree with statements related to their own perceived interdisciplinary talents and skills on a five-point Likert-type scale ranging from *strongly disagree* (1) to *strongly agree* (5). The mean ratings for the statements, "*I have a natural talent for interdisciplinary collaboration*" ($M= 3.54, SD = .867$) and, "*I have the skills to work with researchers in other disciplines*" ($M= 4.02, SD = .694$), indicates that while

respondents do not strongly disagree or strongly agree that they are naturally talented collaborators they do perceive themselves as having the skills to work with fellow researchers across disciplines (Figure 5). These results are promising in they suggest researchers are coming into the collaboration with perceived interdisciplinary collaboration skills. Although it is important to note that we are not able to know the types of skills that participants perceive as important to their work as a collaborator, follow-up semi-structured interviews with SEANET team members will be analyzed to better understand participant perceptions of collaboration in relation to communication duties and communication abilities.

Perceived Interdisciplinary Talent and Skills (Mean Ratings)

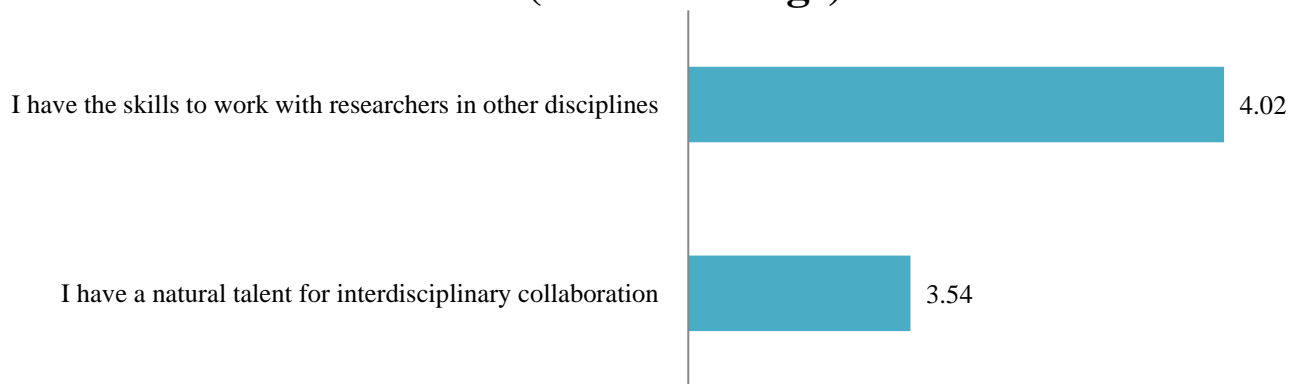


Figure 5- How much do you disagree or agree with the following statements?

Interdisciplinary Actions. A fundamental piece of interdisciplinary collaboration is the engagement of various disciplinary agents across a variety of actions that ranges from face-to-face communication with researchers outside of the field to reading journals from outside one’s disciplinary field. To assess respondent engagement in these types of interdisciplinary actions, respondents were presented with a series of potential interdisciplinary actions. Respondents were asked to rate the frequency with which they typically engaged in each action on a seven-point scale that included: (1) *never* (2) *very rarely* (3) *yearly* (4) *quarterly* (5) *monthly* (6) *weekly* (7) *daily*. The mean scores on each action across response categories are reported in Figure 6. A lower mean score indicates a lower frequency of the action.

Respondents indicated that “*obtaining new insights into their own work through discussions with colleagues who come from different fields or disciplinary orientations*” ($M = 4.58, SD = 1.17$), “*reading journals or publications outside of their primary field*” ($M = 4.14, SD = 1.52$), and “*participating in working groups or committees with the intent to integrate ideas with other participants*” ($M = 4.11, SD = 1.55$) as the three interdisciplinary actions that take place most frequently (Figure 6). These means indicate that the latter two actions take place, on average, *quarterly* and the first action takes place, on average, *quarterly to monthly*. The three actions that were reported, on average, as *yearly to quarterly* were, “*establishing links with colleagues from different fields or disciplinary orientations that have led to or may lead to future collaborative work*” ($M = 3.84, SD = 1.14$), and “*modify your own work or research agenda as a result of discussions with colleagues who come from different fields or disciplinary orientations*” ($M = 3.82, SD = 1.25$). Lastly, the action that was indicated as very rarely to yearly being engaged in was, “*attending meetings or conferences outside of your primary field*” ($M = 2.46, SD = 1.13$). Overall, findings indicate a group of collaborators who are open to the idea of interdisciplinary actions and are actively participating in such actions yearly to quarterly, on average. In order to further encourage such actions, structures could be provided for researchers to have more accessibility to discussions with other researchers. This could include social settings outside of meetings such as a coffee hour and bringing the result up to the SEANET culture committee.

Interdisciplinary Actions (Mean Ratings)

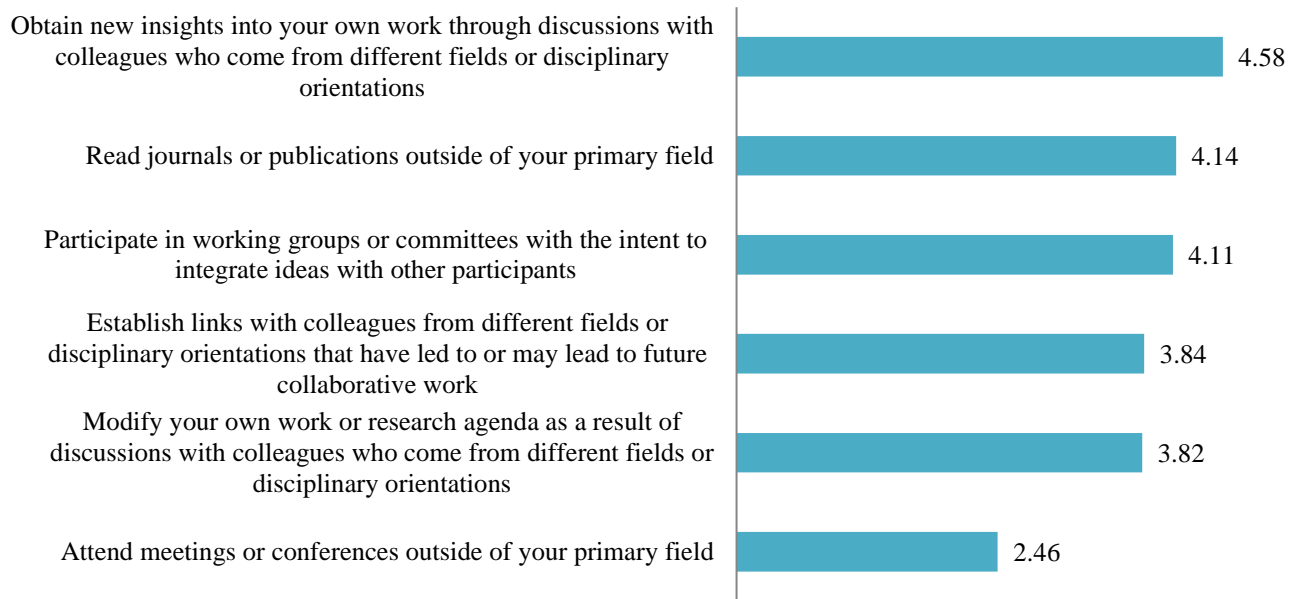


Figure 6- Please rate the frequency with which you typically engage in each of the activities listed below.

Familiarity and Opinion of Social Ecological Systems (SES)

Given SEANET's commitment to interdisciplinary research, SEANET researchers are developing a Social-Ecological Systems (SES) framework to offer fundamental terminology and a conceptual view of the system needed to facilitate communication of research goals and data, and to more generally shape and direct the varied research directions across the project. SEANET's SES framework is based on the widely-applied framework first developed by Dr. Elinor Ostrom and colleagues (Ostrom, 2009). The framework is composed of comprehensive, multilevel subsystems and internal variables that can be used to show interconnections between social and physical systems, and, as such, links data from the biophysical and social sciences (Ostrom, 2009). In order to gauge the awareness of the concept of SES (or SES-driven research) prior to the start of the SEANET project (i.e., Fall 2014), we asked a series of questions about participants' prior familiarity with, opinion of, and interest in SES (Figure 7).

Participants responded to questions related to SES familiarity, experience, opinion, and interest on seven-point Likert-type scales ranging from *strongly disagree* (1) to *strongly agree* (7). *The higher the mean rating, the more participants agree with the statement.* Respondents indicated that they were generally unfamiliar with the framework prior to the SEANET project ($M = 2.89, SD = 1.85$) and that they had little experience with the framework ($M = 3.33, SD = 2.16$). Further, they were fairly neutral (*neither agree nor disagree*) when asked about hearing of SES work ($M = 4.19, SD = 2.27$). Lastly, respondents indicated neutral to positive levels for both opinion on the framework ($M = 4.63, SD = 1.29$) and interest ($M = 4.37, SD = 1.62$) These results indicate a lack of familiarity and experience with the SES framework prior to beginning work on SEANET, but point toward a neutral to positive view and interest in the framework. Most importantly, it is worth noting that, while members indicate that they do not know much about SES, they do not seem to have an unfavorable attitude toward it. This suggests that there is room for shaping favorable opinions in the coming years of the program.

Familiarity and Opinion of SES (Mean Ratings)



Figure 7- Please indicate your agreement with the following statements about your awareness of Social Ecological Systems (SES) research prior to the start of the SEANET project (i.e., Fall 2014).

SEANET Collaborative Experience

Satisfaction with SEANET. In order to gauge members' collaborative experiences related to the SEANET project, we asked a series of questions about their satisfaction in relation to their overall collaborative experience, achievement of professional goals, and institutional encouragement (e.g., encouragement from the University of Maine administration) (Figure 8). Respondents were asked to rate their satisfaction related to the SEANET project on a seven-point Likert scale ranging from (1) =*extremely dissatisfied* to (7) *extremely satisfied*. A higher mean rating indicates a higher satisfaction rate.

Respondents indicated *slightly satisfied* to *moderately satisfied* experiences related to the overall SEANET experience ($M = 5.12$, $SD = 1.16$), with approximately 77% of respondents indicating over a slightly satisfied experience. Researchers indicated a slightly satisfied to neutral experience for both achievement of professional goals ($M = 4.96$, $SD = 1.29$) and institutional encouragement. These results indicate a slightly satisfied to moderately satisfied view of the project overall, achievement of professional goals, and institutional encouragement.

Satisfaction with SEANET Project (Mean Ratings)

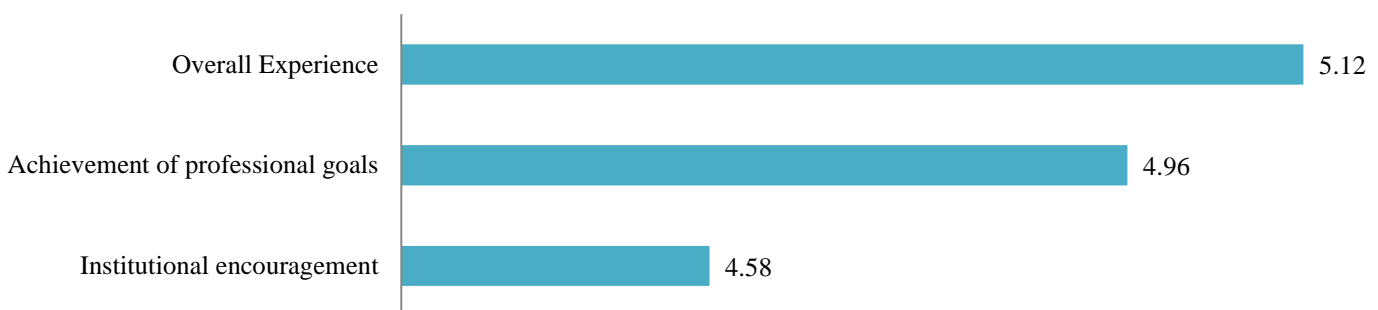


Figure 8- Based on your overall experience related to the SEANET project so far, how would you rate your level of satisfaction with the following aspects of the project?

In an effort to understand possible differences in mean project satisfaction ratings between faculty researchers and student researchers, a one-way ANOVA was conducted (Figure 9). There was not a statistically significant difference between faculty and students in relation to achievement of professional goals, $F(1,47) = 3.39, p = .072$, or overall experience, $F(1,47) = .206, p = .652$; however, there was a statistically significant difference in institutional encouragement between students and faculty members, $F(1, 47) = 4.3, p = .044$, with students reporting higher satisfaction with institutional encouragement ($M = 5.1, SD = 1.58$) on average, than faculty members surveyed ($M = 4.1, SD = 1.69$). It is important to note that, while graduate students and postdoctoral students are significantly more satisfied than faculty members, faculty members were not dissatisfied to begin with, but rather fairly neutral (*neither agreed nor disagreed*). These results are encouraging as both groups show satisfactory ratings in all categories. Analysis of in-depth interviews will provide further clues into why students may report more institutional support, and/or the way(s) in which this support may manifest.

Student/Faculty: Satisfaction with SEANET Project (Mean Ratings)

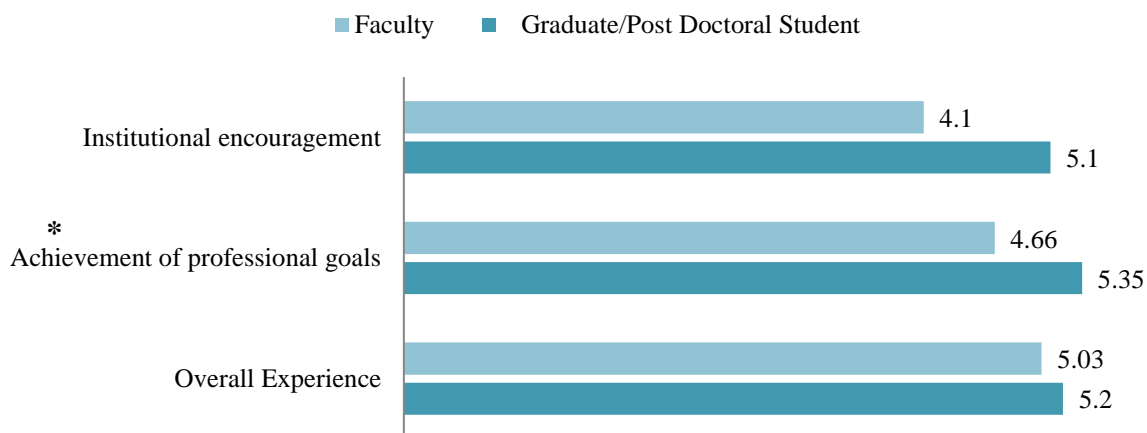


Figure 9- Based on your overall experience related to the SEANET project so far, how would you rate your level of satisfaction with the following aspects of the project?

* indicates statistically significant differences

Experienced or Anticipated Project Outcomes. Respondents were presented with a series of potential project outcomes that were selected based on the research team’s review of previous interdisciplinary surveys, and peer-reviewed literature. Respondents were asked to select all outcomes that they had either experienced or expected to experience while a part of the SEANET team. Respondents indicated that, “*peer-reviewed publications*”, “*peer reviewed publications that are valued by your department*”, “*new research methods or tools*”, and “*research translation to policy education or industry*”, as the top experienced or anticipated project outcomes (Figure 10).

Experienced or Anticipated Project Outcomes

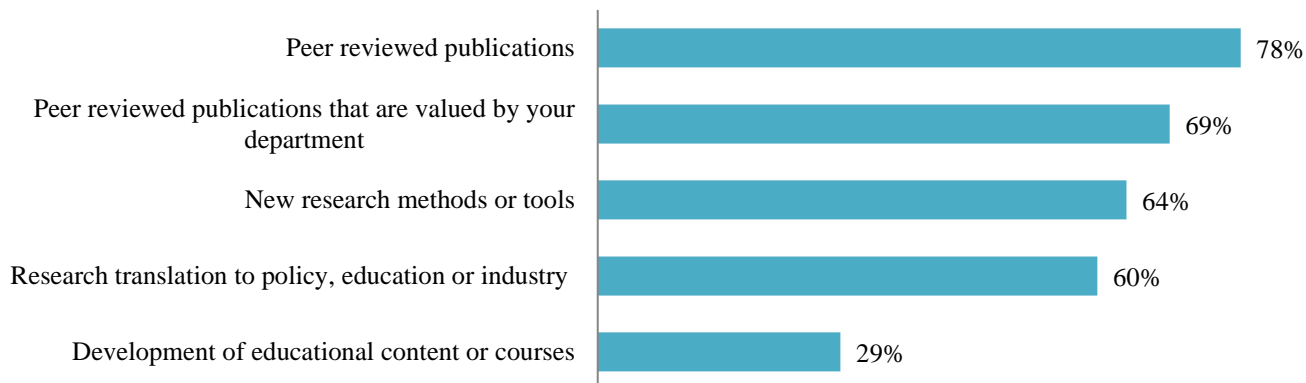


Figure 10- What project outcomes have you experienced or anticipate to experience within the SEANET collaborative project? (Choose all that apply).

In an effort to examine the possible relationship between membership in a theme and experienced or anticipated project outcomes, a chi-square test of independence was performed (Figures 11-15). Results indicated a significant relationship between theme and, “*research translation to policy, education, or industry*”, $\chi^2=9.22$; $df= 3$; $p=.026$. (All other chi-square tests performed were non-significant at the $p = .05$ level.) Themes 1 and 4 have a higher than expected reported level of this project outcome while theme 3 has a lower than expected indication of the outcome. This result indicates that project outcomes that

participants experience or anticipate may not occur uniformly across themes, but rather, may vary for at least one type of outcome.

Individual themes' top experienced or anticipated project outcomes are shown in Figures 11-14. In all, the experienced and/or anticipated project outcomes for this project are diverse and pragmatic. Participants indicated the kinds of outcomes that the National Science Foundation will anticipate from SEANET, namely: publishing papers, developing new research methods or tools, and translating research in policy, education or industry.

Theme 1. Theme 1 indicated a diverse range of outcomes, with, “*peer-reviewed publications*”, “*research translation into policy, education or industry*“, and “*new research methods or tools*” as the top experienced and/or anticipated project outcomes (Figure 11).

Theme 1: Experienced/Anticipated Project Outcomes

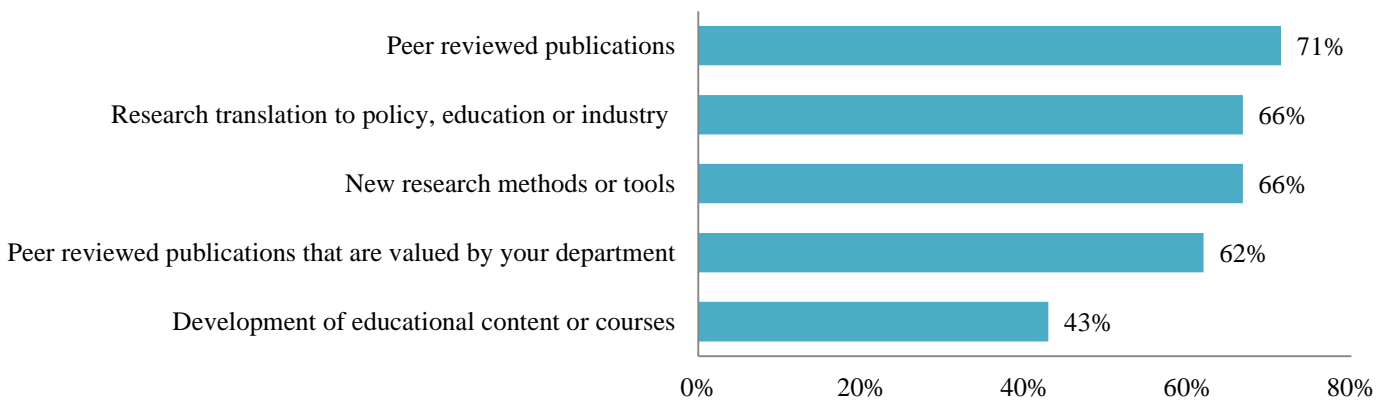


Figure 11- What project outcomes have you experienced or anticipate to experience within the SEANET collaborative project? (Choose all that apply).

Theme 2. Theme 2 indicated, “*peer reviewed publications*”, “*peer reviewed publications that are valued by your department*”, “*new research methods or tools*”, and, “*research translation to policy, education or industry*“, as the top experienced and/or anticipated project outcomes (Figure 12).

Theme 2: Experienced/Anticipated Project Outcomes

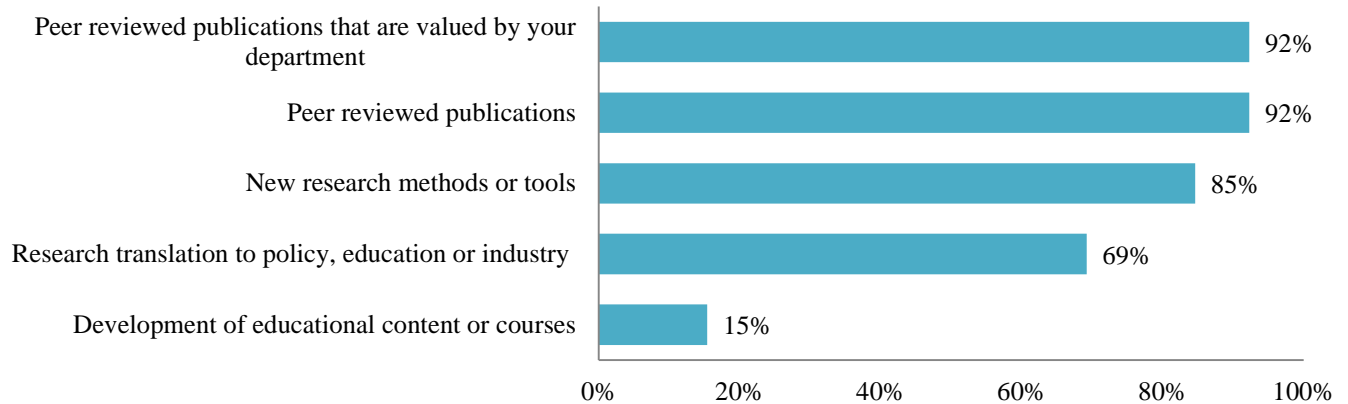


Figure 12- What project outcomes have you experienced or anticipate to experience within the SEANET collaborative project? (Choose all that apply).

Theme 3. Theme 3 indicated, “peer-reviewed publications”, “new research methods or tools”, and “peer-reviewed publications that are valued by your department” as the top experienced and/or anticipated project outcomes (Figure 13).

Theme 3: Experienced/Anticipated Project Outcomes

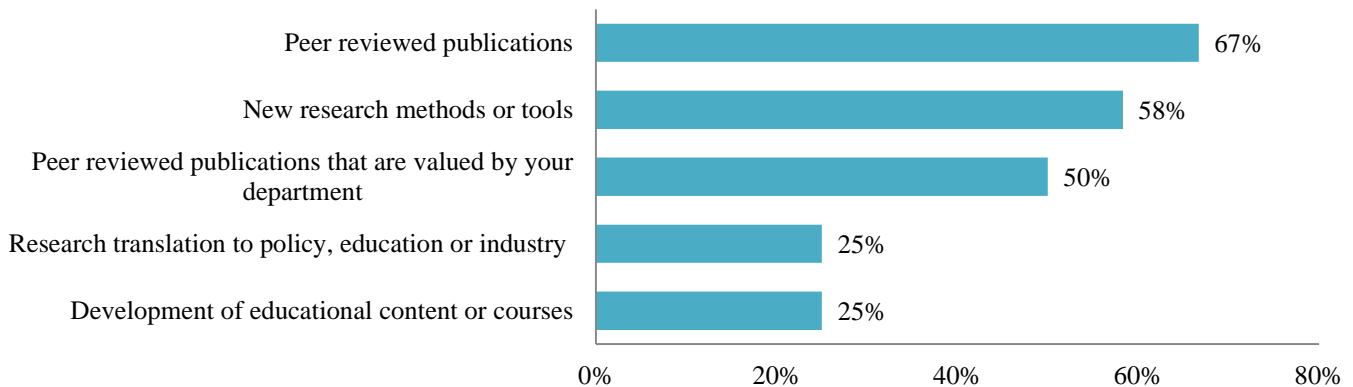


Figure 13- What project outcomes have you experienced or anticipate to experience within the SEANET collaborative project? (Choose all that apply).

Theme 4. Theme 4 indicated, “peer reviewed publications”, “peer reviewed publications that are valued by your department”, “research translation to policy, education or industry” and, “new research methods” as the top experienced/anticipated project outcomes (Figure 14).

Theme 4: Experienced/Anticipated Project Outcomes

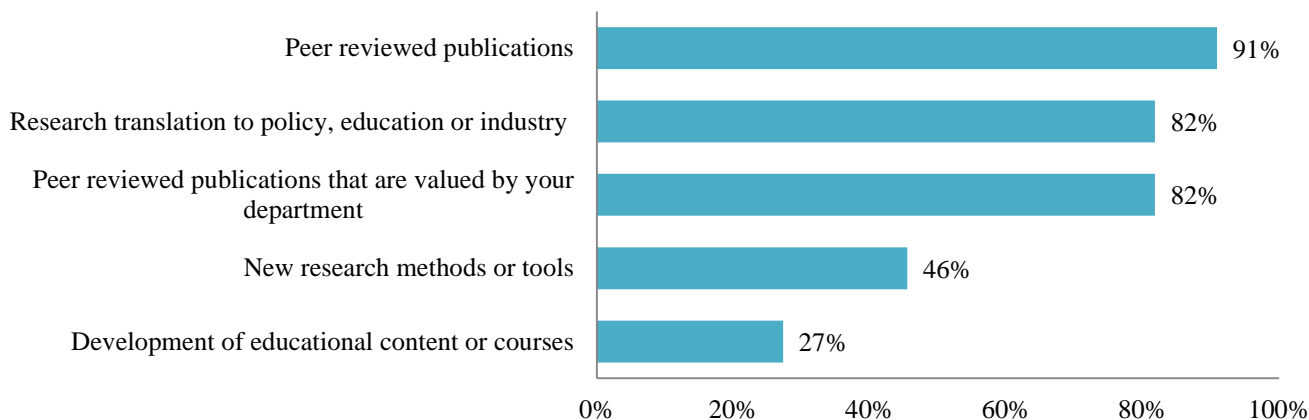


Figure 14- What project outcomes have you experienced or anticipate to experience within the SEANET project? (Choose all that apply).

Information Access

A section of the survey assessed information access, focusing on both information about the research process and products, and access to information related generally to SEANET (Figure 15). Respondents were asked to rate their satisfaction related to the SEANET project on a five-point Likert scale ranging from *strongly disagree=1* to *strongly agree=5*. The results for “having appropriate access to information to allow me to participate in SEANET” ($M = 3.59, SD = .93$) and, “information about the research process and products being readily available” ($M = 3.14, SD = .841$), indicate a somewhat neutral (*neither agree nor disagree*) to optimistic view of information access related to participation on SEANET and a neutral view on information about the research process and products being available.

Information Access (Mean Ratings)

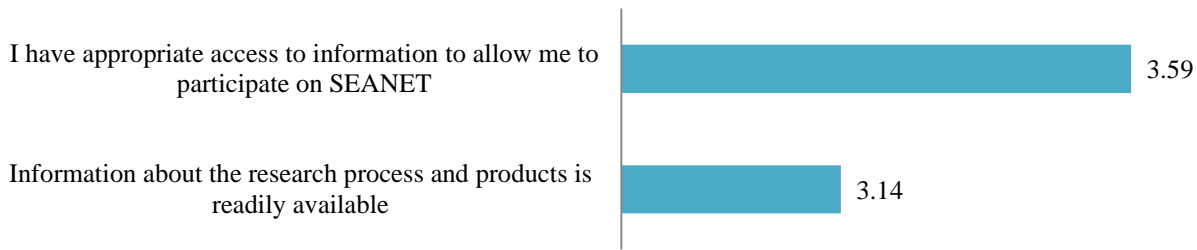


Figure 15- When you consider SEANET as a whole project, how much do you disagree or agree with the following statement?

In an effort to see possible differences in mean ratings between faculty researchers and student researchers, a one-way ANOVA was conducted (Figure 16). There was not a statistically significant difference between faculty and students in relation to having appropriate access to information, $F(1, 47) = .002, p = .962$, nor information about the research process and products being readily available, $F(1, 47) = 1.172, p = .196$. These results indicate that both students and faculty have a somewhat neutral (*neither agree nor disagree*) to optimistic view of information access related to participation on SEANET and a neutral view on information about the research process and products being available.

Student/ Faculty Information Access (Mean Ratings)

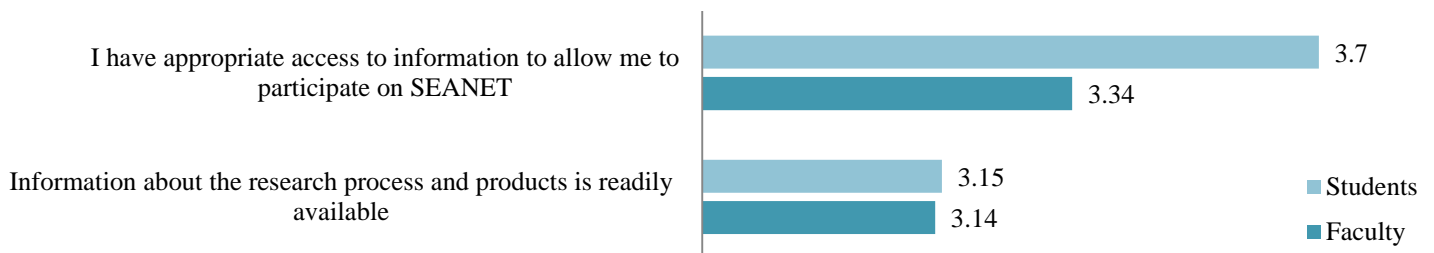


Figure 16- When you consider SEANET as a whole project, how much do you disagree or agree with the following statement?

Collaborative Interactions

Communicating within and across themes, with the management team, and with stakeholders is a large part of the SEANET project. In an effort to identify how SEANET members prefer to collaborate and communicate, a series of questions were asked about identification of potential collaborators, communication preferences, motivations to engage, and decision making structures.

Identification of Potential Collaborators. Respondents were asked to indicate all of the avenues they take to identify potential collaborators from either their own theme or other themes (Figure 17). Respondents indicated that “*attending meetings within their theme*,” “*SEANET hosted events*,” and “*attending meetings outside of their theme*” as the most common ways to identify potential collaborators.

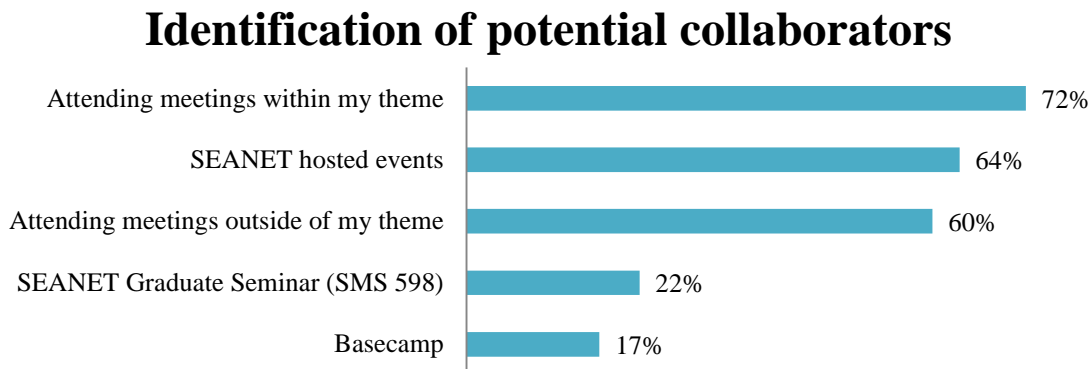


Figure 17- How do you identify potential collaborators from fields other than your own within SEANET? (Check all that apply)

Decision Making. Decision making is at the core of the collaborative process. Knowledge about team decision making preferences can lead to more collaborative processes and more effective leadership. In order to gauge the type of decision making techniques preferred on the SEANET team, a series of questions were asked about decision making preferences (Figure 18). Respondents were asked to rate their preference level on a 4-point Likert Scale (1= *not preferred*, 4 = *highly preferred*). The mean ratings for the decision making preferences of “*no decision making structure*” ($M = 1.07$, $SD = .26$), and, “*a final*

decision is not made unless everyone agrees” ($M = 1.76, SD = .942$) indicate that in general, respondents were in favor of some type of decision making structure and believed such structure need not be directed by consensus. The mean ratings for the decision making preferences of *“everyone should have a degree of influence but one or a few people have final authority”* ($M = 2.95, SD = .826$), *“a small group of people within the team should make most of the decisions”* ($M = 2.13, SD = .848$), *“one person on the team should be responsible for decision making”* ($M = 1.44, SD = 1.44$), *“students are not actively involved in decision making”* ($M = 1.44, SD = .714$), indicates that, overwhelmingly, respondents prefer decision making structures that were inclusive of many points of view over decision making structures that values one person making decisions.

Decision Making Preferences (Mean Ratings)

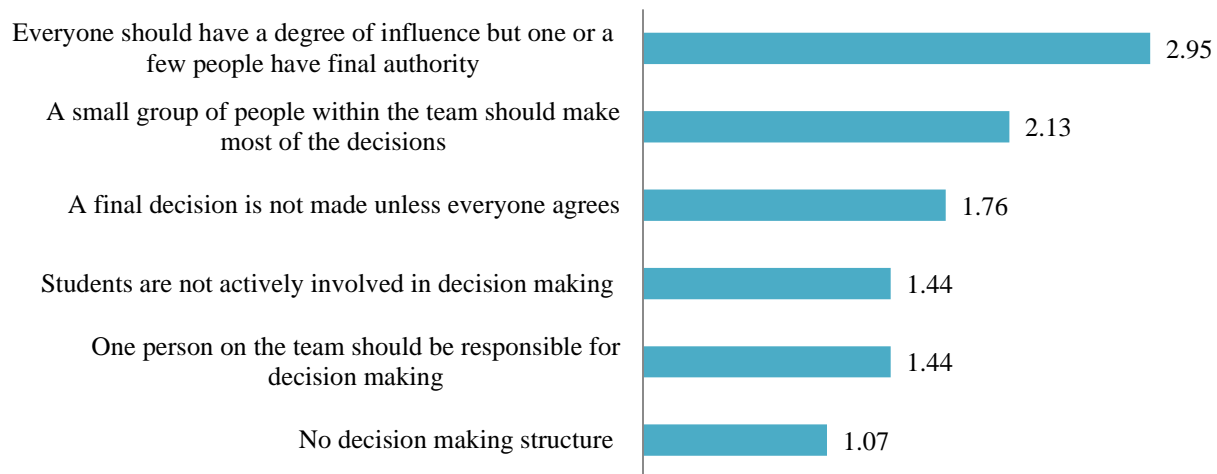


Figure 18- In general when it comes to making decisions on a team...

Overall, these results indicate preferences for decision making processes where every member has a degree of influence but one or a few people have final authority and where students are actively involved in the decision making process. Noting communication components, such as decision making processes, is essential for understanding the complex social dynamics that construct this organization.

In an effort to see differences in mean ratings between themes, a one-way ANOVA was conducted (Figure 19). ANOVA results indicate that there was a statistically significant difference (at a .05 level) between themes in relation to the preferences, “*a small group of people within the team should make most of the decisions*”; $F(1,51) = 3.5, p = .022$. The Tukey post-hoc test revealed that Theme 1 ($M = 2.37, SD = .831$) and Theme 4 ($M = 2.55, SD = .820$) indicated significantly higher agreement ($p = .05$) with this preference than Theme 2 ($M = 1.67, SD = .651$) and Theme 3 ($M = 1.83, SD = .835$). Additionally, there was a statistically significant difference between themes in relation to the preference, “*students are not actively involved in decision making*”; $F(1, 51) = 2.90, p = .044$. The Tukey post-hoc test revealed that Theme 3 ($M = 1.92, SD = .99$) and Theme 4 ($M = 1.45, SD = .68$) indicated significantly higher agreement ($p = .044$) compared to Theme 1 ($M = 1.30, SD = .571$) and Theme 2 ($M = 1.17, SD = .389$). These results indicate that there are significantly different decision making preferences between themes. On average, members of Themes 1 and 4 prefer a small group of people within the team to make most of the decisions while Theme 2 are less supportive of this decision-making type. Furthermore, on average, members of Themes 1 and 2 appear to prefer students to be more actively involved in decision making, as compared to Themes 3 and 4.

Theme: Decision Making Preferences (Mean Ratings)

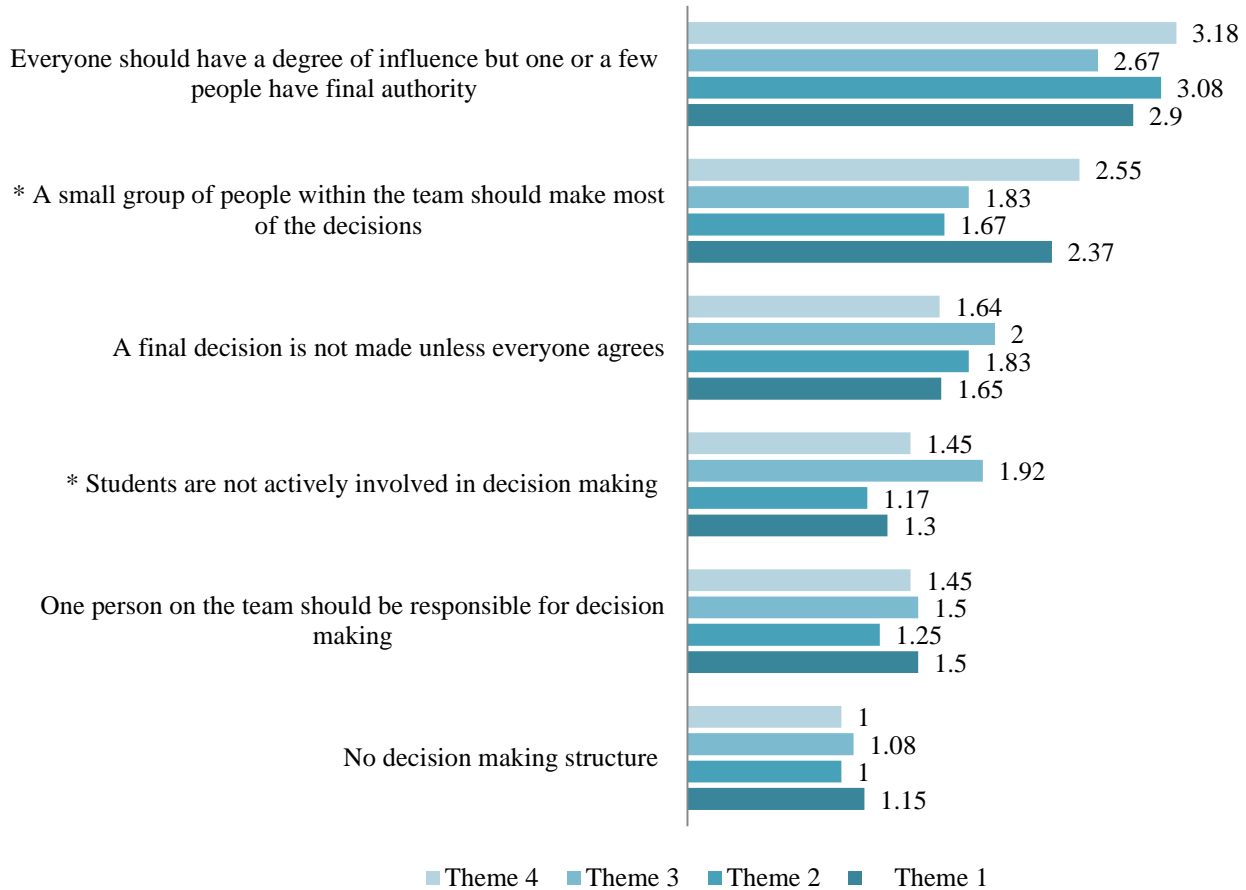


Figure 19- In general when it comes to making decisions on a team...

*indicates significant difference (.05 level of significance)

Motivations to Engage. In an effort to understand the SEANET team’s motivations to engage in collaborative endeavors, we asked respondents a series of questions related to their motivation to engage with fellow researchers in the SEANET project (Figures 20 and 21). Respondents were asked to rate their level of agreement on a five-point Likert scale ranging from (1) *strongly disagree* to (5) *strongly agree*. Respondents indicated the highest level of agreement with “*I enjoy learning from people with different types of knowledge*” ($M = 4.42, SD = .565$), of the satisfaction “*I experience from taking on interesting challenges*” ($M = 4.05, SD = .766$), and, “*will help me be the kind of scholar I want to be*” ($M = 3.95,$

$SD = .742$). Further, respondents indicated the lowest levels of agreement with “*my department required my participation*” ($M = 2.16, SD = 1.2$) and “*I have nothing to lose*” ($M = 2.74, SD = .992$). Overall these results are promising, as they indicate that participants are motivated to engage with others with different types of knowledge.

Motivations to Engage (Mean Ratings)

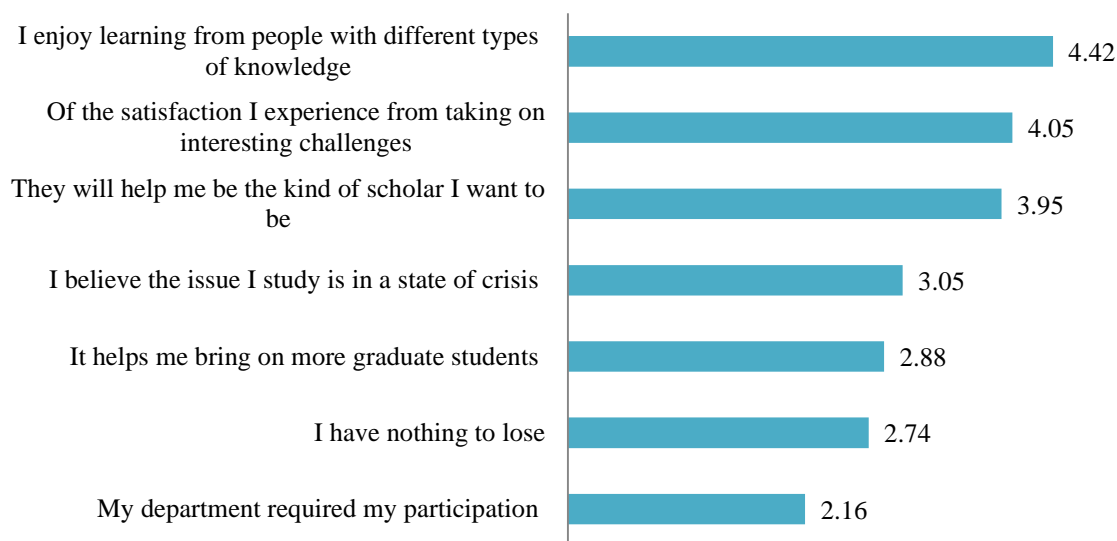


Figure 20- I am motivated to engage with fellow researchers on the SEANET project because...

In an effort to see differences in mean ratings between themes a one-way ANOVA was conducted (Figure 21). There were no statistically significant differences (at a .05 level of significance) between themes in relation to any of the motivations to engage. These non-significant results indicate that respondents share similar motivations to engage in the project. These shared motivations point toward a team of researchers who are driven by the aim to experience and learn from the challenges and opportunities that interdisciplinary collaborations yield.

Theme: Motivations to Engage (Mean Ratings)

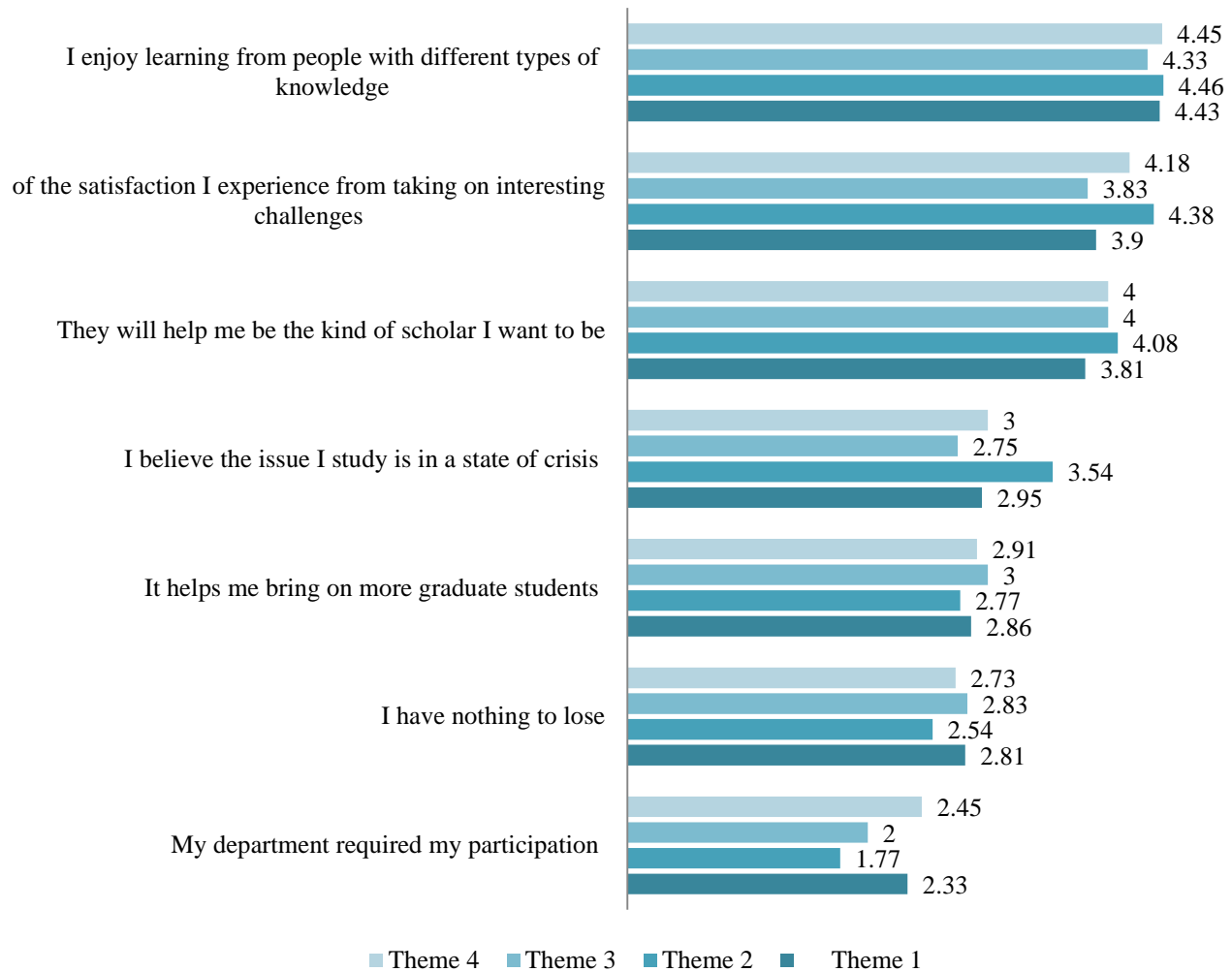


Figure 21- I am motivated to engage with fellow researchers on the SEANET project because...

Collective Communication Competencies. Peer-reviewed literature on interdisciplinary collaboration points toward team interactions, described as collective communication competencies, as influencing the collaborative process and objectives (Thompson, 2009). Challenging statements in a positive manner, inviting opportunities for reflexive talk, demonstrating presence, and the use of humor have all been identified as processes that positively influence the team's ability to communicate

effectively. Conversely, acts of blatant boredom, intentional challenging of expertise and sarcasm can compromise collective communication competencies (Thompson, 2009).

In an effort to measure the SEANET team’s collective communication competency (CCC), and further understand members’ communication preferences, we assessed collective communication competency with a four-item measure developed by McGreavy et al. (2015) (Figure 22). Participants responded to questions on five-point Likert-type scales ranging from 1 = *strongly disagree* to 5 = *strongly agree*. The mean ratings for “*themes should discuss outcomes*” ($M = 4.12, SD = .709$), “*laughter or use of humor improves theme communication*” ($M = 3.91, SD = .662$), “*theme members should show respect for diverse ideas*” ($M = 4.25, SD = .830$), “*needing to understand the goals of fellow theme members*” ($M = 4.02, SD = .694$), “*theme members should show respect for diverse ideas*” indicate a team that is attuned to interpersonal communication practices norms, including: active listening, demonstrating presence, and paying attention to disciplinary differences.

Collective Communication Competency (Mean Ratings)

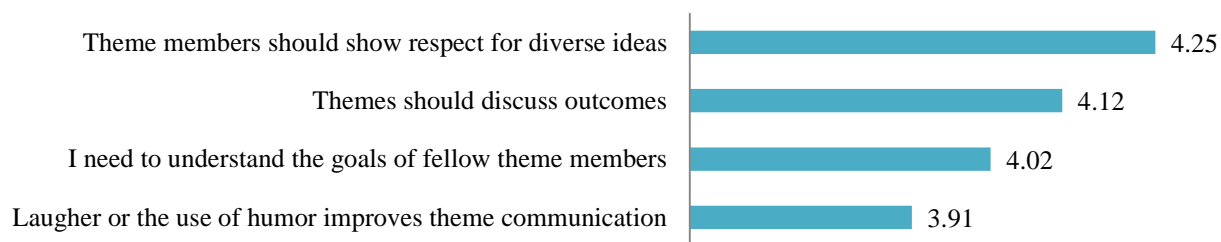


Figure 22- How much do you disagree or agree with the following statements?

To understand team-wide communication competencies, we assessed the relational influences of the researchers’ roles upon self-reported collective communication competency. To do so, gender, disciplinary affiliation, and university status (e.g., student, untenured professor, tenured professor, etc.) were investigated as possible relational influences on communication competency scores. Collective

communication competency was assessed with the same scale of four-item measure developed by McGreavy et al. (2015). Participants responded to each of the following items on five-point Likert-type scales ranging from *strongly agree* (5) to *strongly disagree* (1): (a) I don't need to understand the goals of fellow members, (b) members should show respect for diverse opinions, (c) laughter or the use of humor frequently improves communication, and (d) themes [groups] should rarely discuss outcomes. A Cronbach's alpha test of these four scales produced a reliability coefficient alpha of .749, indicating satisfactory internal reliability.

In addition to the three influences of disciplinary affiliation, university status, and gender, researcher motivation for participating in the interdisciplinary research team may also affect collective communication competency. To measure this possible effect, we assessed researcher motivation using two scales originally developed by McGreavy et al. (2015) in the context of stakeholder engagement and modified to fit the context of participation in SEANET. Utilizing the results described previously from the prompt, "I am motivated to engage with fellow researchers in the SEANET project because..." we employed an exploratory principal components analysis with a varimax rotation. Using the Kaiser criterion to select components with eigenvalues ≥ 1.0 , and a multistep process of interpretation, we identified and retained components (Table 1). We used McGreavy et al.'s (2015) scale to check the components and found substantial overlap in scale loadings on those components. Table 1 presents the results of the component analysis. The first scale included four items: (a) they [other researchers] will help me be the scholar I want to be; (b) I believe the issue I study is in a state of crisis; (c) the satisfaction I experience from taking on interesting challenges; and (d) I enjoy learning from people with different types of knowledge. We interpreted these four items, collectively, as representing "sustainability researcher identity." The second scale consisted of three items: (a) it helps me bring on more graduate

students; (b) my department required my participation; and (c) I have nothing to lose. We identified these three items, collectively, as “opportunity for funding”.

Table 2. Principal Components Analysis of Researcher Motivations for Stakeholder Engagement.
Participant Responses to: “I was motivated to engage with fellow researchers because...”

Rotated Component Matrix		
	Sustainability Science Identity	Opportunity for Funding
My department required my participation.	-.093	.842
It helps me bring on more graduate students.	-.041	.719
I have nothing to lose.	.038	.830
They will help me be the scholar I want to be.	.822	.244
I enjoy learning from people with different types of knowledge.	.747	.165
Of satisfaction I experience from taking on interesting challenges.	.797	-.041
I believe the issue I study is in a state of crisis.	.686	.285

Extraction: Principal Component Analysis. Rotation: Varimax with Kaiser Normalization.

Rotation converged in 3 iterations.

Five-point Likert-type scales ranging from 1 = *strongly disagree* to 5 = *strongly agree*.

Three analyses of covariance (ANCOVAs) were used to test the relational influences of gender, disciplinary affiliation, and university status (e.g., student, untenured professor, tenured professor, etc.) (Figures 23-25). Since motivations for engagement may influence participant’s perceptions of collective communication competency, these variables, the sustainability science identity (see above) and opportunities for funding (see above), were tested along with the participant role influences. The potential influences of disciplinary affiliation, university status, and gender on collective communication competency were tested with separate ANCOVAs due to the relatively small sample size, and the motivation scales of sustainability science identity and opportunities for funding provide covariates for each test.

Disciplinary Collective Communication Competencies (Mean Ratings)

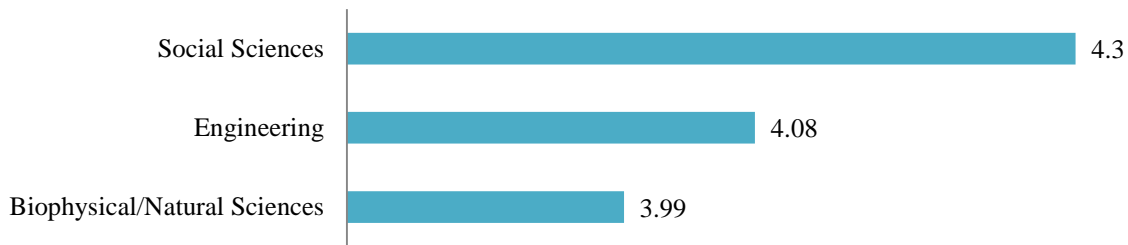


Figure 23- How much do you disagree or agree with the following statements?

The ANCOVA examining the differences in collective communication competency by disciplinary affiliation produced a non-significant result, $F(2,48) = 1.19$, $p = .31$, but shows an effect of the influence of motivation. The sustainability science identity covariate is significantly related to collective communication competency, $F(1,48) = 5.52$, $p = .02$. The opportunity for funding covariate also is significantly related to collective communication competency, $F(1,48) = 3.91$, $p = .05$. Although the effect of disciplinary affiliation on collective communication competency is not significant, social scientists do report slightly higher perceived communication competencies as compared to engineers, as well as biophysical and natural scientists. This result suggests that motivations connected to sustainability science identity and opportunities for funding are related to collective communication competency perceptions.

The ANCOVA exploring the effect of university status on collective communication competency shows nonsignificant results for the two covariates, sustainability science identity and opportunity for funding, but a statistically significant difference between university ranks, $F(3, 39) = 2.92$, $p = .05$. Graduate students and Assistant Professors report significantly higher collective communication

competency scores, as compared to Associate Professors and Professors. This indicates that university status is related to collective communication competency (Figure 24).

University Status: Collective Communication Competencies (Mean Ratings)

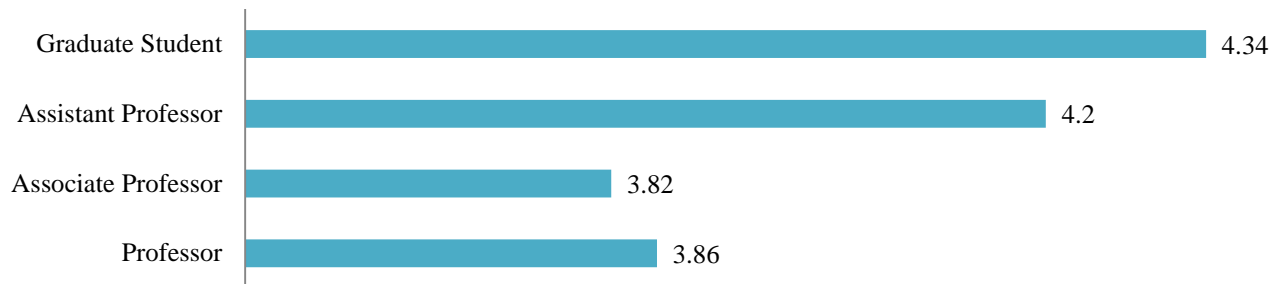


Figure 24- How much do you agree or disagree with the following statements?

The ANCOVA showing the effect of gender on collective communication competency produced a non-significant result, $F(1, 45) = 2.25, p = .14$. The sustainability science identity covariate also produced a non-significant effect, $F(1, 45) = 1.63, p = .21$. The opportunity for funding covariate, however, showed a significant effect on collective communication competency, $F(1, 45) = 4.86, p = .03$ (Figure 25)

Gender: Collective Communication Competencies (Mean Ratings)

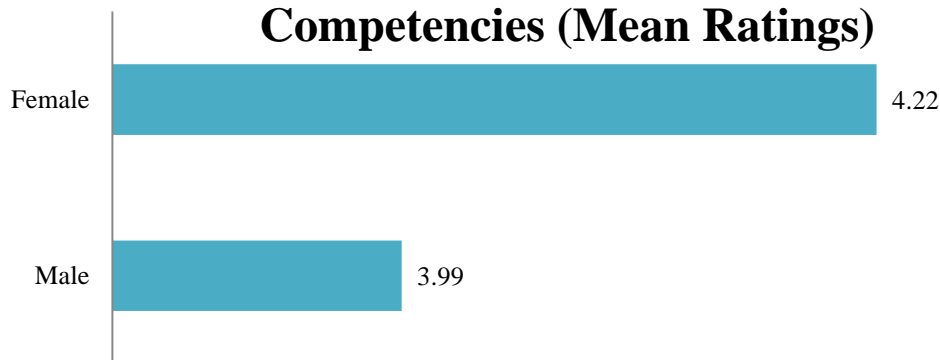


Figure 25- How much do you agree or disagree with the following statements?

The results reveal no significant differences by gender or disciplinary affiliation on collective communication competency. The university status results are more intriguing and require further clarification. These findings indicate that differing ranks of researchers have differing perceptions of collective communication competency. The sample size for faculty researchers was small, but suggests that graduate students and assistant professors may perform their collective communication competency with more flexibility. These results will be taken into consideration when analyzing the semi-structured interviews. For example, responses to questions pertaining to communication priorities and perceived communication obligation will be analyzed for differences between differing ranks of researchers.

Interestingly, motivation to engage in relation to funding opportunity consistently shows an influence on collective communication competency in the gender and disciplinary affiliation ANCOVAs. Sustainability researcher identity and opportunity for funding affect collective communication competency significantly when the influence of disciplinary affiliation is also examined, but not when university status is examined, and only opportunity for funding when gender is examined. This suggests that future research should probe further the differences in disciplinary affiliation in perhaps different orientations toward what sustainability science identity means and assumptions about the need or orientation toward seeking out funding opportunities; the gender effect might be probed this way as well.

Challenges

A section of the survey assessed any challenges SEANET members may have already experienced or anticipate to experience within 3 sets of potential challenges to interdisciplinary collaboration: institutional (structure of academic institutions), epistemological (different ways of knowing or modes of thinking), and teamwork (individuals, interpersonal, or group dynamics). Respondents were asked to indicate all of the challenges they have experienced or think they might experience in the future. These results are represented in Figures 26-40.

Structural Challenges. As a whole, the SEANET team indicated “*funding challenges/lack of funds,*” “*time demands not supported,*” and “*first author value*” (i.e., greater recognition or worth placed on first authorship) as the top three structural challenges (Figure 26).

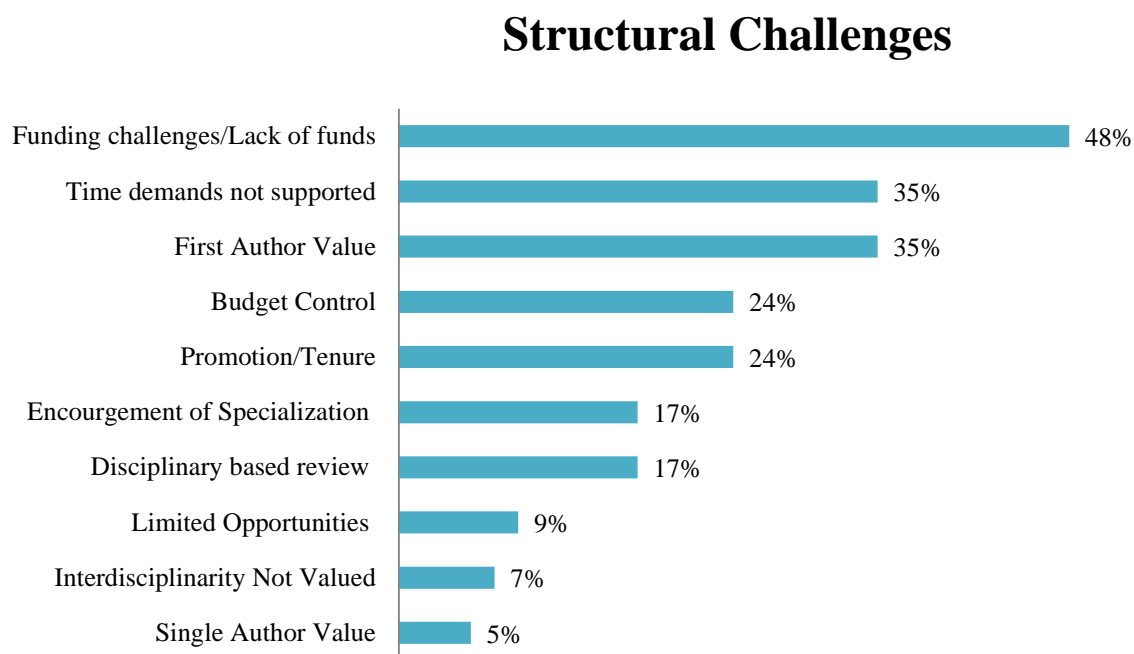


Figure 26- Which of the following institutional challenges (structure of academic institutions) have you experienced or plan to experience? (Choose all that apply).

In an effort to examine the relationship between themes and experienced or anticipated institutional challenges, a chi-square test of independence was performed. The relationship between theme and the following two institutional challenges were significant: “*time demands not supported*”, $\chi^2 = 9.08$; $df = 3$; $p = .028$; “*first author value*”, $\chi^2 = 10.34$; $df = 3$; $p = .016$. Theme 1 had a higher than expected indication of *time demands not supported* and Theme 3 had a lower than expected indication of this institutional challenge. Theme 1 had a lower indication and Themes 2 and 4 had higher indications of “*first author value*” than expected. This result indicates that certain experienced or anticipated institutional challenges may vary by theme, with certain themes, on average, assigning greater or lesser importance to them. Further, this result relates to disciplinary norms, with some fields ranking last authorship as more

prestigious and others first authorship as more prestigious. Future studies should take this difference into consideration when measuring this challenge.

Theme 1. Themes were further broken out to show top structural challenges. Theme 1 indicated “*time demands not supported,*” “*funding challenges/lack of funds,*” “*budget control,*” and “*promotion/tenure*” as the top structure challenges (Figure 27).

Theme 1: Structural Challenges

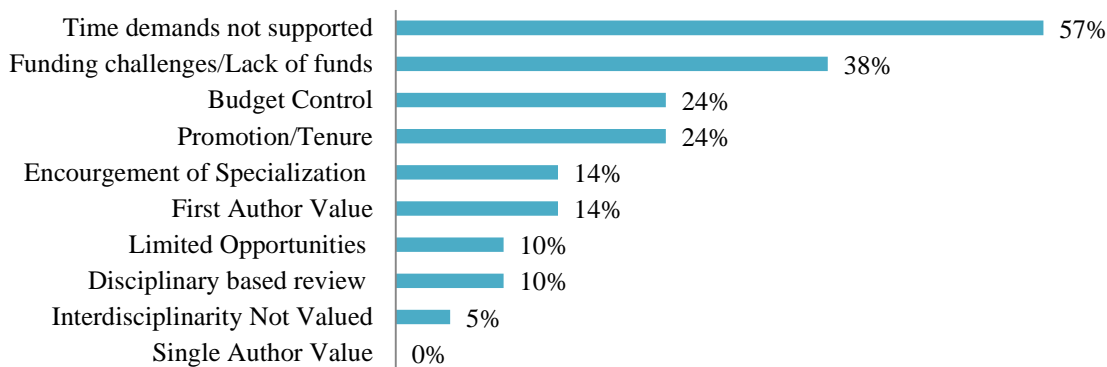


Figure 27- Which of the following institutional challenges (structure of academic institutions) have you experienced or anticipate to experience during the SEANET collaborative process? (Choose all that apply).

Theme 2. Theme 2 indicated “*funding challenges/lack of funds,*” “*first author value,*” and “*budget control*” as the top structure challenges (Figure 28).

Theme 2: Structural Challenges

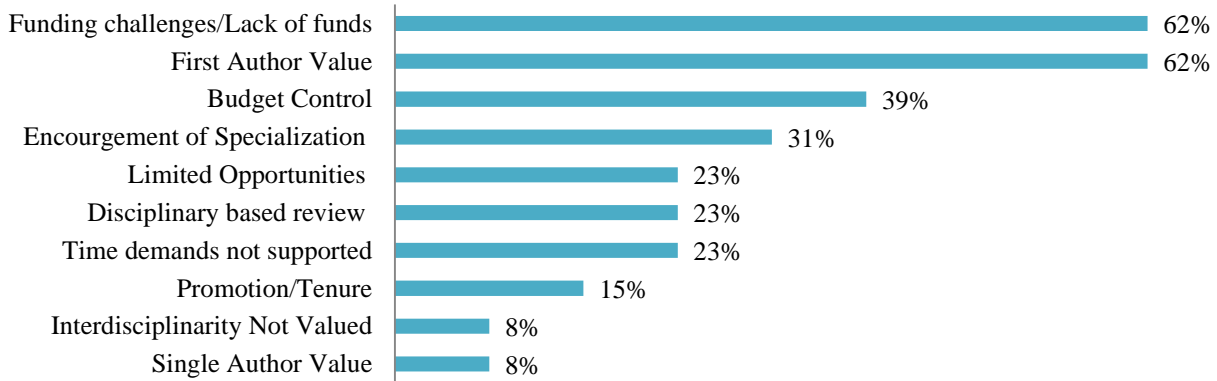


Figure 28- Which of the following institutional challenges (structure of academic institutions) have you experienced or anticipate to experience during the SEANET collaborative process? (Choose all that apply).

Theme 3. Theme 3 indicated “*funding challenges/lack of funds,*” “*budget control,*” “*first author value,*” and “*promotion/tenure*” as the top structure challenges (Figure 29).

Theme 3: Structural Challenges

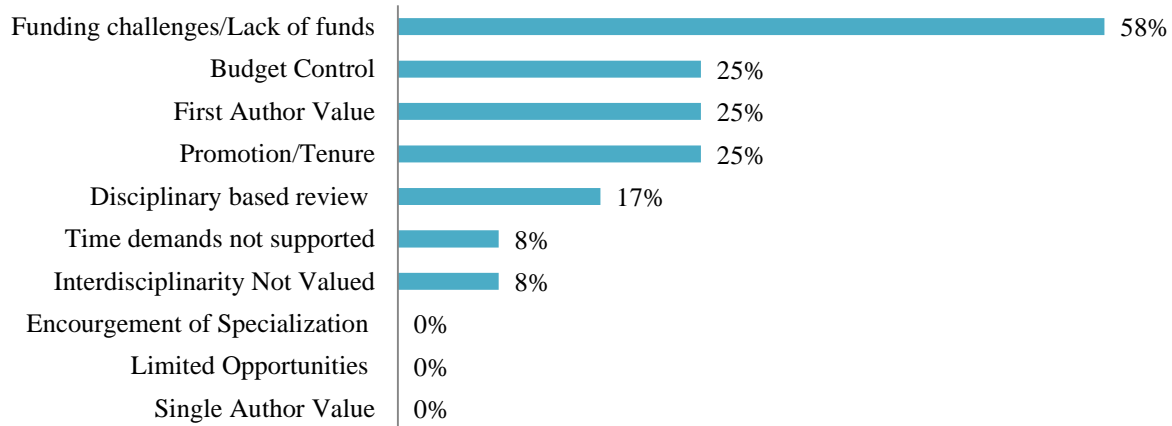


Figure 29- Which of the following institutional challenges (structure of academic institutions) have you experienced or anticipate to experience? (Choose all that apply).

Theme 4. Theme 4 indicated “*first author value,*” “*funding challenges/lack of funds,*” “*time demands not supported,*” and “*promotion/tenure*” as the top structure challenges (Figure 30).

Theme 4: Structural Challenges

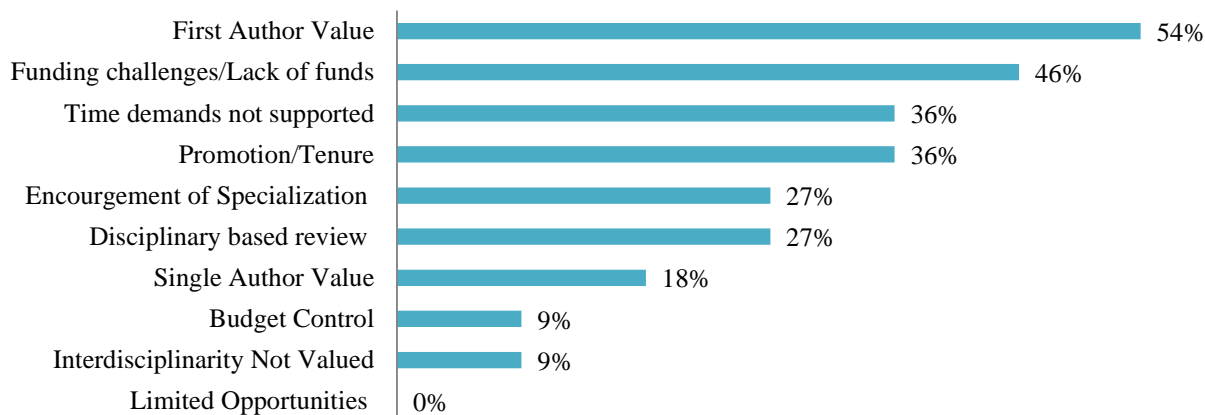


Figure 30- Which of the following institutional challenges (structure of academic institutions) have you experienced or anticipate to experience? (Choose all that apply).

Epistemological Challenges. In an effort to measure challenges related to disciplinary affiliation, norms, and structure, the SEANET team was asked to indicate top epistemological challenges. As a whole, the SEANET team indicated “*lack of common language,*”, “*clarifying research problem & integrating objectives,*”, “*different disciplinary theories/knowledge,* and “*different disciplinary methods*” as the top epistemological challenges (Figure 31).

Epistemological Challenges

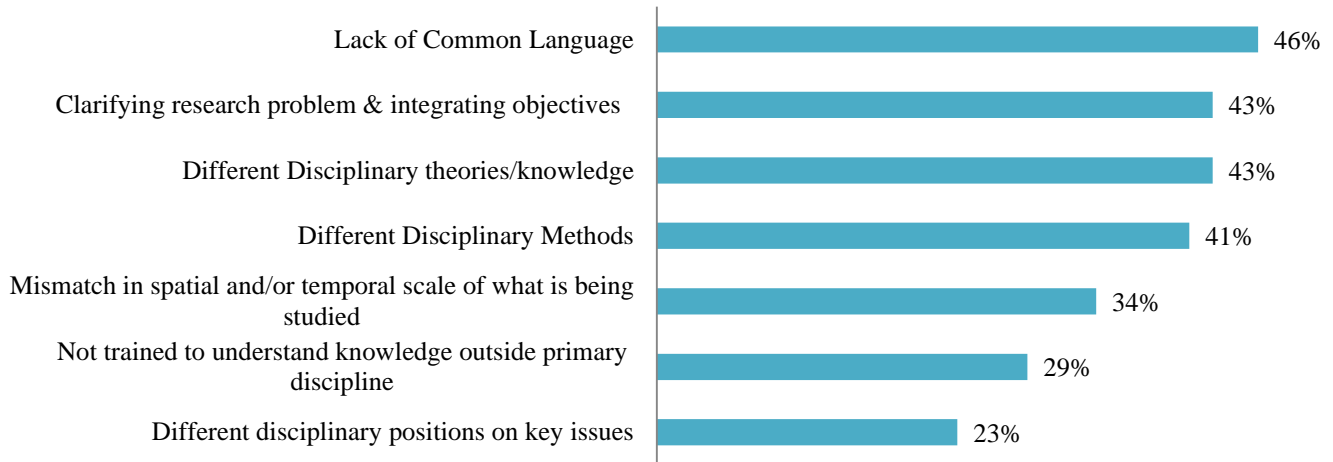


Figure 31- Which of the following epistemological challenges you experienced or anticipate to experience? (Choose all that apply).

In an effort to examine the relationship between themes and experienced or anticipated epistemological challenges, a chi-square test of independence was performed. No significant relationship was found between themes and experienced or anticipated epistemological challenges. Themes were further broken out to show top epistemological challenges. Individual themes' top experienced or anticipated project outcomes are shown in Figures 32-35.

Theme 1. Theme 1 indicated a diverse range of epistemological challenges with a third of responses in each of these categories, “*clarifying research problems and integrating objectives*“, “*mismatch in spatial and/or temporal scale of what is being studied*“, and, “*lack of common language*“.

Theme 1: Epistemological Challenges

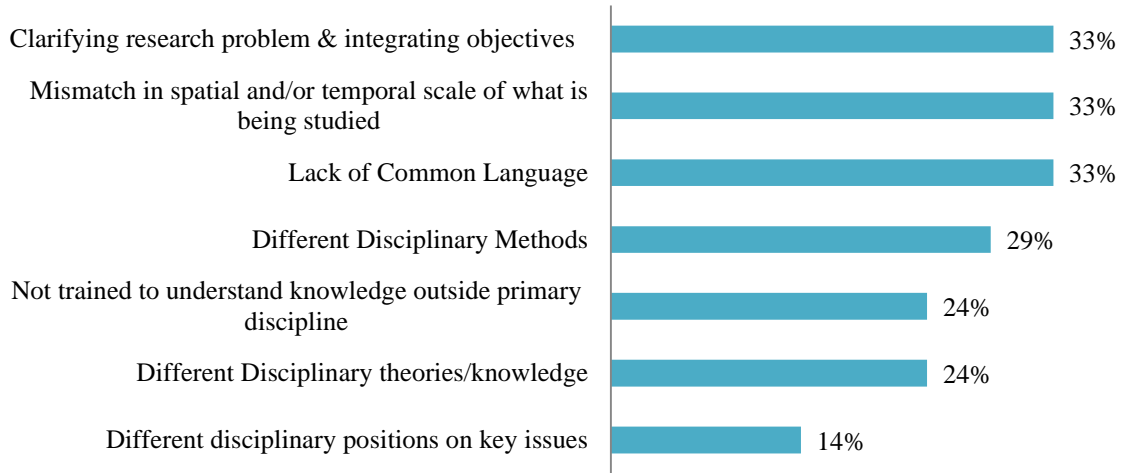


Figure 32- Which of the following epistemological challenges you experienced or anticipate to experience? (Choose all that apply).

Theme 2. Theme 2 indicated “clarifying research problems and integrating objectives,” “not trained to understand knowledge outside of primary discipline,” “different disciplinary positions on key issues,” “different disciplinary theories/knowledge,” and “different disciplinary methods“(38.5%) as the top epistemological challenges (Figure 33).

Theme 2: Epistemological Challenges

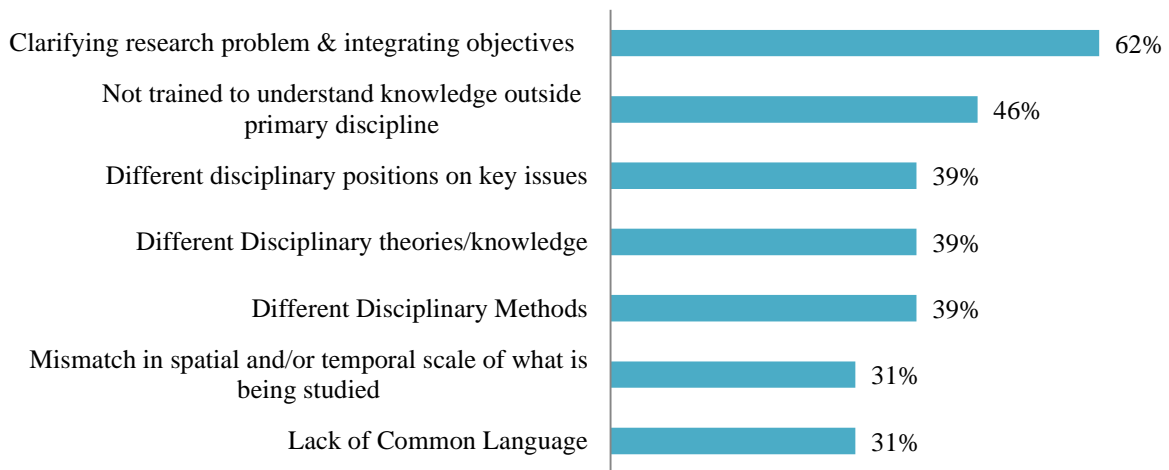


Figure 33- Which of the following epistemological challenges you experienced or anticipate to experience? (Choose all that apply).

Theme 3. Theme 3 indicated “*different disciplinary theories/knowledge,*” “*lack of common language,*” and “*different disciplinary methods*” as top the epistemological challenges (Figure 34).

Theme 3: Epistemological Challenges

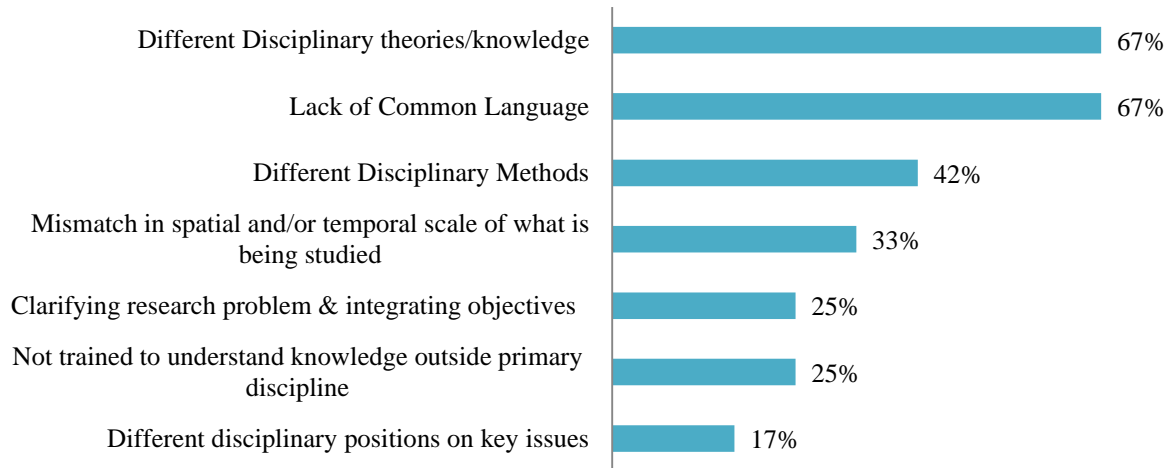


Figure 34- Which of the following epistemological challenges you experienced or anticipate to experience? (Choose all that apply).

Theme 4. Respondents in Theme 4 indicated “*different disciplinary methods,*” “*lack of common language,*” “*different disciplinary theories/knowledge,*” and “*clarifying research problems and integrating objectives*” as the top epistemological challenges (Figure 35).

Theme 4: Epistemological Challenges

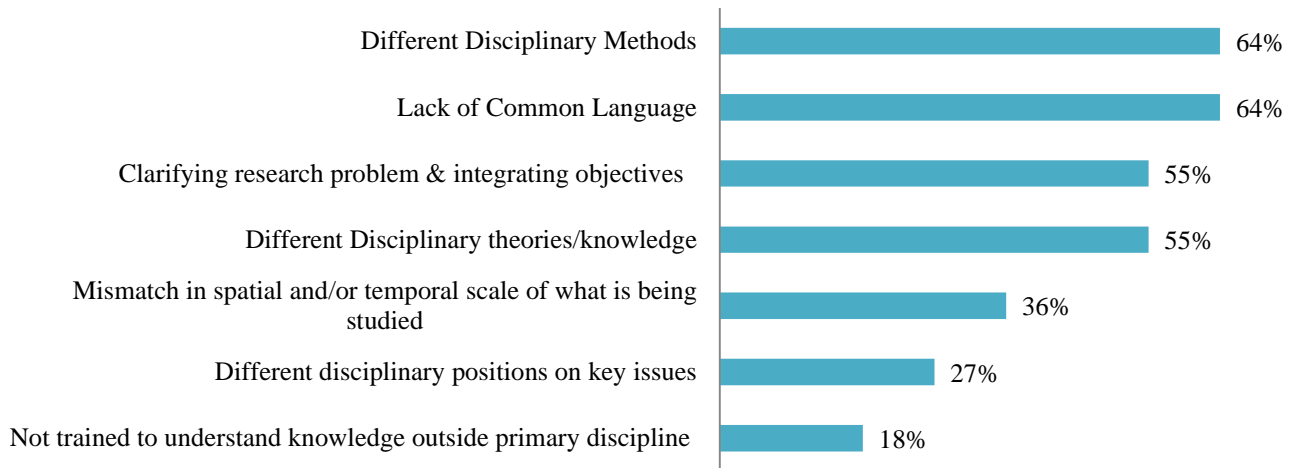


Figure 35- Which of the following epistemological challenges you experienced or anticipate to experience? (Choose all that apply).

Teamwork Challenges. Respondents were asked to identify the challenges related to teamwork that they have or anticipate to experience while apart of the SEANET team. As a whole, the SEANET team indicated “*travel required*,” “*project organization/project management*,” and “*group size*” as the top teamwork challenges (Figure 36).

Teamwork Challenges

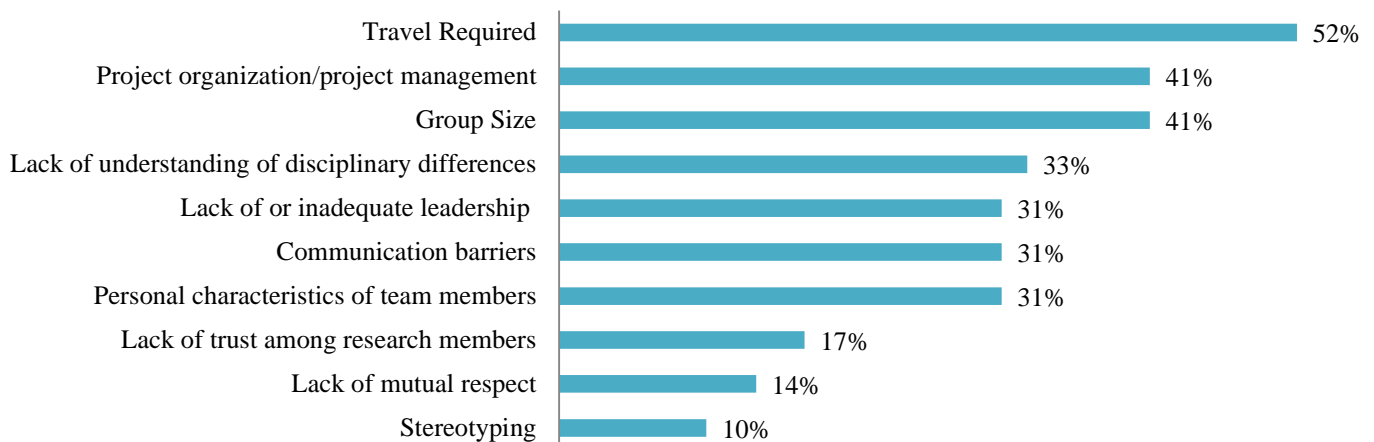


Figure 36- Which of the following epistemological challenges you experienced or anticipate to experience? (Choose all that apply).

In an effort to examine the relationship between themes and experienced or anticipated teamwork challenges, a chi-square test of independence was performed. The relationship between theme and *travel required*, $\chi^2=10.57$; $df = 3$; $p = .014$ was significant. Themes 1 had a higher than expected indication of *travel required* and Themes 2 and 3 had a lower than expected indication. Given Theme 1’s geographical spread across Maine (at University of New England, etc.) this result is to be expected, as many members from this theme are required to travel for meetings. Themes were further broken out to show top teamwork challenges. Individual theme’s top challenges are shown in Figures 37-41.

Theme 1. Theme 1 indicated “*travel required*”, “*communication barriers*”, “*lack of or inadequate leadership*”, “*project organization/project management*”, and “*group size*” as the top teamwork challenges (Figure 37). These teamwork challenges could point toward the fact that the majority of Theme 1 works primarily at the University of New England. This result is important to highlight especially in light of the significant chi-square result.

Theme 1: Teamwork Challenges

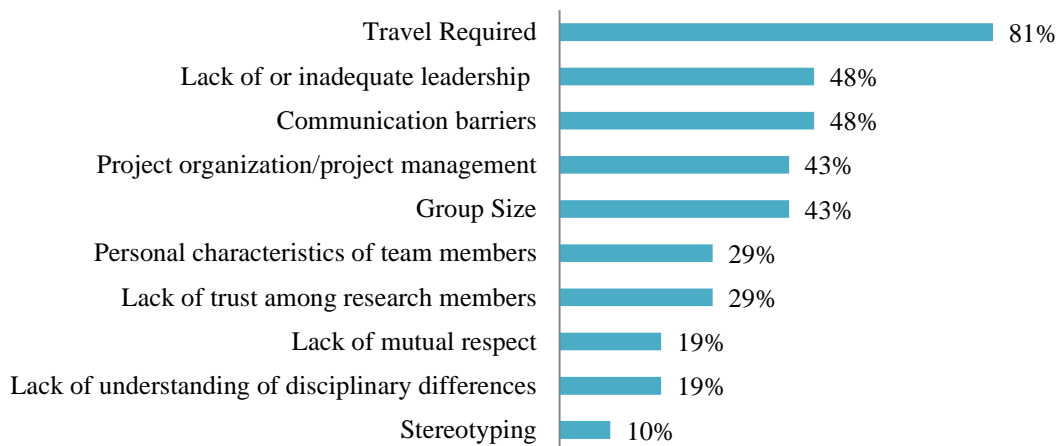


Figure 37- Which of the following epistemological challenges you experienced or anticipate to experience? (Choose all that apply).

Theme 2. Theme 2 indicated “*lack or inadequate leadership*”, “*project organization/project management*”, and “*personal characteristics of team members*” as the top teamwork challenges (Figure 38).

Theme 2: Teamwork Challenges

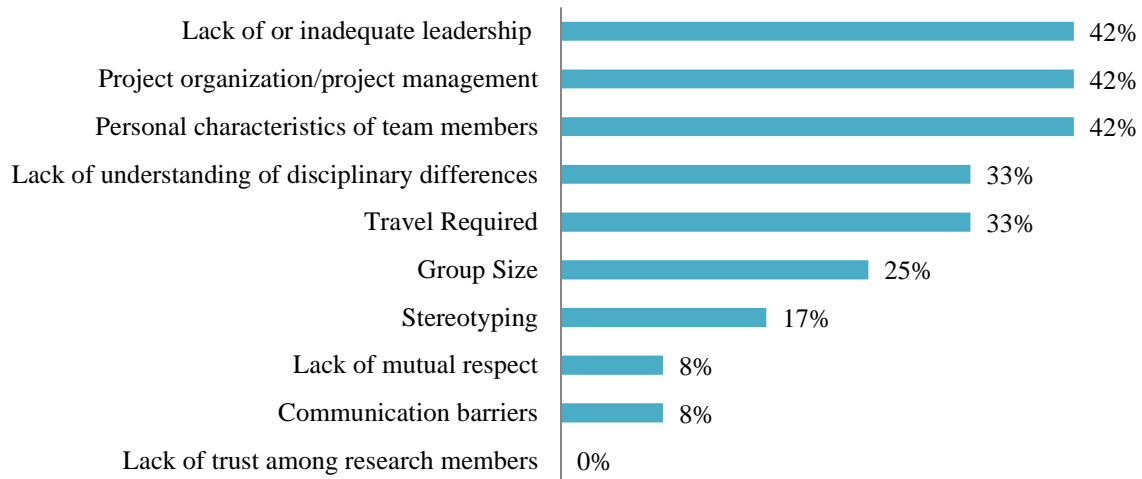


Figure 38- Which of the following epistemological challenges you experienced or anticipate to experience? (Choose all that apply).

Theme 3. Theme 3 indicated a range of teamwork challenges, including: “*project organization/project management*”, “*communication barriers*”, “*lack of understanding of disciplinary differences*”, “*travel required*”, and “*group size*” (Figure 39).

Theme 3: Teamwork Challenges



Figure 39- Which of the following epistemological challenges you experienced or anticipate to experience? (Choose all that apply).

Theme 4. Theme 4 indicated “group size”, “lack of understanding of disciplinary differences”, and “project organization/project management” as the top teamwork challenges (Figure 40).

Theme 4: Teamwork Challenges

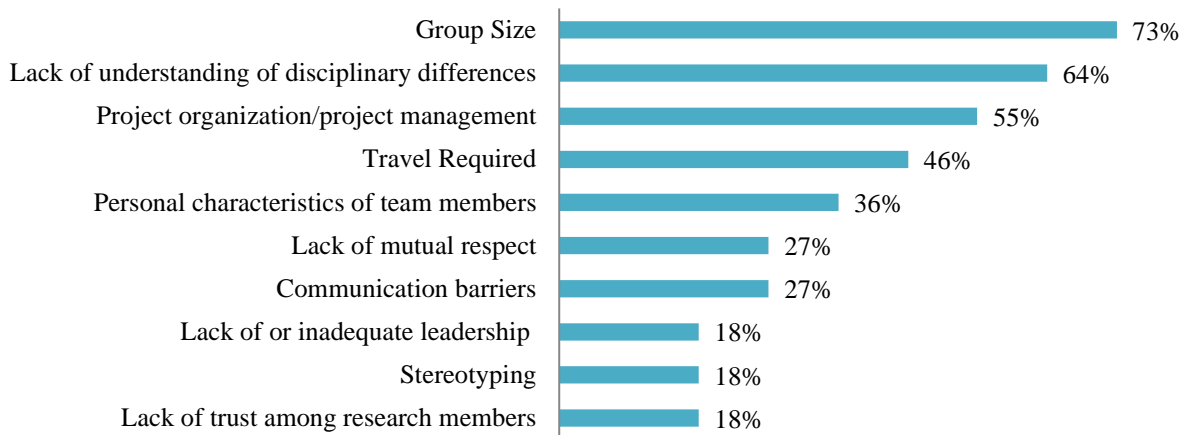


Figure 40- Which of the following epistemological challenges you experienced or anticipate to experience? (Choose all that apply).

Conclusion

Like any skill, interdisciplinary approaches to research can be learned and improved over time. The path to interdisciplinarity necessitates self-reflection on both the strengths and areas of improvement that a team holds. The next section will summarize some of the team's strengths and areas of improvement, giving some broad takeaways and lessons learned for moving forward.

Communication Processes

Communication skills, both scientific and interpersonal, are critical for the cohesion and movement of an interdisciplinary project. Our research indicates that members of the SEANET team are equipped with many of the needed communication tools necessary to effectively communicate across disciplines and fields and have similar decision making preferences. In the section below, collective communication competencies and decision making preferences are laid out with results and suggestions for moving forward.

Collective Communication Competencies. Collective communication competencies are team interactions that have the ability to influence the collaborative process and objectives. The SEANET team demonstrates high levels of collective communication competencies (CCC) across themes, disciplines, disciplinary ranks, and genders. These findings point towards a team that is attentive to interpersonal communication practices, including active listening, demonstrating presence, and paying attention to disciplinary differences.

While collective communication competency levels are high among researchers, our research indicates that SEANET researchers do differ in these levels in relation to their roles and motivations. Researchers bring their roles related to disciplinarily, rank and gender into these complex systems of relationship and meaning making. Having an understanding of how these roles affect the eventual success of a research project is important to facilitating productive collaborative endeavors. The

findings of the present study suggests that while roles may have a relational influence on collective communication competencies, motivations to engage appear to play a larger part in these systems of collaborative meaning making. While we did not find definitive evidence of university status affecting collective communication competence in the research teams, the results indicate enough of a hint of this as an influence to suggest that future research could look at this more systematically across more research teams. We also found that motivation, sustainability science identity and opportunity for funding, affect collective communication competency significantly when the influence of disciplinary affiliation is also examined (but not when university status is examined, and only opportunity for funding when gender is examined). This suggests to us that future research should probe further the differences in disciplinary affiliation in perhaps different orientations toward what sustainability science identity means and assumptions about the need or orientation toward seeking out funding opportunities; the gender effect might be probed this way as well. This research is limited by the number of participants in the study. It should also be acknowledged that the present investigation involves responses from only one medium-sized collaborative team and generalization of these results is limited. Furthermore, the results of this study were limited by the self-report method and quantitative analysis used. Future research might benefit from approaching this study through a qualitative analysis.

However, the present study does contribute to knowledge, as it offers some insight into the relationship between collective communication competency and the roles and motivations that individuals bring to these collaborative endeavors. The findings, although not definitive, are suggestive of different disciplinary affiliation ways of approaching and thinking about, and motivations for being involved in, collaborative research projects. Furthermore, the results support

the reflective notions of the scholars in this field on the relationship of the individual roles that researchers bring to these endeavors and the collective communication competencies expressed.

Having an understanding of how these roles affect the eventual success of a research project is important to facilitating productive collaborative endeavors. Studies of interpersonal dynamics and group functions have recognized that through self-reflection, individuals can become more aware of their communication behaviors and the impacts those behaviors have on others. Further, such attentiveness can lead to more complete control over relationships and reactions. We suggest that SEANET researchers dedicate time to talk about communication preferences, which could include practices of critical reflection and open discussions about differences. This can begin by self-awareness of communication practices including e-mails, meetings, and interpersonal interactions. Questions to consider and ask oneself could include: How are my communication practices affecting this group? How could I improve these practices?

Decision Making Preferences. An awareness of decision making preferences can help lead teams through conflicts and better strengthen and encourage modes of input throughout the team. Overall, results indicate preferences for decision making processes where every member has a degree of influence but one or a few people have final authority, and where students are actively involved in the decision making process. When means between decision making preferences were compared among themes, results indicate that there was a statistically significant difference between themes in relation to some preferences. Theme 1 and Theme 4 indicated significantly higher agreement with the statement “*a small group of people within the team should make most of the decisions,*” compared to Themes 2 and 3. Additionally, there was a statistically significant difference between themes in relation to the preference “*students are not actively involved in decision making,*” with Theme 3 and Theme 4 indicating significantly higher agreement compared to Theme 1 and Theme 2.

It is recommended that the SEANET team as a whole be aware and discuss differing decision making preferences in relation to students' involvement and the management team decisions. Because themes differ in the areas of student involvement in decision making and small group decision making (i.e., a small group of people within the team making most of the decisions) the team as a whole must more concretely define the tasks assigned to specific roles within the group and their decision making structure. Having conversations about preferred decision making processes and having a clear method for making decisions will likely save the team and themes from disagreements in the future.

Shared Problem Frames and Visions of Success

Shared vision among collaborators is essential to the foundation of an interdisciplinary team. While it is important for members to have a collective sense of the team, this does not mean that all team members must see the team in exactly the same way. Team members may each have a slightly different sense of the team's vision depending on their roles and responsibilities within the team or their stage of career development. What is most important is that each person understands the *overall* goals of the project and that the activities and responsibilities of each individual and group within the team are integrated in a collective effort to reach them.

Our research uncovered that the SEANET team does indeed hold a collective vision in terms of challenges and projected outcomes. The anticipated or experienced challenges, which dip into institutional, epistemological, and team work sets, are common within large interdisciplinary collaborative teams. In the sections below we lay out the challenges by set and further by theme, in cases that challenges varied by theme, and then provide suggestions for moving forward.

Structural Challenges. When asked about structural challenges, the team indicated "*funding challenges/lack of funds,*" "*time demands not supported,*" and "*first author value*" (i.e., greater

recognition or worth placed on first authorship) as the top three challenges. When the relationship between themes and experienced or anticipated institutional challenges were examined, our findings indicate that experienced or anticipated institutional challenges may vary by theme, with certain themes, on average, assigning greater or lesser importance to them. The relationship between theme and the following two institutional challenges were significant: “*time demands not supported*” and “*first author value*”. Theme 1 had a higher than expected indication of “*time demands not supported*” and Theme 3 had a lower than expected indication of this institutional challenge. Theme 1 had a lower indication and Themes 2 and 4 had higher indications of “*first author value*” than expected.

It is not unusual for researchers to suspect that they will bump into troubles in procuring support for and conducting successful interdisciplinary research. In large teams, researchers are working with a common pool of funding, with each member coming to the table with different programmatic emphases. Having open conversations about funding opportunities and making resources available for researchers to learn more about such opportunities could be one way for the team to tackle this challenge.

The other two challenges, “*time demands not supported*” and “*first author value*,” suggest more of an institutionally structured challenge. The SEANET team functions within the context of multiple and interconnected academic institutions. There are multiple systemic factors that could be contributing to these challenges, including lack of institutionalized support for collaborative endeavors. In many ways, this calls for more than institutionally voiced support for collaborative efforts. Procedures and criteria must be put into place in order to assess the accomplishments and contributions of the collective efforts of scientific interdisciplinary teams, as well as of the individual members who contribute to those efforts. These structural challenges will not be fixed overnight but will require changes to the system as a whole. Such structural changes to institutional support and recognition are essential for facilitating and sustaining team approaches. We suggest that such team members advocate on behalf of themselves and their

experiences at the institutional level in order to move these types of changes forward. This could include members of interdisciplinary teams opening lines of communication with university boards and funding agencies in order to report the challenges.

Epistemological Challenges. Researchers are trained in a discipline, and over time acquire a specific language and learn the methodological paradigms that have amassed in that particular discipline. These specialized ways of knowing and working serve an important function within disciplinary work, but can present obstacles to interdisciplinary work. In terms of these types of epistemological challenges, the SEANET team indicated “*lack of common language,*” “*clarifying research problem & integrating objectives,*” “*different disciplinary theories/knowledge,*” and “*different disciplinary methods*” as the top epistemological challenges. When themes were compared, no significant relationships existed between themes and experienced or anticipated epistemological challenges.

Epistemologies steer researchers’ daily interactions with knowledge and influence the amount of validity interpreted via differing research methods and data sources. In order to grapple with the epistemological challenges listed above, researchers much commit to fostering an environment that promotes opportunities to become oriented in new intellectual communities. Strategies could include respectively addressing and resolving debates over science or scientific results, encouraging an awareness of and embracing of the concept that differing scientific opinions may hold kernels of new ideas, and providing an environment and opportunities for team members to informally talk about their work.

Teamwork Challenges. Teamwork challenges include many of the daily nuts and bolts team interactions and dealings. As a whole, the SEANET team indicated “*travel required,*” “*project organization/project management,*” and “*group size,*” as the top teamwork challenges. When themes were

compared, the relationship between theme and *travel required* was significant. Themes 1 had a higher than expected indication of *travel required* and Themes 2 and 3 had a lower than expected indication.

Given the team's geographical spread across Maine (at UNE, etc.), especially Theme 1's, the indication of travel required as a challenge is to be expected. While certain meetings may require face-to-face interactions, there are likely some meetings where it is possible for members to be virtually present. The SEANET team does have communication technologies in place to make this type of virtual space possible. This result could be indicative of some of these technologies lacking in some way. In order to balance this challenge as best as possible, we suggest that the SEANET management team begin conversations with team members about required face-to-face meetings and come to agreements on other meetings where communication technologies could be used. Further, team members must be willing to talk about challenges experienced with such technologies.

Visioning for Success. Recognizing shared and divergent project outcomes is essential to a team's foundation. The collective visions for the success of this project were indicated as "*peer-reviewed publications,*" "*peer reviewed publications that are valued by your department,*" "*new research methods or tools,*" and "*research translation to policy education or industry*" as the top experienced or anticipated project outcomes. When themes were compared, results indicated a significant relationship between theme and "*research translation to policy, education, or industry.*" Themes 1 and 4 have a higher than expected reported level of this project outcome while theme 3 has a lower than expected indication of the outcome. This result indicates that project outcomes that participants experience or anticipate may not occur uniformly across themes, but rather, may vary for at least one type of outcome.

These visions for success are diverse, and practical. Members of the team indicated kinds of outcomes that the National Science Foundation will expect from the project, specifically publishing

papers, developing new research methods or tools, and translating research in policy, education or industry. In order to sustain these collective visions of success and to enhance the overall vision, we suggest that encouragement of sharing and mutual learning across disciplines come from PI's and the project management team. On a theme by theme level, we suggest that themes discuss as a group each member's accomplishments and challenges and make connections to how these relate to the project-wide mission.

Promise of Partnerships

Centrally important to the resilience of a collaborative project is the recognition of the similar and diverse motivations that are present within a team. In many ways the SEANET team is already demonstrating similar aims and actions related to this area. In the section below, we summarize the team's motivations and avenues for collaboration as well as SES familiarities, with the intention to communicate the promise of partnerships within the team.

Motivations and Avenues for Collaboration. Motivations to collaborate can vary across disciplines and fields. Often, the most successful teams have a handle on such motivations and clear paths forward to encourage such actions. Some examples of collaborative motivations include: obtaining new insights into work through discussions with colleagues who come from differing disciplines, reading journals or publications from outside of their primary field, and participating in working groups or committees with the intent to integrate ideas with other participants. SEANET participants indicated the highest levels of agreement in relation to motivations as: interest in learning from people with different types of knowledge, the satisfaction experienced from taking on interesting challenges, and the drive to be the type of scholar who works across disciplines. When themes were compared, motivations to engage did not

significantly differ between themes, indicating respondents share similar motivations to engage in the project.

It is important to note that these shared motivations suggest that the SEANET team of researchers are driven by the aim to experience and learn from the challenges and opportunities that interdisciplinary collaborations yield. In many ways this points toward strong promises of partnerships across themes and disciplines. In order to maintain and encourage such partnerships, opportunities for these types of partnerships must be available for team members. Recognizing that respondents indicated that “*attending meetings within their theme*,” “*SEANET hosted events*,” and “*attending meetings outside of their theme*” were the most common ways to identify potential collaborators is an important piece of this sustainment. Providing spaces for these types of interactions to take place would be wise. Casual settings such as coffee hours could be one way to facilitate these types of interactions.

Social-Ecological Systems (SES). As a whole, the researchers indicated a lack of familiarity with Social Ecological Systems prior to the start of the project. Additionally, results show neutral (*neither agree nor disagree*) to positive view of and interest. These results demonstrate that while the SEANET team is coming into the project not knowing much about SES, they do not indicate an unfavorable attitude toward it.

Given the framework’s role in the project, it is imperative that there is a team-wide commitment to the promotion and education about the framework. Fortunately, the results suggest that there is room for shaping such opinions and knowledge. We suggest that the SEANET team as a whole, and individual themes, earmark time to discuss the framework and its applications to research. This could include team-wide workshops, theme-by-theme conversations, and/or the availability of information and resources on the framework.

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CHAPTER 3

UNDERSTANDING SUCCESS ON INTERDISCIPLINARY RESEARCH TEAMS

Introduction

Forms of interdisciplinary collaboration have grown in recent years as funding agencies, universities, and research units recognize the need to fill gaps in knowledge and to tackle complex societal problems that cannot be adequately addressed by single disciplines alone. As this mode of research organization is increasingly being used to investigate the dynamic and interdependent needs of science and society, a growing body of literature is focused on the processes of team success. Studies that focus on the processes of these interdisciplinary teams present understandings of the capacities, contexts, and resources that collaborators draw upon in their collaborative interactions that contribute to interdisciplinary team success. Scholars in the “science of team science” field, for example, have developed conceptual frameworks, establishing classifications of contextual influences that serve as indicators of the success of collaborative endeavors as well as practical parameters to measure team process and integration (Armstrong & Jackson-Smith, 2013; Stokols et al., 2003; Wagner et al., 2011). Likewise, literature from the field of communication has focused on processes, structures, and outcomes associated with interdisciplinary teams (Thompson 2007, 2009; Fraser & Schalley, 2009; McGreavy et al., 2013, 2015). Taking a systems approach, these researchers assess how patterns of interaction can influence the success of these teams, identifying patterns of communication behavior and the quality of interpersonal relationships that affect how group goals are accomplished (McGreavy et al., 2015; Thompson, 2009). At the same time, however, several scholars studying these teams contend that current definitions of research success are narrowly defined to outputs that are easy to measure (i.e., publications, citation rates) (Bark et al., 2016;

Cheruvilil et al., 2014; Goring et al., 2014; Sonnenwald et al., 2007; Stokols et al., 2008), thus leaving process orientated measures – often assessing interpersonal relationships – out of the conversation (Wagner et al., 2011). In turn, calls for new definitions of research success have been made, with scholars pushing the boundaries of defining research success, including a regard for the collaborative process (Cherulelil et al., 2014).

Spurred by the recent calls for expanded measures of success, and the apparent tension between differing measures, this research asks, “How do collaborators themselves construct and pursue the idea of success?” The following study examines how collaborators define success, providing evidence of how collaborators contend with deeply normative dimensions of interdisciplinary success, and providing insight into how scientists and research agencies might shape research agendas and their relationship to society moving forward. Based on semi-structured interviews with sustainability scientists from an interdisciplinary, social ecological systems (SES)-driven, National Science Foundation (NSF)-funded grant in the Northeast U.S., this study uses participants’ narrative accounts to progress our understanding of success on sustainability science teams and address the tensions arising between differing visions of success. In so doing, we propose not simply to identify rigid formulations of success and put them into boxes; rather, we intend to create a basis for a “deeper dialogue amongst sustainability scientists” (Miller et al., 2013). That is, we intend study results to contribute to more open and informed discussions about how we gauge success within sustainability science collaborations, forming a foundation for appreciation and exploration of the disciplinary and normative dimensions of this work.

Literature Review

Many terms exist to describe collaborative research including: multidisciplinary, interdisciplinary, and transdisciplinary. These terms distinguish between levels of working with and across diverse expertise and disciplinary assumptions (see Stock and Burton (2011) for contextual information on this terminology). This paper uses the terms “interdisciplinary” and “collaborative,” often interchangeably, when discussing the research. For the present purpose, we define interdisciplinary and collaborative research as an approach that involves a group made up of researchers from different disciplines or fields who are working together to integrate some aspect(s) of their own disciplinary approach and method in order to jointly tackle a research problem as a team. The term IDR is used throughout the manuscript to denote interdisciplinary research teams (IDR).

Understandings of success may diverge amongst the key players within a given sustainability science collaborative team. For the context of this study, we define sustainability science as a process of inquiry that works to engage multiple stakeholders and their varying patterns of thought, opinion, approach, and identity in order to foster a space that propagates knowledge creation designed to inform and support action (Lindenfeld et al., 2012; McGreavy et al., 2013). While no known research has directly considered any of the following examples, they are nonetheless suggestive of ways in which visions of success may differ between those involved in these interdisciplinary teams. Consider, for example, the following: several researchers are working together on a collaborative team, tasked with examining an emergent issue in a coastal region. Researcher #1 considers the pragmatic outcomes of a new coastal management practice, such as improvements in leasing policies, as “successful.” On the other hand, Researcher #2 values knowledge generation goals and publication outputs. All the while,

Researcher #3, though valuing and working toward the measures of success mentioned above, is also concerned with the nature of the process needed to achieve these goals. Which researcher is correct in his/her vision of success? Is each vision of success equally useful on its own terms, and/or is one version “better” or “less” than the other? Who decides? Further, if funding agencies are involved, how do these answers affect resource allocation? The following literature review begins to explore these areas by reviewing how success on IDR teams has been characterized in the literature, and then suggests how these ideas contribute to the present study.

Process Orientated Views of IDR Teams

Science of Team Science. Largely in response to concerns about the value and effectiveness of public- and private-sector investments in team-based science, the “science of team science” field has emerged in recent years (Bennet et al., 2010). Incorporating a blend of conceptual and methodological strategies, the science of team science field focuses on expanding our understanding and enhancing the outcomes of large-scale collaborative research programs through an emphasis on the antecedent, process, and outcome factors involved in these efforts (Armstrong & Jackson, 2013; Bennet et al., 2010; Stokols et al., 2008a). Recognizing the “readiness” of a team to succeed (Hall et al., 2008), antecedent factors reflect user-centered factors such as values, expectations, and prior experience, as well as and structural and institutional contexts (Armstrong & Jackson, 2013; Wagner et al., 2011). Process factors include capacity building actions, whether intentional or unintentional, which facilitate or improve interpersonal or intrapersonal relationships among members who are expected to collaborate (Stokols et al. 2008). Outcomes of team science processes can be immaterial, such as mutual understanding and feelings of trust, or include quantifiable indicators of scientific productivity, such as publications and successful external granting (Armstrong & Jackson, 2013).

Recent studies also investigate the facilitating and constraining factors on collaborative teams, establishing a classification of contextual influences that can determine the success of collaborative endeavors as well as be used as practical parameters to measure team process and integration. For instance, in a formative review of empirical evidence for contextual determinants of team performance across varying areas of team science research literature, Stokols et al. (2008b) present a six-pronged success typology, including: intrapersonal, interpersonal, organizational/institutional, physical/environmental, technologic, and sociopolitical factors. Additionally, Chervelil et al. (2014), drawing from the authors' collective experience on such teams, and the science of team science literature (e.g. Stokols et al. 2008a), describe the characteristics of "high performing" teams and strategies for maintaining such teams. They describe diversity (e.g., ethnicity, gender, culture, career stage, points of view, disciplinary affiliation); interpersonal skills (e.g., social sensitivity, emotional engagement); team functioning (e.g., creativity, conflict resolution), and team communication (e.g., talking and listening) as the characteristics of these successful teams.

Systems View of Collaborative Teams. It is important to note that the overall landscape and boundaries of the science of team science field are challenging to determine (Bennett et al., 2010; Stokols, Hall, Taylor, Moser, & Syme, 2008) and that not all research endeavors that examine team processes identify under the auspices of this field. Other recent studies have also investigated and identified processes that lead to success in sustainability science collaborations (Fraser & Schalley, 2009), but have taken a systems approach. Research in this tradition has found that success is related to the patterns of communication behavior and the quality of the relationships formed as a product of the teams (Fraser & Schalley, 2009; McGreavy et al., 2015; Thompson, 2009). In a formative, ethnographic study of a large interdisciplinary team, Thompson

(2009) reports that interactions described as “collective communication competencies” (CCC) on the team level influence the collaborative endeavor and its movement toward objectives. Challenging statements in a positive manner, inviting opportunities for reflexive talk, demonstrating presence, and using humor are processes that influence the team’s ability to communicate effectively. Conversely, acts of blatant boredom, intentional challenging of expertise, and sarcasm can compromise collective communication competencies (Thompson, 2009).

McGreavy et al. (2015) take this research a step further to identify important communication dimensions of sustainability science teams, when viewed as complex systems. These researchers explore how communication within sustainability science teams influences the results related to team learning and progress toward group goals. Building on the work completed by Thompson (2009), these scholars utilize a mixed methods approach, developing quantitative instruments to measure collective communication competencies. Their results demonstrate that differing styles of decision making and communication competencies influence mutual understanding, inclusion of diverse ideas, motivations to engage, and progress toward sustainability related objectives.

The Call for Expansion

Beyond process approaches to IDR teams, scholars looking at the more commonly used rubrics of success have gone on to suggest that the measures of interdisciplinary success typically used to evaluate interdisciplinary teams remain a challenge (Balvanera et al., 2017; Hasan & Dawson, 2014). Several scholars contend that current definitions of research success are narrowly defined as outputs that are easy to quantify (Cheruvilil et al., 2014; Goring et al., 2014; Sonnenwald et al., 2007; Stokols et al., 2008). One of the most conventional indicators of

research success is bibliometrics (Bark et al., 2016). In essence, bibliometric methods utilize a quantitative approach in order to describe, evaluate, and monitor published research (Zupic & Cater, 2014). Traditional bibliometric measures include citation based indicators such as co-authorship, citations, and co-citations (Wagner et al., 2011).

A limited body of research examines these mainstream measures of success within interdisciplinary collaborative settings, such as bibliometrics, and call for expanded measures that focus specifically on the value of process. Goring et al. (2014) identifies and problematizes two traditional forms of success within academic research careers. They note that the number of grants secured and dollar amount awarded, and peer-reviewed publications do not adequately reflect contributions of team members, arguing that collaborative team effort measurements need to, “evolve to explicitly value all of the outcomes of successful interdisciplinary work” (Goring et al., 2014, p. 43). These broadened views of success within research scholarship include: creating broader impacts beyond traditional publication metrics, recognizing and rewarding administrative and mentoring duties, as well as communicating and sharing the knowledge created within these efforts to the general public.

Along these lines, in a seminal literature review on both quantitative and qualitative measurements of outputs of IDR teams, Wagner et al. (2011) find a need for more holistic metrics to measure IDR teams. They note that the current measures of success within IDR, which rely heavily on output measures, may offer an inaccurate assessment of IDR teams, as IDR practices are dynamic and encompass more than just the end products (Wagner et al., 2011). These scholars point toward integrated approaches to IDR measurement, linking “process” orientated approaches by utilizing tenets from the science of team science tradition with “output” measures (i.e., bibliometrics). Likewise, Cheruvelil et al. (2014) conclude their “high performing

team” proposition (described above) by calling for new definitions of collaborative success – ones that promote, recognize, and value collaborative processes.

Summary: Making Sense of IDR Success

As the literature reviewed above has shown, the understanding of IDR team success is a central and relevant focus of much contemporary research; however, in many ways, what researchers mean by “success” remains black-boxed – that is, not sufficiently problematized. Current literature on the success of these teams reveals a tension between various attributes of success, including both product- and process-oriented outcomes, and what is traditionally valued in academic settings. While these studies allow us to understand the differing ways success can be viewed within the IDR team setting, we do not necessarily understand how those who are a part of these teams are making sense of the seemingly abstract notion of success. We couple this notion with the calls for expanded measures, driving our study toward better understanding how those involved in these collaborations choose to construct and pursue (possibly differing) visions of success. More specifically, we ask:

RQ1: How do collaborators form definitions and make sense of success on a large, sustainability science, interdisciplinary team?

Method

Sampling and Recruitment

The sampling frame for this study included graduate students and faculty researchers currently involved in a large, five-year, \$20 million National Science Foundation (NSF) - funded grant, Sustainable Ecological Aquaculture Network (SEANET), aimed at increasing research and development activities that will assist in the further growth of Maine’s aquaculture industry. The

authors of this study are affiliated with the team being studied and obtained Institutional Board Review (IRB) approval before embarking on the research. This research is part of a larger study conducted under the auspices of SEANET, which involves a quantitative analysis of survey data.

The team studied is comprised of approximately 60 faculty and staff and 20 graduate students spread across more than 9 academic and research institutions. SEANET includes four sub-groups or “themes” organized around specific aspects of the project, including: (a) ecological and sociological carrying capacity, (b) aquaculture in a changing ecosystem (c) innovations in aquaculture, and (d) human dimensions. Each theme includes members from varying academic disciplines, including: marine sciences, computing and information science, aquaculture biology, engineering, food science, chemistry, economics, anthropology, and communication.

Respondents included graduate students, including those pursuing MA, MS, and PhD degrees, and faculty, including assistant, associate, full professors, and one post-doctorate, employed by a variety of institutions involved in SEANET. Other respondents included two individuals involved in the management and facilitation of the grant, as these individuals had significant experience working as a part of these teams. Due to the team’s wide-ranging disciplinary affiliations, ranks, and institutional affiliations, a purposive sampling approach was used to ensure a representative sample on several dimensions (i.e., disciplinary affiliation, rank, institutional affiliation) (Tracy, 2013; Welman & Kruger, 1999). Two interviews of the 26 were removed due to the respondents not explicitly answering the questions pertaining to the present research, leaving 24 interviews to be used in the analysis.

Interviews

Following a grounded theory approach (Corbin & Strauss, 2008) to data collection, 26 in depth, semi-structured interviews were conducted between June and November 2016. Interviews ranged from 24 minutes to an hour and a half, with an average length of 37 minutes. All interviews were conducted in person and in a semi-structured manner. While interviews fluctuated in length and order, all respondents were asked questions under three broad categories, which included: (1) identity as a researcher and as an interdisciplinary researcher; (2) perceptions of interdisciplinary work; (3) attribution of communication in interdisciplinary work. The full extent of results from all three categories are not used within this paper; instead, only responses related to respondent perceptions of success, including the question “what counts as success on interdisciplinary collaborations?,” and narrative accounts in response to the prompt, “can you tell me a story of a time or experience when you felt successful on an IDR team?”

Analysis

Interviews were recorded and transcribed, then coded initially line-by-line. In the process, the first author recorded memos (Corbin & Strauss, 2008), giving form to emergent codes. NVivo qualitative data analysis software was used to keep track of and gather quotations within emergent codes. This work subscribed to validity measures consistent with grounded theory technique, including a high level of methodology and coding transparency, such as labeling and categorizing phenomena, grouping concepts at an abstract level and then moving to developing main categories and their sub-categories (Corbin & Strauss, 2008). This lent to a extensive, iterative process of working closely with the data and the literature to pursue alternate justifications for data trends, while also working with the model in progress to embrace data that

did not immediately conform to researcher understandings and other emergent data (Corbin & Strauss, 2008)

Results

In this section, we present themes that emerged from interviews that serve to illustrate varying approaches to and implications for participant-defined collaborative success. The presentation of results is organized around what we characterize as two forms of success emerging from the interviews: (1) purpose driven; and (2) capacity building. Respondents' definitions of success almost always conformed exclusively to one or the other category, with the exception of two respondents. These individuals “had their feet in both rivers” – responding in ways that suggested elements of both purpose driven and capacity building definitions of success. Given their unique standing, these respondents will be discussed separately, below.

The first construct, purpose driven forms of success, concerns the degree to which goals and measurable outputs are achieved. Respondents described deliverables that ranged from broad level accomplishments, such as the achievement of project goals, to more specific examples, such as academic and application based deliverables. The second construct of success concerns the development and sustaining of relationships and knowledge capacities– in other words, working to build a network of researchers who understand one another's work and can rely on each other in professional and interpersonal ways. Each construct and the emergent themes within are described below.

Purpose Driven Forms of Success

The first construct focuses on purpose driven forms of success, with 14 respondents describing this form of success (hereafter, n indicates the number of participants who mentioned,

and thus are grouped under each construct or emergent theme). When making sense of success, respondents in this group described it in terms of measurable outputs, often involving problem solving that led to demonstrable deliverables. A linear tone was set within these responses, as respondents described the end product of their work as representing the success.

For example, a faculty member (F1) from engineering noted, “a simple yardstick for how well the collaboration has worked is whether we achieved the goals we set out from the beginning.” The necessity to produce outcomes was frequently mentioned as one of the determining factors of collaborative success and this purpose driven definition of success runs throughout this construct. Respondents identified two interrelated forms of purpose driven success: mainstream measures of success and sustainability science goals. These emergent themes are described below.

Mainstream Measures of Success. The first emergent theme within the construct of purpose driven success included kinds of outcomes that are recognized as mainstream measures of success within IDR teams (n = 9). These outcomes included the achievement of project goals and academic deliverables. Broadly speaking, respondents described success as the completion of a set goal. As a graduate student from engineering (GS2) put it, “I think that the accomplishment of a given goal defines success. I think that it should be verifiable.” Part of this construct also had to do with deliverables that tend to be valued in academic settings. For instance, respondents cited publishable papers, follow-up grant money, and conferences attended as examples corresponding to this theme. As one faculty member (F7) from the biophysical sciences described, the measurement of success starts with solving a problem and then leads to academic deliverables:

There's just being able to answer the question, but then get outcomes that are again like publishable papers or new research grants as follow-on from those collaborations. Those would all be, I think, metrics for success.

Further, when asked if she could tell a story of collaborative success, a faculty member from the biophysical sciences (F7) recounted a meeting that resulted in talk about future academic deliverables. As she said:

I think we made a lot of progress.... this was across institution too. And we talked about a paper, and we talked about some follow-on research, and actually we wrote two follow-on proposals shortly after that, so it was – there were – a lot came out of it. It was – it felt like – I think everybody was like "Oh." We came away from the day feeling like "That was really productive." [Laughs] And it was.

As mentioned above, part of this emergent theme was focused on publications, which included discourse that could be characterized as both supporting and challenging the notion that these products be viewed as quintessential metrics for success. One biophysical scientist faculty member (F4), recognizing publications as counting as success, noted that he would expect "collaborative successes being recorded systematically," with the author indexing value going up for collaborators. Further, he contended that these publications should reach outside collaborators' home disciplines, stating:

You hope to see new publications using new collaboration teams and not in journals that you would necessarily expect. So you may see a chemical journal publishing a sea lice paper based on this polymer. You may see an engineering journal publishing a micro fluidics paper on sea lice, and that I would count as a success.

Relevant to this discussion, and explored further in the theme we refer to as “sustainability science outputs” (below), other respondents pushed back against the metric of academic deliverables, specifically published papers. Demonstrating this, one biophysical graduate student (GS5) noted, “there’s a lot of other things other than academic papers.” Other respondents noted similar understandings, often “othering” themselves from those who believe in such measurements. A faculty member from the biophysical sciences (F6) noted that academic articles do not always reach the audiences for whom the research might be most impactful, stating:

I was just reading – well, I’ve stopped reading it [review board assessments], but I noticed that they really did rely on bibliometrics, so they’re going to measure success by what we publish. And, you know, I know the commissioner of marine research pretty well. I’ve known a few of them – I can’t think of any of them that subscribe to a scientific journal. Their staff might, but the person in that hot seat isn’t going to read scholarly works, just not going to happen. So that’s not even a good measure of success, I don’t think.

Sustainability Science Outputs. The theme of sustainability science outputs ($n = 9$) was the second emergent theme within the construct of purpose driven success. Responses indicated that, on a broad level, individuals subscribing to this perspective see success in terms of sustainability science research outputs. Echoing discussion above, several respondents pushed back against “mainstream measures of success,” positioning themselves in a way that we identify as representative of sustainability scientists — specifically, by describing problem-focused approaches to working across disciplines and with diverse stakeholders in order to “link

knowledge to action” (Cash et al., 2006; Miller, 2012). As a faculty member (F13) from the biophysical sciences stated:

From a researcher’s perspective success is in the paper, that theoretically, other people can make an argument that no one ever reads. I like to think of success as either in terms of, A), to just help improve policy, tweaking existing systems, the overall benefit to a large group of people, and then I think there’s an economic success story to this –does this information we produce, for instance, about the environment, help people make economically sustainable and environmentally sustainable decisions about sighting aquaculture? That would be, I think, success.

Others expressing opinions categorized within this theme, while not pushing back as explicitly against “mainstream measures,” described making a difference with the information produced, and providing real world solutions was seen as central to this practice. One graduate student (GS1) from the biophysical sciences noted that success is doing work that goes beyond “research for the sake of research,” explaining, “I think that successful integration of gathering all of the information and then trying to get an answer that’s useful for people, I guess that’s a good baseline to have.”

Capacity Building Forms of Success

Responses from interviews ($n = 12$) suggested that some collaborators tended to consider what we refer to broadly as “capacity building” as a form of success within interdisciplinary settings. When making sense of success, respondents in this group recognized a commitment to constructing new configurations and arrangements within the collaboration in order to build capacities for sustainability work to take place. This capacity work included the development and

sustaining of the relationships and knowledge capacities, as respondents described efforts to build a network of researchers who understand one another's work and can rely on each other in professional and interpersonal ways. Distinct but not completely unrelated to purpose driven success, this viewpoint still recognizes deliverables as a desirable consequence of success but primarily focuses on the connections that take place along the way – in many ways, capturing the essence of “the journey rather than the destination” mindset. According to a graduate student (GS7) from the social sciences:

I think a lot of the success comes from the process rather than the outcomes. For us, because it's a grant, we have to have certain outcomes achieved and certain things met....If you're only focusing on your own research and trying to tie it into the bigger framework at the end, you're not –when this grant dissolves, you're not going to have a sustainable system of researchers.

Similarly, respondents seemed to be focused on the pragmatic side of capacity building, not just the “touchy-feely” quality of relationship building. That is, respondents recognized that with bolstered capacities, both in terms of interdisciplinary relationships and robust knowledge basis (e.g., of varying epistemologies, research methods, etc.), the team would be poised to accomplish more. According to a faculty member (F10) from the biophysical sciences:

I think that it's [success] when the research becomes fun and everybody's excited about it and not just when something gets accomplished. I mean, yes, it adds to that excitement when you can get a grant funded and when the publications start to come out of that work, but I think it's about putting together a group of people, students included, that

have mutual respect, and they know that they can ask questions and they can move through the process quicker.

As alluded to above, respondents recognized the two cross-cutting themes that we refer to as “relational capacities” and “knowledge capacities” within this construct of success. These emergent themes are described and explored below.

Knowledge Capacities. Respondents described connecting to and understanding fellow collaborators who hail from disparate disciplines and backgrounds as a form of success ($n = 6$). This included going beyond representational explanations of another’s discipline in order to form an understanding of the nuances of the discipline and the ability to communicate with others on an academic level. One faculty member from the social sciences (F2) recognized “deep understandings” of fellow researchers’ epistemological values as a success. As she expressed:

I think sort of an even deeper level [of success] is when you and a colleague from different disciplines can sit down and say, “Okay we’re gonna study this because this. And so what are some questions we could ask?” And even start to have an understanding of what your colleague’s questions might be, and even some of the start to how they might address it.

In this same vein, one respondent, a graduate student from the social sciences (GS7), noted the process of “constantly showing up” in order to develop these deep understandings. Her use of this phrase surpassed being present physically, as she explains:

I think the process of constantly working together and showing up and actually understanding where other researchers and other themes are coming from and finding connections to your own work, or connecting to someone else.

When asked to tell a story of success, a faculty member from the social sciences (F15) recounted an experience with a natural scientist in which neither of the parties had an exact idea of the other’s research methods at the beginning of the collaboration. As she described, “It took us a

while to get there where we understand each other's methods to the point where we can talk about things." And when her collaborator finally came to the understanding that social science is not synonymous with providing outreach, this researcher explained feeling the most successful.

As she describes:

So I felt that moment of wow, we get it. That was a successful moment for me. Oh, now she understands, and she said what she said. Like oh, she (the social scientist) has questions and research that she is doing. So I think just moments where it's clear that oh, you get what I'm doing. That's sort of a moment of success...you understand why I'm asking that question. You understand why I need a sample like this.

Relational Capacities. Engendering, as well as maintaining, relationships ($n = 8$) was also an emergent theme within the interviews that described success as capacity building. According to the respondents, part of interdisciplinary success is building relational capacities in order sustain and forward the research taking place. Within this grouping, several respondents described success in collaborative settings as being contingent on the "people"—that is, both people with strengths in separate areas, as well as people on whom you can rely in professional and interpersonal ways. According to a faculty researcher (F8) from the biophysical sciences:

So interdisciplinary research: yes, it is about the science; it is about the work; but also it's about the people and the relationships. And I think the best—at least in my case, I've worked with many- this is my 20th year here. I don't know, I've probably done research with 30, 40 different people. But the most successful ones were the ones that I actually liked hanging out with 'em, with people. Those are always the most successful ones.

Tying back into knowledge capacities, several respondents described successful collaborations as involving people who respect and care for the work that fellow collaborators are taking part in. Respondents described teams that have not been "harmed" by the varying patterns of thought, opinion, approach, goals, and identity within the collaborative setting. As one graduate student (GS3) from the biophysical sciences, put it, "I would say just having a research project, 3-5 years, whatever, that at the end everybody's still on good terms, and you

felt like you met the goals of each person within that.” In this same vein, when describing a successful collaboration, a faculty member (F9) from engineering said:

Everyone feels like they’ve gotten what they set out to get out of the initial collaboration, that the science is improved because you’re collaborating, and that the relationship isn’t hurt because of the collaboration and the different points of view on how to do anything.

Additionally, respondents gave examples of what we call “productive environments,” citing feelings of ease to ask “dumb” questions, respect for deadlines, and appreciation for one another’s work. Along these lines, a faculty member (F14) from the biophysical sciences noted:

..if you’re comfortable with certain persons, they’re really good at responding to an email, they care what you look for, you know, they understand what are the pieces of work you can do and how you can solve it.

Furthermore, respondents pointed out that the relationships that prompted these productive environments are not just about making friends, but rather that the connections made within the collaboration transpire into opportunities for networking that often lead to pragmatic outcomes. Multiple respondents coupled knowledge and relational capacity formation through stories they told about relationships with collaborators from outside of their own discipline that turned into valuable learning and networking opportunities. One faculty member from engineering (F3) told a story about a collaborative relationship between himself and a biophysical scientist that was built over time and resulted in departmental connections:

And in fact through our work in SEANET together with our student and we also co-advise some undergrads. We have invited [X] to become a cooperative faculty in our department, because he is co-advising students with me –because he teaches many of our undergrads a course, an elective course, and because he has experience.

In this same vein, a faculty member from the biophysical sciences (F12) told a story of networking that resulted in connections for her home department. Describing an event that had recently taken place in her home department, this respondent recounted how her “network” of

researchers from other departments helped her contribute to a hiring process within her home department by recommending researchers that others would otherwise not have known:

Anyway, but building networks.... I feel like oh (the grant) aside this issue coming up has nothing to do with aquaculture or sustainability but I felt like because of this network that I was able to really contribute something and I felt really happy and I felt like that was a success...

“Foot In Each River”

Respondents almost always identified success as distinctly purpose driven or capacity driven, with the exception of two respondents, whom we identify as having “a foot in each river.” These respondents described visions of success that were clearly focused on both the “process” and the “product.” These respondents hailed from distinct disciplinary backgrounds, social science and engineering. One respondent, a faculty member from the social sciences (F15), identified strongly with capacity building, focusing on success as the development and sustaining of relationships and knowledge capacities, but simultaneously seemed to exemplify purpose driven when describing a caveat in her views of success:

The other is getting the work done. Right? Answering the questions at hand and so if it's an applied question solving the problem and contributing new information or something that will help move that solution to that problem or if its an academic question, papers, presentations, outputs, having made some outputs that are important and successful. So if it's a project that doesn't produce anything, yes, it's great that everyone sat together and worked and collected data, but if they didn't do anything with it that's not very successful to me.

Further, the other respondent (F9), an engineer, seemed to describe success in terms of capacity-building, as noted above, when stating that success was linked to relationships and the ability to sustain such relationships. Yet, illustrating purpose-driven success, this respondent went on to tell a story of success that focused on the fact that the project that was pitched was funded; indeed, she emphasized that the most successful collaboration that she has participated in

involved the receipt of further funding. In essence, these respondents understand collaborative work in a non-bifurcated manner, as they see the collaborative setting as dynamic and as an iterative process. Implications and avenues for future research related to these observations will be described below.

Table 3: Constructs and Themes

Construct	Definition	Emergent Theme	Definition	# Interviews Occurred
Purpose driven (n=14)	Success is a measurable output that involves problem solving that leads to application based deliverables; undertone of 'relational' but focused on an output	Mainstream deliverables	-Achievement of goals set out at the beginning of the collaboration; Publishable papers; follow-up grants; conferences attended	9
		Sustainability science outputs	-Followed spirit of creating knowledge designed to inform and support action and strategies for improvement	9
Capacity building (n=12)	Success is a process of developing and strengthening the capacities of the team; journey rather than the destination; commitment to building new configurations and arrangements within the collaboration.	Knowledge capacity	-deep understanding of others work; can communicate and create together; work the boundaries of the collaboration; leads to co-mentoring and departmental networking	6
		Relational capacity	-Relationships are sustained; feel valued; showing up; staying committed	8

Discussion

This study has worked toward two goals: first to describe how those involved in a sustainability science IDR team made sense of success, and second, to contribute to ongoing discussion in the academic literature about gauging success within sustainability science collaborations. Interview findings revealed that those involved in this IDR team are forming distinct definitions of interdisciplinary success. Interestingly, the definitions formed appear to

align with those currently recognized in traditional academic settings as success (i.e., purpose driven), as well as with others that have been less often acknowledged (i.e., capacity building). This distinction between the two groupings, the “even” grouping, with neither group being larger than the other, and researcher diversity -- that is, the distinction did not adhere to disciplinary or university rank lines (see Tables 4 and 5) -- is important to note. After discussing limitations of the research, we discuss the findings from this study and implications for future research within these parameters below.

Limitations

As with any case study, focused on a singular team, and qualitative investigations in general, there are limits to extrapolating our findings. Here, we highlight three limitations of this study. First, the present investigation involves responses from only one medium-sized, sustainability science-focused collaborative team. The nature of the grant that our respondents are working on is driven by the need to solve issues within the community and state, as the scientific vision of the grant includes the development of innovative solutions to a myriad of social ecological system challenges posed by the state’s coastal social, economic, and environmental nexus. Therefore, the culture of this team and the values that members hold may be very different than that of IDR teams that do not have a sustainability science focus.

A second limitation is the fact that the lead author was the lone coder, and, as such, the initial tool of analysis and interpretation, though other authors assisted in interpretation. To counter this limitation, the lead author frequently checked in with other researchers who have done IDR work, shared initial findings with fellow authors, and requested feedback throughout the process.

Lastly, this study interviewed participants in year two of a five-year grant. While results described were not limited to describing the “successes” of this particular grant, interviewing respondents a later stage in the grant’s lifetime could affect how respondents answer, as many researchers were still in beginning stages of their research.

Purpose Driven

Respondents who articulated purpose driven forms of success described success in terms of measurable outputs, often involving problem solving that led to some type of deliverable. This form of success is in line with measures of success that are currently recognized in academic culture such as bibliometric measures (Hasan & Dawson, 2014; Wagner et al., 2011), professional success measures (Goring et al., 2014) and criteria such as NSF’s two overarching aims of knowledge generation and broader impact integration. This construct does, however, offer an interesting conundrum –while both *mainstream deliverables* and *sustainability science outputs* fall under the umbrella of being measurable and leading to confirmable deliverables, there is a tension between the two, as *mainstream deliverables* are reported to be more widely understood in both academia and funding agencies like NSF than *sustainability science outputs*.

The *mainstream deliverables* respondents described include the completion of academically verifiable outputs, such as the achievement of project goals, research funding, and outputs related to bibliometrics. These types of deliverables are the most recognizable form of success (Hasan & Dawson, 2014; Wagner et al., 2011) and fall under the National Science Foundation’s first merit review principle of, “All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge” (NSF, p. 63). Our interviews point to an interplay between *mainstream deliverables* and *sustainability science outputs*, both in that they are related and can go hand-in-hand but also in that they can run

counter to one another. Before exploring this tension and its implications, we describe NSF's understanding of *sustainability science outputs* and compare them with our respondents' understandings.

The *sustainability science outputs* that respondents described work to engage multiple stakeholders and their varying patterns of thought, opinion, approach, and identity in order foster a space that propagates knowledge creation designed to inform and support action (Lindenfeld et al., 2012; McGreavy et al., 2013). These outputs are recognizable in NSF's broader impact criterion (BIC) requirements, which in many ways overlap with what we are calling sustainability science outputs. Essentially, the BIC is a scientific outreach exercise carried out by researchers funded by NSF, with the potential to benefit society and contribute to the achievement of specific, desired societal outcomes (NSF, 2017). Having evolved throughout the years, BIC presently includes five core, long-term outcomes: teaching and education, broadening participation of underrepresented groups, enhancing infrastructure, public dissemination, and other benefits to society (Wiley, 2014). While this type of output is recognized, measured and encouraged by funding agencies like NSF, there has been considerable recognition in the IDR community of the criterion's pitfalls. In many ways, the criterion has been met with "considerable confusion and dread" (Lok, 2010) as many involved in collaborative research have cited issues with the criterion being neither transparent nor practical (Bornman, 2013). The research surrounding the BIC indicate that these difficulties run deep, and include such complaints as the answering and fulfilling of the criterion does not allow for individual efficacy, as well as the belief that it is not within researchers' duties to engage in science communication and outreach (Alpert, 2009; Bozeman & Boardman, 2009; Holbrook & Frodeman, 2011; Wiley, 2014).

The results we share provide a significant nuance to the literature on NSF's BIC. Many of our respondents seem to find 'BIC-like' criteria (i.e., *sustainability science outputs*) meaningful to their personal definitions of success, which in many ways, stands in contrast to the literature. If researchers, especially those working on sustainability science endeavors such as our respondents, are identifying these forms of success, it becomes necessary for funding agencies, such as NSF, to better understand how to measure these types of outputs and improve existing measurement structures. Not only do we need to take heed of this development, but we must also critically consider the apparent tension both cited in the literature and indicated by our respondents. Even more than capacity building forms of success, *sustainability science outputs*, stand in stark contrast to the *mainstream deliverables*. Take, for example, the several instances of respondents pushing back against measures not classified as *sustainability science outputs*, such as the faculty member criticizing scientific journals' publication metrics due to the fact that stakeholders (i.e., those in need of the information) neither subscribe to nor read such publications. The fact that respondents are explicitly "calling out" *mainstream deliverables* as insufficient further suggests the need for *sustainability science outputs* and the BIC criterion to be explored. Foremost, our research suggests that there is perhaps a need for "traditional" measures of success used both in academic settings and by funding agencies to include adequate space for, and weighting of, broader measures of success, such as what we have referred to as *sustainability science outputs*. Additional research is needed to examine how collaborators are reporting their findings, and if perhaps this finding is isolated to sustainability science-focused IDR teams.

Capacity Building

Respondents who described capacity building forms of success focused on the development of new connections within the collaboration. The capacity building construct does not fit as neatly into current measures of success recognized within our IDR culture and by funding agencies such as NSF; however, it does coincide with much of the “science of team science” and systems-centered work appearing within the IDR literature. This described form of success and connection to previous literature concerned with the variables of success provides both evidence of the process based work that has been done in the past, as well as responds to the calls for these forms of success within IDR and academic culture. This construct of success and the connections that are present brings up various questions related to the way collaborators are making sense of success, while also standing (in some ways) in stark contrast with purpose driven forms of success.

Respondents recognized that the building of capacities results in pragmatic outcomes for and beyond the collaboration. In many ways, this practically-oriented capacity-building echoes assertions from the science of team science literature. One instance of this is can be seen as respondents appeared to recognize, through their definitions and narratives of success, the three stages of collaboration, as described in the literature: antecedents, processes, and outcomes (Armstrong & Jackson, 2013; Wagner et al., 2011). Although the stages are not necessarily recognized in “order” described by the authors (i.e., antecedent first, processes second, and outcomes third), and each stage is not described in full, taken together, the stages are evident within respondents’ descriptions of success. Instances of the antecedent stage are apparent when respondents’ definitions reflect user-centered factors such as success being contingent on the “people.” The process stage is largely present within the accounts of development and sustaining

of the relationships and knowledge capacities. Lastly, outcomes were described as both material (i.e., networks and learning environments established and maintained) and immaterial (i.e., feelings of ease, trust, happiness). Additionally, many of the characteristics of “high performing teams” cited by Cheruvelil et al (2014) and the contextual typologies cited by Stokols et al (2008b) are present in responses, specifically: interpersonal skills, diversity, team functioning, and team communication.

Further, these responses can be looked at as signs of researchers recognizing IDR team settings as complex systems, as respondents described constructing configurations, arrangements, and communication behaviors within the collaboration that have the ability to influence the pragmatic outcomes of the team (McGreavy et al., 2015; Thompson, 2009). In many ways, respondents identified success in terms of “collective communication competencies” (CCC) (Thompson, 2009). Our respondents described environments wherein opportunities for researchers to negotiate understandings of knowledge and identity were available, presence was demonstrated, and comprising behaviors were not engaged in, as they could harm the team (Thompson, 2009). An example of this includes the described “productive environments,” wherein respondents appeared to embrace feelings of ease and ability to learn about one another’s disciplines and appreciation for one another’s work. Another example includes respondents describing teams as “unharmful” by the collaborative research process; take, for instance, the faculty member from engineering who described a successful team as one that has intact relationships – unaffected by the varying patterns of thought present within the research team.

Moreover, in terms of knowledge capacity, respondents recognized epistemological pluralism (Miller et al., 2008) as a form of capacity building. Respondents demonstrated that

beyond recognizing that there is more than one way to know, that this varied knowledge recognition in action can be seen as a measure of success. For example, one faculty member told the story of her relationship with a biophysical scientist, where “success” was made possible by the continued communication about each researcher’s discipline and methods, and resulted in a deeper understanding of the seemingly disparate disciplines. In this same vein, and worth mentioning, is the description of “deep understanding” that led to the ability to communicate with others on academic levels, that a faculty member used when providing her own definition of success.

While our respondents are recognizing capacity building as a form of success, it can be argued that these forms of success do not currently have a place at the IDR table. Despite the fact that these forms are recognized in the literature as “processes,” “factors” or “variables” of success, by many they are not seen as measurable outputs to be recognized as a success (Cheruvilil et al., 2014). This result of the capacity building construct does beg to be understood, as it seems that some respondents are tapping into indicators of well-being of the team, and recognizing that -- if not for certain practices -- collaborative work would not get off the ground. Moreover, this research responds to the calls in the literature, specifically by Cheruvilil et al. (2014) to begin expanding measures. That is, we provide empirical evidence of researchers involved in these collaborative projects recognizing forms of success that are distinct from purpose based forms –adding to the conversation on and delivering substantiation to expanded measures of success.

“Foot in Each River”

The two respondents who described visions of success that were clearly focused on both the “process” and the “product” provide an interesting counterpoint to the either-or trend that emerged in the other 22 responses. As mentioned, the respondents who described both were from distinct disciplinary backgrounds, social science and engineering. In many ways, these respondents embody the claim made by Wagner et al. (2011) when they describe IDR taking place as, “ a dynamic process operating at a number of levels” (Wagner et al., 2011: 19), as these respondents seem to recognize that IDR success is both process and output. Better understanding these respondents and their views of interdisciplinary success would entail expanding sampling in new research methods, both of which are described in the following section.

Table 4: Disciplinary Divides (Purpose Driven)

Discipline	Total
Social Sciences	2
Engineering	6
Biophysical sciences	6

Table 5: Disciplinary Divides (Capacity Building)

Discipline	Total
Social Sciences	4
Engineering	2
Biophysical sciences	6

Implications and Future Research

The implications of this study are broad and deserve future research in order to expand this type of work. Moving forward we contend that additional work will need to be done both through research and practice. First, in terms of research, we see the need to expand this study in an effort to better understand how agencies', such as NSF, definitions and measures of success are matching with research perceptions. This could include studies that ask researchers explicitly about these measures and their experiences and perceptions of them, and how these results accord with current measures. Second, this line of work would also benefit from research that encompassed more than one IDR team, and further, went beyond the focus on interdisciplinary collaboration in order to incorporate a transdisciplinary viewpoint, that is, a focus on stakeholders and other "non-academic" knowledge and practice contributors within these teams. Third, moving forward there are many more pieces of this "process" form of success that need to be explored, as well as a need for funding agencies to consider the value, role, and prospect of this form of success. For example, process measures call into question if measures of success based on capacity building are able to be measured and how funding agencies like NSF will or can blend these types of measures into their criterion. And lastly, future research should also ask how these "output" and "process" based forms move together in practice. Our "foot in each river" respondents provide some notion of how individuals might embrace both of these conceptions of success at once, but it would also be interesting to see how and if others demonstrate this duality in day-to-day interactions. Extended ethnographic observations would be one way to move forward on this research avenue.

In terms of practice, we intend that this work will add value to the conversation about IDR measurements of success. As many scholars in the literature note, in order for measures to

gain traction we must start on the level of academic culture. Our results indicate that this shift might already be taking place. Our user-centered approach allowed for illustrative examples of many instances of emergent shifts within respondents' words. About half of our respondents focused their responses on measures of success that are unmistakably distinct from "mainstream" outputs. The focus on *sustainability science outputs* and the range of capacity building forms of success provide an empirically grounded response to the calls for expanded measures. However, the prospect of an expanded and more richly integrative approach to IDR success is one that is needed, and we hope that this work spurs future research and moves this dialogue forward.

Conclusion

Understandings of success diverge amongst the key players within sustainability science collaboration teams. Through this study, we have seen some indication that collaborators are forming distinct definitions of success that do not always match up with measures that are currently employed. Results indicate that collaborators are carving out a role for collaborative work and shaping the ways this work is valued. For some researchers success takes a "purpose" form, with definitions and narratives that concern the degree to which goals and measurable outputs are achieved. For others, success is looked at through the lens of "capacity building" as researchers take "the journey rather than the destination" mindset. Combined, these distinct, participant-defined collaborative successes help to understand the nuances of IDR success. Ultimately, our work provides a basis for a "deeper dialogue amongst sustainability scientists" (Miller et al., 2012) -that is, our empirical results contribute to a more open and informed discussion about how we gauge success within sustainability science collaborations, forming a foundation for appreciation and exploration of the disciplinary and normative dimensions of this work.

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CHAPTER 4

CONCLUSION

Implications of the Work

The purpose of this research was two-fold: (1) to clarify the communicative practices present in collaborative research on the SEANET team, (2) to contribute to a growing body of literature on interdisciplinary collaboration. Taken together, our findings demonstrate the importance and presence of the processes and interworking of sustainability-minded collaborative teams. However, from our limited case study, there are many questions that emerge related to the driving question: “How do we foster informed collaborative processes moving forward?” The results shared in the second chapter can shed light on the challenges facing the team at this point in time. Investigating various options and approaches related to collaborative research is central to the project’s goal of advancing the scientific basis for collaborative preferences and engagement. As evidenced in this chapter, the SEANET team has both strengths and areas in need of improvement. Take, for example, the results from the “familiarity and opinion of social ecological systems (SES)” section of the survey, which indicated that the team as a whole shows a need for improved familiarity with the SES framework. This insight, and proper sharing of it, gives us an opportunity to better understand one of the team’s limitations while simultaneously starting open dialogues that have the ability to foster positive change within the team setting. In all, the research we are conducting serves as an important contribution to SEANET’s interdisciplinary approach and aims to benefit present and future community-university partnerships by helping us understand communication dynamics in complex collaborations and ways to improve these dynamics.

Further, the research provides opportunities to share this work with review boards, and other sustainability-minded collaborative efforts in order to normalize and make a place for IDR

processes within academic culture. For instance, findings from this report were well-received in March 2017 when presented to a panel of American Association for the Advancement of Science (AAAS) scientists serving as an advisory board for SEANET. Panel members suggested sharing the findings with state and national NSF EPSCoR offices as a way to increase attention to and opportunities for other research groups to reflect on their collaboration practices, decision-making, and learning needs.

In the third chapter, we explored how collaborators are making sense of success. Through this study, we see some indication that collaborators are forming distinct definitions of success that do not always match up with measures that are currently employed. The results of this study extend previous research that has called for expanding formal measures of success of IDR teams, and opens several potential avenues for research, both in terms of exploring participants' emergent meanings, and in relation to researching the meaning of "success" on IDR teams in general.

The first construct, purpose driven forms of success, concerns the degree to which goals and measurable outputs are achieved. Respondents described deliverables that ranged from broad level accomplishments, such as the achievement of project goals, to more specific examples, such as academic- and application-based deliverables. We noted that while this construct of success, in general and in comparison to capacity building measures, is the most widely acknowledged form within the IDR literature that perhaps, even within the construct, one emergent theme is more widely recognized than the other. Moving forward, we see a need to better understand the connections between funding agencies' and collaborators' definitions of sustainability science measures.

The second construct, capacity building forms of success, suggests that, in fact, collaborators are recognizing the “process” aspects of IDR teams, as approximately half of our respondents described capacity building forms of success focused on the development of new connections within the collaboration. As noted in much of the “science of team science” and systems-centered work appearing within the IDR literature, this view of success as “capacity building” may not fit as neatly into current measures of success recognized within our academic culture and by federal funding agencies such as NSF. This construct of success and the connections it entails brings up various questions related to the way collaborators are making sense of success, while also standing (in some ways) in stark contrast with purpose driven forms of success. Heuristically, our results are valuable in terms of generating and indicating possible avenues for future research, such as investigating other forms of process or capacity building measures of success that may appear in other IDR team contexts. Collectively, these findings suggest that future research examine how these types of process and capacity building measures could be realistically incorporated into IDR and academic cultures of success.

My Relation to the Work

Taken together, the work presented here is a demonstration of my initial steps as a communication scholar interested in sustainability science minded work. Embarking on this research journey has given me confidence to identify as a research-orientated scholar, as I now find myself with a new commitment to this role of researcher and practitioner. Before beginning this thesis, I did not fully recognize the creative undertones that are inherent within research settings. This opportunity has given me room to apply theoretical tools from the communication discipline to applied sustainability work.

Pursuing doctoral work at UMaine is an opportunity to build on the research experiences I have experienced as a master's student studying Communication on SEANET and I am excited about the disciplinary spanning opportunities that could come from linking my interests with the connections I have made with other departments. This work in particular, has ignited questions related to researchers' "senses of place" and how this connection to a place can be studied through communication research methods. Furthermore, on a broad level, I am interested in pursuing research within the environmental/science communication and risk perception realm. Specifically, I see my research interests including work that centers on how risk information is communicated in rural communities, such as how those in such communities get information on sustainability issues, how communities of practice are forming in response to sustainability issues, and how a "sense of place" is incorporated in these communication interactions. In terms of a future career, after completing a Ph.D. in Communication, I see myself working as an advocate, researcher, and educator within the field of Environmental Communication. I hope to continue placing tenets of sustainability science at the center of my research and maintain teaching as central, rather than ancillary, in any position that I pursue.

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APPENDICES

APPENDIX A:
IRB Approval: SEANET Collaborative Survey Instrument

(KEEP THIS PAGE AS ONE PAGE – DO NOT CHANGE MARGINS/FONTS!!!!!!!!!!)

APPLICATION FOR APPROVAL OF RESEARCH WITH HUMAN SUBJECTS
Protection of Human Subjects Review Board, 114 Alumni Hall, 581-1498

PRINCIPAL INVESTIGATOR: Abby Roche
EMAIL: abby.roche@maine.edu TELEPHONE: (701)200-2346
CO-INVESTIGATOR(S):
FACULTY SPONSOR (Required if PI is a student): Dr. Laura Lindenfeld
TITLE OF PROJECT: SEANET Interdisciplinary/Stakeholder Survey

START DATE: 11/01/2015 PI DEPARTMENT: Communication and Journalism Department
MAILING ADDRESS: Margaret Chase Smith Policy Center; 5784 York Complex #4, Room 209
FUNDING AGENCY (if any):
STATUS OF PI:

FACULTY/STAFF/GRADUATE/UNDERGRADUATE Graduate Student

1. If PI is a student, is this research to be performed:

<input type="checkbox"/> for an honors thesis/senior thesis/capstone?	<input checked="" type="checkbox"/> for a master's thesis?
<input type="checkbox"/> for a doctoral dissertation?	<input type="checkbox"/> for a course project?
<input type="checkbox"/> other (specify)	

2. Does this application modify a previously approved project? Y (Y/N). If yes, please give assigned number (if known) of previously approved project:

3. Is an expedited review requested? Y (Y/N).

Submitting the application indicates the principal investigator's agreement to abide by the responsibilities outlined in [Section I.E. of the Policies and Procedures for the Protection of Human Subjects](#).

Faculty Sponsors are responsible for oversight of research conducted by their students. The Faculty Sponsor ensures that he/she has read the application and that the conduct of such research will be in accordance with the University of Maine's Policies and Procedures for the Protection of Human Subjects of Research. **REMINDER:** if the principal investigator is an undergraduate student, the Faculty Sponsor MUST submit the application to the IRB.

Email complete application to Gayle Jones (gayle.jones@umit.maine.edu)

FOR IRB USE ONLY Application # 2015-10-18 Date received 10/13/2015 Review (F/E): E
Expedited Category:

ACTION TAKEN:

- X Judged Exempt; category 2 Modifications required? Y Accepted (date) 10/27/2015
 Approved as submitted. Date of next review: by Degree of Risk:
 Approved pending modifications. Date of next review: by Degree of Risk:
Modifications accepted (date):
 Not approved (see attached statement)
 Judged not research with human subjects

FINAL APPROVAL TO BEGIN 10/27/2015
Date

08/2015

APPENDIX B: SEANET Collaborative Preferences Survey Instrument

Informed Consent

You have been asked to participate in research project being conducted by researchers at the University of Maine Orono who are affiliated with the Track II EPSCoR project, the Sustainable Ecological Aquaculture Network (SEANET). The purpose of the research is to study interdisciplinary collaboration on the project. This study is being conducted by personnel from the University of Maine in Orono, including Abby Roche, masters student and Dr. Laura Rickard from the Department of Communication and Journalism.

What will you be asked to do?

If you decide to participate, you will be asked to participate in an online survey. The survey will take approximately 20 minutes to complete. You will be asked to respond to statements that address your preferences for collaboration and learning needs and preferences.

Risks

Except for your time and inconvenience, there are no foreseeable risks to you in participating in this study.

Benefits

Although your involvement in this research may not benefit you personally, your participation is important to the success of the study and will contribute to the research being conducted by SEANET, an initiative intended to addresses coastal management decision processes. The project will benefit present and future community-university partnerships by helping us understand communication dynamics in complex collaborations and ways to improve these dynamics. Further, researcher feedback will provide the group with the opportunity to reflect on its collaboration practices, decision-making, and learning needs throughout the collaboration.

Confidentiality

The information you provide will be treated as professional confidences. No information, which might directly identify you, will be presented in any possible research reports or communications. Your name will not be associated with your responses to the survey. Data generated through the survey software will remove any identifying markers before the survey results are generated. Written reports summarizing the findings of the research project will only present general results. The survey data will be stored on the PI's personal computer drive and destroyed after ten years.

Voluntary

Participation is voluntary. If you choose to take part in the study, you may stop at any time or skip any items in the survey. Completion of the online survey implies consent to participate. You can refuse to take the survey and still take part in other components of the SEANET research if you so choose.

Contact information

If you have any questions, comments, or concerns about the study, please contact Abby via: mail: Department of Communication and Journalism, 403 Dunn Hall, University of Maine, Orono, ME 04469, or e-mail: Abby.roche@maine.edu. You may also reach faculty advisor, Dr. Laura Rickard, by mail: Department of Communication and Journalism 428 Dunn Hall, University of Maine Orono, ME 04469 or e-mail: laura.rickard@maine.edu. If you have any questions about your rights as a research participant, please call or write: Gayle Jones, Assistant to the University of Maine's Protection of Human Subjects Review Board, at: (207) 581-1498 or gayle.jones@umit.maine.edu By clicking the arrow below I am indicating that I have read the above information and agree to participate in this survey.

Section One: Interdisciplinary Collaboration

In this section, we would like to learn about your prior experiences, motivations, and expectations for interdisciplinary collaboration in the SEANET project. There are other common terms that can be used when discussing collaborative research endeavors such as 'transdisciplinary' and 'multidisciplinary', but for the purposes of this survey we will be using the term 'interdisciplinary collaboration'. Interdisciplinary collaboration refers to collaboration with researchers in different disciplines and academic institutions.

How many interdisciplinary collaboration projects have you been involved in before SEANET?

- 1 (1)
- 2 (2)
- 3 (3)
- 4 or more (4)
- SEANET is my first interdisciplinary collaboration project (14)

Overall, how dissatisfied or satisfied are you with your previous interdisciplinary collaboration(s)?

- Very Dissatisfied (1)
- Dissatisfied (2)
- Somewhat Dissatisfied (3)
- Neutral (4)
- Somewhat Satisfied (5)
- Satisfied (6)
- Very Satisfied (7)
- Not Applicable (8)

For the interdisciplinary collaborative research that you have typically engaged in, how would you characterize the composition of the research team? (If you've engaged in more than one type of collaborative research, please select the type you've engaged in most frequently.)

- Inclusive of multiple fields within my primary discipline (e.g., polymer chemistry and atmospheric chemistry) (1)
- Inclusive of multiple disciplines in the natural sciences (e.g., physics and biology) (2)
- Inclusive of multiple disciplines in the social sciences (e.g., sociology and political science) (3)
- Inclusive of multiple disciplines across social and/or natural sciences (e.g., economics and chemistry) (4)
- Inclusive of multiple disciplines and sectors of society (e.g., economics, chemistry, federal agency, practitioner) (5)

How much do you disagree or agree with the following statements:

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I have a natural talent for interdisciplinary collaboration. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have the skills to work with researchers in other disciplines. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please rate the frequency with which you typically engage in each of the activities listed below.

	Never (1)	Very Rarely (2)	Yearly (3)	Quarterly (4)	Monthly (5)	Weekly (6)	Daily (7)
Read journals or publications outside of your primary field (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attend meetings or conferences outside of your primary field (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Participate in working groups or committees with the intent to integrate ideas with other participants (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Obtain new insights into your own work through discussion with colleagues who come from different fields or disciplinary orientations (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<p>Modify your own work or research agenda as a result of discussions with colleagues who come from different fields or disciplinary orientations (5)</p>	○	○	○	○	○	○	○
<p>Establish links with colleagues from different fields or disciplinary orientations that have led to or may lead to future collaborative work (6)</p>	○	○	○	○	○	○	○

Please indicate your agreement with the following statements about your awareness of Social Ecological Systems (SES) research prior to the start of the SEANET project (i.e., Fall 2014). "Prior to SEANET, I...

	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
Had never heard of Social Ecological Systems (SES) research. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Was interested in SES research. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Had no experience with SES research. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Had a positive opinion of SES research. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Was familiar with the SES framework developed by Elinor Ostrom. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate your agreement with the following statements. "I am motivated to engage with fellow researchers in the SEANET project because . . .

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
they will help me be the kind of scholar I want to be. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
of the funding this project provides. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
of the satisfaction I experience from taking on interesting challenges. (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I want to be recognized by my peers as doing this work well. (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
it helps me bring on more graduate students. (14)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
my department required my participation. (15)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy learning from people with different types of knowledge. (16)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe the issue I study is in a state of crisis. (17)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
it will help ensure the sustainability of the issue(s)/resource I study/care about. (18)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have nothing to lose. (19)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<p>their involvement in this research is more likely to influence individual and/or institutional action. (20)</p> <p>Other: Please specify. (25)</p>	<input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/>
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Based on your overall experience related to the SEANET project so far, how would you rate your level of satisfaction with the following aspects of the project?

	Extremely satisfied (25)	Moderately satisfied (26)	Slightly satisfied (27)	Neither satisfied nor dissatisfied (28)	Slightly dissatisfied (29)	Moderately dissatisfied (30)	Extremely dissatisfied (31)
Overall experience (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Achievement of professional goals (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Institutional encouragement (e.g., University of Maine administration) (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What project outcomes have you experienced or anticipate to experience within the SEANET collaborative project? (Choose all that apply).

- Peer-reviewed publication(s) (1)
- Peer-reviewed publication(s) that are valued by your department (2)
- New research methods or tools (3)
- Completion of Ph.D. or Master's studies (7)
- Completing Ph.D. or Master's students (4)
- Development of educational content or courses (5)
- Research translation to policy, education or industry (6)
- I have not experienced or anticipate to experience any of these outcomes (9)
- Other (Please specify): (8) _____

Rate the level of impact for each type of interdisciplinary project outcome on your evaluation and advancement (e.g. tenure or permanent appointment). 1= no impact and 5= significant impact.

How do you identify potential collaborators from fields other than your own within SEANET? (Check all that apply)

- Attending meetings within my theme (1)
- Attending meetings outside of my theme (2)
- Basecamp (3)
- SEANET hosted events (4)
- SEANET Graduate Seminar (SMS 598) (5)
- Other (Please specify): (6) _____

Section 2: Communication Preferences and Learning Needs: In this section, we would like to know about your preferences and capacities for communication, focusing on styles of interaction, frequency of communication, preferred technologies, and learning needs. You will be asked to think separately about your experiences as a researcher in relation to the theme you are a part of and your experiences as a researcher in relation to the SEANET project as a whole.

Please mark which theme you are a part of. (If you are a part of more than one please identify the theme you associate with most)

- Theme 1: Ecological and Sociological Carrying Capacity (1)
- Theme 2: Aquaculture in a Changing Ecosystem (2)
- Theme 3: Innovations in Aquaculture (3)
- Theme 4: Human Dimensions (4)

Q16 In this section, please answer the statements below in context of the specific theme you selected in the prior question:

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I have a low degree of influence over the decision making on the theme. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall, I feel uncomfortable when I participate in research-related meetings. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel confident that I can express my views in research-related meetings. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Some people have more power on the theme to make decisions and guide the process. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am not given opportunities to express my choices and opinions about the research. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Meetings are held at convenient times for me. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our theme has a specific strategy to demonstrate that we are listening to each other. (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident that my concerns and opinions have been heard and acted upon. (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Our theme explores multiple alternatives and options for the research. (9)	○	○	○	○	○
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We would like to know about your preference for styles of interaction on the theme of which you are a member. How much do you disagree or agree with the following statements:

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I don't need to understand the goals of fellow theme members. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Theme members should show respect for diverse opinions. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Laughter or the use humor frequently improves theme communication. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Themes should rarely discuss outcomes. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is not important to me that my ideas be incorporated in team decisions. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We need to build a common language on SEANET. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please answer the next set of questions in relation to your experiences to the SEANET project as a whole, not just within your specific theme.

In relation to your experience to SEANET, as a whole project, how much do you disagree or agree with the following statements:

	Strongly Disagree (1)	Disagree (2)	Neither disagree nor agree (3)	Agree (4)	Strongly Agree (5)
I am confident that SEANET will be successful in achieving its interdisciplinary research goals. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The collaborators in SEANET have a high level of mutual trust in each other. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The collaborators in SEANET are a socially cohesive group. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The PIs for SEANET have been effective in promoting a climate of collaboration and trust. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The PIs for SEANET do not have a transparent governance process. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

When you consider SEANET, as a whole project, how much do you disagree or agree with the following statements:

	Strongly Disagree (1)	Disagree (2)	Neither disagree nor agree (3)	Agree (4)	Strongly Agree (5)
I have a clear understanding of what is expected of my involvement in this project. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Information about the research process and products is readily available. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have appropriate access to information to allow me to participate in SEANET. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel like my opinions influence the research process. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can provide at least one example of how my opinion has influenced the research process. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I pay attention to issues of social power when working on teams. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I pay attention to issues of gender when working on teams. (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not pay attention to issues of ethics when working on teams. (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In this section, please answer the statements below in connection with your experiences with the SEANET project as a whole:

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I have a low degree of influence over the decision making on the team. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall, I feel uncomfortable when I participate in research-related meetings. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel confident that I can express my views in research-related meetings. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Some people have more power on the team to make decisions and guide the process. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am not given opportunities to express my choices and opinions about the research. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Meetings are held at convenient times for me. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our team has a specific strategy to demonstrate that we are listening to each other. (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident that my concerns and opinions have been heard and acted upon. (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Our team explores multiple alternatives and options for the research. (9)	○	○	○	○	○
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In general when it comes to making decisions on a team...

	Not preferred (1)	Somewhat preferred (2)	Preferred (3)	Highly Preferred (4)
One person on the team should be responsible for decision making. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A small group of people within the team should make most of the decisions. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Everyone should have a degree of influence but one or a few people have final authority. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A final decision is not made unless everyone agrees. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
No decision making structure. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Students are not actively involved in decision making. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Why did you answer the way you did? How might these strategies be used in SEANET?

Please enter any additional comments you would like to share to help us understand your partnership and communication preferences and your learning needs.

Section 3: Potential Challenges

The following set of questions ask you about any challenges you may have already experienced or anticipate to experience within 3 sets of potential challenges to interdisciplinary research collaboration: institutional (structure of academic institutions; epistemological (different ways of knowing or modes of thinking; teamwork (individuals, interpersonal or group dynamics).

Which of the following institutional challenges (structure of academic institutions) have you experienced or anticipate to experience during the SEANET collaborative process?

- Promotion and Tenure Structure (1)
- Single-author papers are more highly valued (2)
- First author status is more highly valued (3)
- Interdisciplinary research is not valued by my institution (4)
- Time demands necessary for interdisciplinary research collaboration not supported (5)
- Funding challenges/lack of financial incentives (6)
- Disciplinary-based review of interdisciplinary research publications and grant proposals (7)
- Limited opportunities (8)
- Budget control (e.g. indirect cost recovery) (9)
- Training and educational structure encourages specialization (10)
- I have not experienced or anticipate to experience any of these institutional challenges (11)
- Other (Please specify) (12) _____

Of the institutional challenges you have experienced, select up to three that have been or you anticipate to be the most influential to the SEANET collaborative project, dragging them with your mouse from the left hand column to arrange them on the right, starting with the most significant influential challenge to the research collaboration process.

Which of the following epistemological challenges (different ways of knowing or modes of thinking), have you experienced or anticipate to experience during the SEANET collaborative project? (Select all that apply).

- Lack of common terminology or language (1)
- Different disciplinary methodologies and assumptions about what constitutes adequate scientific rigor (2)
- Different disciplinary theories and characteristics of knowledge (3)
- Different disciplinary theories and characteristics of knowledge (4)
- Different disciplinary positions on key issues (5)
- Mismatch in spatial and/or temporal scale of what is being studied (6)
- Not trained to understand knowledge foundations outside primary discipline (7)
- Clarifying research problem and integrating objectives from different disciplinary perspectives (8)
- I have not experienced or anticipate to experience any of these epistemological challenges (9)
- Other (Please specify) (10) _____

Of the epistemological challenges you have experienced, select up to three that have been or you expect to be the most influential during the SEANET collaborative project, dragging them with your mouse from the left column to arrange them on the right, starting with the most significant influential challenge to the research collaboration process.

Which of the following challenges to teamwork (individual, interpersonal, or group dynamics) have you experienced or anticipate to experience during the SEANET collaborative project? (Select all that apply).

- Group Size (1)
- Travel required for in person research meetings (2)
- Lack of trust among research team members (3)
- Lack of understanding of disciplinary differences (4)
- Personal characteristics of team members (5)
- Communication barriers (6)
- Lack of mutual respect (7)
- Stereotyping (8)
- Project organization and/or management (9)
- Lack of or inadequate leadership (10)
- I have not experienced any of these teamwork challenges (11)
- Other (Please specify): (12) _____

Of the challenges to teamwork you have experienced, select up to three that have been or you expect to be the most influential during the SEANET collaborative project, dragging them with your mouse from the left column to arrange them on the right, starting with the most significant influential challenge to the research collaboration process.

Section Four: Background Information:

In this section, we would like to learn a little more about you.

Please select your primary institutional affiliation.

- Aquaculture Research Institute (1)
- Bowdoin College (2)
- Center for Cooperative Aquaculture Research (3)
- Cobscook Community Learning Center (4)
- Darling Marine Center (5)
- Down East Institute (6)
- Maine Maritime Academy (7)
- Sea Grant (8)
- Southern Maine Community College (9)
- St. Joseph's College (10)
- University of Maine, Orono (11)
- University of Maine, Machias (12)
- University of New England (13)
- University of Southern Maine (14)
- Other: Please specify (15) _____

How many years have you worked in your current institution?

Please select your position(s) within your institution:

- Director or other upper administrative position (1)
- Faculty (2)
- Graduate Student (3)
- Post-Doctoral Fellow (4)
- Professional Staff (5)
- Other: Please specify (6) _____

What is your current job title?

- Lecturer (1)
- Instructor (2)
- Assistant Professor (3)
- Associate Professor (4)
- Professor (5)
- Distinguished Professor (6)
- Department Chair (7)
- Professor of Professional Practice (8)
- Other (Please specify): (9) _____

How would you describe your current job's disciplinary affiliation?

- Administrative (1)
- Biophysical sciences (2)
- Engineering (3)
- Fine Arts or Humanities (4)
- Social sciences (5)
- Other: Please specify (6) _____

What is your gender?

- Male (4)
- Female (5)
- Other (Please specify) (6) _____

Thank you for your time! If you have any questions, comments, or concerns about the study, please contact Abby via: mail: Department of Communication and Journalism, 403 Dunn Hall, University of Maine, Orono, ME 04469, or e-mail: Abby.roche@maine.edu. You may also reach faculty advisor, Dr. Laura Rickard, by mail: Department of Communication and Journalism 428 Dunn Hall, University of Maine Orono, ME 04469 or e-mail: laura.rickard@maine.edu. If you have any questions about your rights as a research participant, please call or write: Gayle Jones, Assistant to the University of Maine's Protection of Human Subjects Review Board, at: (207) 581-1498 or gayle.jones@umit.maine.edu

APPENDIX C:
IRB Approval: SEANET Collaborative Interviews

(KEEP THIS PAGE AS ONE PAGE – DO NOT CHANGE MARGINS/FONTS!!!!!!!!!!)

APPLICATION FOR APPROVAL OF RESEARCH WITH HUMAN SUBJECTS
Protection of Human Subjects Review Board, 418 Corbett Hall, 581-1498

PRINCIPAL INVESTIGATOR: Abby Roche
EMAIL: abby.roche@maine.edu TELEPHONE: (701)200-2346
CO-INVESTIGATOR(S):
FACULTY SPONSOR (Required if PI is a student): Dr. Laura Rickard
TITLE OF PROJECT: SEANET Interdisciplinary Interviews

START DATE: 6/1/2016 PI DEPARTMENT: Communication and Journalism Department
MAILING ADDRESS: 5724 Dunn Hall, Room 420 Orono, ME 04469
FUNDING AGENCY (if any): National Science Foundation award #1355457; Maine EPSCoR
STATUS OF PI:

FACULTY/STAFF/GRADUATE/UNDERGRADUATE Graduate Student

- If PI is a student, is this research to be performed:

<input type="checkbox"/>	for an honors thesis/senior thesis/capstone?	<input checked="" type="checkbox"/>	for a master's thesis?
<input type="checkbox"/>	for a doctoral dissertation?	<input type="checkbox"/>	for a course project?
<input type="checkbox"/>	other (specify)		
- Does this application modify a previously approved project? N (Y/N). If yes, please give assigned number (if known) of previously approved project:
- Is an expedited review requested? Y (Y/N).

Submitting the application indicates the principal investigator's agreement to abide by the responsibilities outlined in [Section I.E. of the Policies and Procedures for the Protection of Human Subjects](#).

Faculty Sponsors are responsible for oversight of research conducted by their students. The Faculty Sponsor ensures that he/she has read the application and that the conduct of such research will be in accordance with the University of Maine's Policies and Procedures for the Protection of Human Subjects of Research. **REMINDER:** if the principal investigator is an undergraduate student, the Faculty Sponsor MUST submit the application to the IRB.

Email complete application to Gayle Jones (gayle.jones@umit.maine.edu)

FOR IRB USE ONLY Application # 2016-05-07 Date received 05/06/2016 Review (F/E): E
Expedited Category:

ACTION TAKEN:

- X Judged Exempt; category 2 on 5/19/16 Modifications required? Y Accepted (date) 5/23/2016
 Approved as submitted. Date of next review: by Degree of Risk:
 Approved pending modifications. Date of next review: by Degree of Risk:
Modifications accepted (date):
 Not approved (see attached statement)
 Judged not research with human subjects

FINAL APPROVAL TO BEGIN 05/23/2016
Date

08/2015

APPENDIX D:
Interview Protocol: SEANET Collaborative Interviews

Introduction information:

1. Informed consent
2. How info will be used
3. Thank you
4. Ability to skip questions and stop at any time

Identity as a researcher/identity as an interdisciplinary researcher

1. How would you describe your work? (generally as a researcher)
2. What is your role on SEANET?
 - a. How would you describe your work on SEANET?
3. Does your work change when it is a part of a large project like SEANET?
 - a. If so, how?
4. Do you consider yourself an interdisciplinary researcher?
 - a. Why or why not?
5. In your opinion, what is a researcher's role in an interdisciplinary endeavor?
 - a. What should a member of an interdisciplinary research team know before becoming involved in a collaborative endeavor?
6. How connected do you feel to the SEANET team? *theme vs. team?*
 - a. Can you recall a time that you felt disconnect or maybe isolated from the SEANET team?
7. How connected do you feel to the aquaculture system in Maine?
8. Do you feel like your work is valued on SEANET?
 - a. Can you think of a particular time that you felt like your work was not valued?

Perceptions of interdisciplinary research

1. Has your perception of interdisciplinary research changed since you have become a part of a collaborative endeavor?
 - a. If so, how?
2. Have you been a part of other interdisciplinary research endeavors?

- a. If so
 - i. How many?
 - ii. What has your experience on those endeavors?
 - b. If not go to question 3
3. In your view what are the benefits of being on an interdisciplinary team?
- a. What are the challenges or drawbacks?
 - b. Do these challenges interfere with the success of your project?
 - i. If so, how?
4. In thinking about interdisciplinary collaboration, what do you think counts as “success”?
- a. Can you think of a story of success/recall a time that you felt successful in an interdisciplinary endeavor OR SEANET?

Attribution of communication

13) To what extent is communicating with other researchers on the SEANET project part of your role as an interdisciplinary researcher?

Have you received any training in this area? If not, would you like to have training?

14) Do you communicate across themes often?

How do you communicate?

What do you think would make this easier?

15) What do you consider ‘effective’ communication with other researchers? (i.e. how do you know you are communicating effectively)?

16) Can you recall a time that communication with other researchers worked really well?

a. Can you think of a time that it has not been?

Is there anything you would like to discuss that I have not mentioned?

BIOGRAPHY OF THE AUTHOR

Abby J. Roche was born in Marshall, MN and grew up in Fargo, ND where she graduated from Fargo North High School in 2011. Following high school graduation she moved to Marquette, Michigan to be near Lake Superior and to attend Northern Michigan University. In 2015 Abby graduated magna cum laude from Northern Michigan University with a Bachelor of Science in Public Relations and minors in English (writing) and Environmental Sustainability. During her time at Northern Michigan University she was a leadership scholar, a varsity athlete on the cross-country and track and field teams, student body vice-president from 2013-2014, Mortar Board Honors Society vice-president and member from 2014-2015, a member of the Sigma Tau Delta and Gamma Theta Upsilon, and an intern in the Communications and Marketing Department. Abby will commence her doctoral studies in Communication at the University of Maine in the Fall of 2017. After completing a Ph.D. in Communication, she sees herself working as an advocate, researcher, and educator within the field of Environmental Communication. She hopes to continue placing tenets of sustainability science at the center of her research while also maintaining teaching as central, rather than ancillary, in any position she pursues. Abby is a candidate for the Master of Arts degree in Communication from the University of Maine in August 2017.