THESIS

BUILDING CAPACITY AND INTEGRATING TRAINING, EDUCATION AND EXPERIENCE: THE FIRE LEARNING NETWORK'S PRESCRIBED BURN TRAINING EXCHANGES

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ABSTRACT

BUILDING CAPACITY AND INTEGRATING TRAINING, EDUCATION AND EXPERIENCE: THE FIRE LEARNING NETWORK'S PRESCRIBED BURN TRAINING EXCHANGES

Prescribed fire is an important tool for forest and rangeland management, but there are barriers to its use, including a lack of qualified personnel with the necessary ecological knowledge and operational expertise. In order to implement prescribed fire across landscapes containing a variety of ownerships, these personnel should be from both federal agencies and non-federal organizations. Further, fire science educators have suggested that in order to prepare the next generation of fire professionals, three components—training, education, and experience—must be integrated in a professional development triangle. However, recognized needs for professional development and increased use of fire are not being met. The Prescribed Burn Training Exchange model from the Fire Learning Network incorporates the three components of the professional development triangle while fostering collaboration between nongovernmental organizations, private contractors, landowners, and government agencies. This study evaluated the training model and assessed outcomes using surveys, interviews, focus groups, and participant observation. I found that the participants are very satisfied with the flexible model across disparate training needs and experience levels. The results suggest that the training model is a valuable addition to prescribed fire education opportunities, can be implemented by other organizations, and therefore can serve to increase the capacity for fire management.

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EXECUTIVE SUMMARY

Prescribed fire is widely accepted by natural resource professionals as an important management tool, and there is a recognized need for more fire practitioners with a developed understanding of ecological objectives. However, it has been difficult to increase the use of prescribed fire and build workforce capacity in this area. In order to prepare the next generation of fire management professionals, Kobziar et al. (2009) recommend the "fire professional development triangle" model that incorporates three features: 1) education, in the form of coursework in fire science, forestry, or ecology; 2) training, in the form of certifications from the National Wildfire Coordinating Group (NWCG); and 3) direct experience with fire. The Fire Learning Network (FLN) was created by The Nature Conservancy in partnership with the United States Forest Service (USFS) and agencies of the Department of Interior, and it seeks to increase local capacity and promote the use of prescribed fire through the Prescribed Burn Training Exchange (TREX) initiative. This study investigated several aspects of the TREX initiative. The first objective was to understand the purpose and design of the TREX model in order to: a) discover the perceived gaps in prescribed fire training and how TREX addresses them; b) describe the training model and how it is implemented; and c) investigate whether and how training, experience, and education are integrated into the model. The second and third objectives were to discover what motivates participants to attend TREX events along with their satisfaction rates, and then to evaluate what firefighters value about NWCG training, operational experience, and ecological education.

I conducted the study using both qualitative techniques (interviews, focus groups and participant observation) and quantitative surveys; this mixed methods approach allowed me to

build upon the strengths of both approaches and minimize their weaknesses. I attended four of the TREX events in 2013, interviewed or conducted focus groups with more than 45 individuals, and surveyed participants, with a response rate of 75% resulting in 204 individual responses.

TREX events are designed to bring in veteran support staff for safety and to train others; early to mid-career professionals who are looking to network and develop certifications; and inexperienced individuals, often students, who are looking for their first experience in fire operations. These participants are put into mixed "squads" in order to develop their professional networks and learn from firefighters with different backgrounds.

Satisfaction ratings were overwhelmingly positive, with an overall composite score of 7.69 out of 9, corresponding to "Very Satisfied;" 99.5% of respondents said they would recommend attending a TREX event to a friend. The primary motivation for attending an event correlated to the experience level of the participant. Individuals with little experience overwhelmingly wanted hands-on experience in fire operations, but veteran firefighters still valued experiences in new fuel types and unfamiliar regions. As participant experience increased so did the desire for NWCG taskbook certifications.

By incorporating NWCG training with experiential learning and ecological education sessions, the TREX strategy has developed an approach that includes key features of the fire professional development triangle. NWCG certifications were seen as useful, though imperfect standards, and although the TREX model has been able to overcome some barriers in attaining them, the certification process is still tailored to those in the federal system. Attendees at all experience levels valued on-the-ground experience and the supportive learning environment. There is contention regarding the importance of formal education; participants viewed wildfire

suppression as a skillset that is dependent solely on experience and training, but in cases where there is an emphasis on ecological integrity as a management objective, formal education was seen as more valuable.

In summary, my findings indicate that there is a need to provide additional fire management training opportunities, particularly to a non-federal workforce. With dwindling federal budgets, agencies need to leverage a wider variety of resources. The FLN is developing a workforce that can operate across jurisdictions and includes federal and non-federal natural resource professionals such as foresters, ranchers, loggers, students, and researchers in addition to firefighters. While a formal education is not an outcome of a one to two week training event, providing training and experience to students is especially valuable because managers need personnel with adequate educational backgrounds to meet ecological objectives. As a flexible training model, the TREX strategy is able to accommodate the needs of this diverse group of trainees, and address some of the long-standing capacity issues that impede our ability to apply more prescribed fire in order to address critical ecological needs.

The research and findings described above are detailed in the body of this thesis, which I prepared as a manuscript to be submitted for publication in a peer-reviewed journal. This thesis also includes an appendix discussing additional findings related to one of my original research objectives, which was to examine the policy learning theory. These findings were less robust, but are worthy of a brief description.

According to policy learning theory there are three types of learning. Social learning overcomes deep-seated divisions and is followed by conceptual learning that helps unify priorities. Finally, technical learning occurs and pertains to the tactics and strategies used to accomplish objectives. In theory, each successive phase becomes less contentious due to the

success of the previous phases. In this research, I included questions in my qualitative and quantitative instruments to investigate whether and how policy learning was occurring. I found that the social learning occurring in the TREX model successfully integrates individuals with and without formal education, and that these groups were generally able to work together effectively. There was seemingly little need to shift the priorities of participants through conceptual learning, because there is broad agreement that prescribed fire is necessary and that managers need to restore fire-dependent ecosystems. However, I observed conflict during the technical learning phase. This indicates that the training sessions should address priorities by reinforcing the scale of the fire management problem rather than the achievement of immediate objectives. This conceptual learning would emphasize the scale of achievement in terms of the cost and return, rather than a focus only on total acres treated, regardless of costs. This may better prepare participants to learn innovative techniques that could increase the application of prescribed fire in the long term.

INTRODUCTION

Fire suppression policy of the 20th century has had significant, negative consequences for forest health across the United States, because fire is a vital process in many ecosystems that cannot be replaced by other management actions (Dombeck et al., 2004; Pyne 1982, 2010; Stephens & Ruth 2005). Although a suppression approach was successful in managing fire and protecting timber resources for decades, it was an inadequate long-term fire management strategy, due to the lack of accompanying fuel reduction programs (Busenberg, 2004). A suppression-centric approach to fire management has resulted in a buildup of fuels, and when combined with drought, climate change, and the growth of communities in the wildland-urban interface, has led to both the degradation of ecosystems that depend on low to mixed-severity fires and ballooning suppression expenses (Dellasala et al., 2004; Gorte, 2013).

Prescribed fire can be a valuable management tool for restoring landscapes and reducing hazardous fuel loadings that can lead to high severity wildfires (Brown et al., 2004; Kauffman, 2004; Reinhardt et al., 2008; Ryan et al., 2013). Fire can be used to meet a wide variety of management objectives. Prescribed fire used for ecological objectives generally aims to create a patchy mosaic of burned and unburned fuels with variable burn severities, a state that mimics natural forest conditions and promotes biodiversity (Hamman et al., 2011; Robichaud, 2000). Mechanical treatments, such as tree thinning, are useful and sometimes necessary, particularly in areas with dense human infrastructure or where high fuel loads require thinning and prescribed fire in order to prevent the unwanted fire severity and possible type-conversion of ecosystems that can result from a wildfire (Allen et al., 2002). However, fire is the process necessary to promote ecological complexity, is a cost-effective way to maintain the benefits of mechanical

treatments, and can be implemented at large scales and on difficult terrain that prohibits mechanical operations (Pollet & Omi, 2002).

Although prescribed fire is widely accepted by natural resource professionals as an important management tool, there are significant hurdles to conducting prescribed burns and increasing the number of acres burned annually. One barrier to conducting prescribed burns is the lack of adequate personnel, and overcoming this barrier requires increased opportunities and improved models for training (Kobziar et al., 2009). The Wildland Fire Leadership Council (2009) found that in order to maintain current workforce capabilities, without significant new recruitment and training, retirees would need to be relied upon (WFLC, 2009). A comprehensive study in California found that the lack of adequate personnel is a greater hindrance to prescribed fire than funding, liability, public opinion, residential proximity, planning or environmental laws; this lack of personnel can result from the lack of quality training assignments (Quinn-Davidson & Varner, 2012).

New approaches are needed in order to train the next generation of fire professionals because, as the need for forest restoration and fuel reduction increases both in scale and urgency, so does the ecological understanding and operational expertise needed from firefighters. To achieve this, Kobziar et al. (2009) recommend the "fire professional development triangle" model that incorporates three features: 1) education, in the form of coursework in fire science, forestry, or ecology; 2) training, in the form of certifications from the National Wildfire Coordinating Group (NWCG); and 3) direct experience with fire to operationalize the education and training. However, positions in fire require a relative balance, and the optimal combination of these three features is often difficult to attain. Recent university graduates generally lack operational experience and NWCG training certifications, while career firefighters may have

experience and advanced NWCG certifications, but few opportunities to attain the education needed for professional advancement. While some universities have alternative educational formats targeted at professionals, these are not the norm, and the workforce deficit deepens as veteran firefighters retire. This workforce deficit likely will inhibit capacity for conducting prescribed fire and even wildfire suppression if not confronted directly.

Figure 1. The Fire Professional Development Triangle as proposed by the Education Committee of the Association for Fire Ecology. Training, experience and education are all essential components for effective career development in fire (Kobziar et al., 2009).

Boundary Organizations and the Implementation Crisis

Although there is a recognized need for fire and practitioners trained to conduct prescribed fires with ecological objectives, it can be difficult to translate these needs into practice. The challenge of translating scientific knowledge into practice has been termed the "implementation crisis" (Knight et al., 2006). "Boundary organizations" are structures that can bridge this gap in implementation (McNie, 2007). These organizations, which are generally non-governmental, facilitate the two-way movement of information between the scientific community and the natural resource managers who are mandated to apply ecological principles in land management (McNie, 2007; White et al., 2008).

In the area of fire management, an important boundary organization is the Fire Learning Network (FLN), which was organized by The Nature Conservancy (TNC) in partnership with the United States Forest Service (USFS) and agencies of the Department of Interior in response to the fire seasons of the early 2000s. At that time, national fire suppression policy garnered public scrutiny as suppression costs ballooned to over $1.3 billion during the 2000 fire season alone (Kostishack & Rana, 2002). At the same time, TNC had been redefining its mission—shifting from being focused primarily on land acquisition to increasing collaborative capacity with other organizations and agencies (Butler & Goldstein, 2010). During the 2001 National Fire Roundtable, TNC proposed a new initiative to address the challenges surrounding fire-dependent ecosystem restoration that was modeled on their existing Conservation Learning Networks. The FLN was organized that year, and formalized with an agreement, *Restoring Fire Adapted Ecosystems*, that was signed in 2002 between TNC, the USFS, and the land management agencies of the Department of the Interior (Goldstein et al., 2010). The primary purposes of the FLN are to foster collaborative planning, implementation, and adaptive management, and to share lessons learned across land management agencies and landowners at multiple scales (TNC, 2012). The FLN serves as a boundary organization in that it fosters learning and collaborative implementation between the public, researchers, private entities, federal and state land managers.

In order to increase prescribed fire implementation and build local capacity, the FLN provides training for firefighters through the Prescribed Burn Training Exchange (TREX) initiative (TNC, 2010). Some of the specific training objectives are to host workshops that engage federal, state, and private entities in an "interagency learning environment" and "build skills of non-fire federal employees" (TNC, 2010 p. 5). The exchanges began in 2008 with several prescribed fires in Nebraska and Texas and a total of 75 participants. There has been

significant growth in number, size and geographic dispersal of these trainings, which in 2013 took place in four states, provided training to 220 participants from around the world, and developing relationship with Student Association for Fire Ecology (SAFE) chapters at universities across the United States (Bailey et al., 2012).

Building the local workforce, both within and outside of the federal government, and working collaboratively are central to the TREX strategy for increasing prescribed fire capacity. The TREX also is unique among fire training opportunities in the extent to which it serves non-federal personnel. For instance, the National Interagency Prescribed Fire Training Center also provides training in prescribed fire application. However, from 2011 to 2013 this Prescribed Fire Training Center's trainee population was 87% federal employees; during the same time period, only 21% of the TREX participants were from federal agencies (see Table 1).

Table 1
A comparison of participant agency affiliation between the Prescribed Burn Training Exchange (TREX) and the Prescribed Fire Training Center (PFTC) training models, 2011-2013[1]

Participant Host Organization	Training Model	
	TREX [2] (%)	PFTC [2] (%)
Federal Government		
US Forest Service	8	58
Bureau of Land Management	3	6
National Park Service	3	11
Fish and Wildlife Service	3	9
Bureau of Indian Affairs	0	1
Other Federal Agencies/Military	4	2
Total	**21 (*n* = 99)**	**87 (*n* = 342)**
Non-Federal Government		
State, Tribe or Local Government	19	7
Nongovernmental Organizations	21	1
Private Enterprise	9	1
International Participants	10	4
University Students	20	0
Total	**79 (*n* = 372)**	**13 (*n* = 44)**
Total *n*	471	386

[1] These years were chosen because the PFTC has provided participant data for 2011-2013, and the TREX data for these years was the most reliable (National Interagency Prescribed Fire Training Center, 2012).

[2] These numbers include participants and field coordinators/facilitators at all TREX events as well as PFTC 20-day sessions and workshops from 2011-2013.

Given the importance of prescribed fire for forest and rangeland management, the need for training opportunities, and the need to build collaborative capacity for prescribed fire, both within and outside of federal agencies, I designed this study to investigate several aspects of the TREX initiative, which has not yet been examined by a third-party researcher. The study's primary objectives were three-fold. The first objective was to understand the purpose and design of the TREX model which would allow me to: a) discover the perceived gaps in prescribed fire training and how TREX addresses them; b) describe the training model and how it is implemented; and c) investigate whether and how training, experience, and education are integrated into the model. My second objective was to discover what motivates participants to attend TREX events and whether participants are satisfied with the program's design. Finally, my third objective was to evaluate what, specifically, firefighters value about NWCG training, operational experience, and ecological education, both generally and specifically in the context of the TREX events.

METHODS

The Model for Collaborative Evaluation, which directs researchers and research subjects to work together in planning the evaluation, guided the design of this study on the TREX training method (Rodriguez-Campos, 2012). According to this model, by involving the stakeholders directly in the initial research design and during the research itself, there is an increased likelihood that the results will be useful to those being evaluated (O'Sullivan, 2012). I approached staff from the FLN with the study concept early on in the process of designing this project, and the research objectives were developed together; this collaboration facilitated my access to TREX events, participants, and documents. I had no previous connection with TNC or the FLN, nor had I attended their workshops or training exchanges prior to this study. While the TREX model has never been investigated, the FLN has previously undergone several years of study by third-party researchers, which indicates an organizational culture that accepts critique (Butler & Goldstien, 2010; Taut, 2008).

I conducted the study using a mixed methods approach. The use of both qualitative and quantitative procedures builds upon the strengths of both approaches and minimizes the weaknesses, allowing the researcher to build a grounded and pragmatic understanding of the research topic (Creswell, 2009). My particular mixed methods approach, which is described below, is called the concurrent triangulation strategy by Creswell (2009); it was designed to acquire a wealth of data from the points of view of developers, participants, and observers to provide a full picture of the training model from multiple angles. This method allowed me to describe the training model, explain firefighter observations and training needs, and understand training effectiveness in relation to needs, using both qualitative and quantitative analysis.

TREX events have occurred across the Great Plains and Western United States since 2008. Some of these exchanges occur annually, and some are one-time events. A total of five TREX events took place in 2013; four of these were chosen for site visits to capture both the variation in events and to allow for a programmatic synthesis of results (Yin, 2009).

Qualitative Methods: Interviews, Focus Groups, and Participant Observation Design

Qualitative methods included interviews, focus groups, and participant observation. My goal in conducting interviews was to explore in-depth the training model design and history, and the purpose and need for the collaborative approach to firefighter training. To this end, I conducted interviews with 13 individuals, including the two primary training designers from TNC. I also interviewed TREX facilitators at each of the study sites who were employed by other non-governmental organizations, the National Park Service, the USFS, private contractors, and municipal fire departments. Rather than using a set of questions as a script, the interviews were semi-structured, using an interview guide that was

The Niobrara Valley, Nebraska

The 56,000 acre preserve is owned and managed by TNC and caters particularly to university students. This TREX was an ideal site to observe how a large event with a long-standing precedence operates.

Black Lake, New Mexico

The Forest Guild, an organization that promotes responsible forestry, hosted their first TREX with TNC serving as support. The goal was to build local capacity for more prescribed burns in the future by applying prescribed fire to New Mexico State lands.

Arcata, California

The Northern California Prescribed Fire Council, which promotes the use of prescribed fire, collaboratively planned this TREX with TNC in northern California. It involved prescribed burn operations on both public and private lands in order to build local capacity.

Santa Fe, New Mexico

The international TREX was conducted in Spanish and English. Run by the FLN with USFS support staff and using the same basic model as the other TREX events, participants were fire management professionals from across Latin America and Europe. It served as an example of how the basic training model could be adapted to serve a group of participants with needs that differ from those

Figure 2. TREX Study Sites

flexible, allowing conversations to focus on each subject's knowledge base and experience with the fire community and the FLN (Charmaz, 1991; Kvale, 1983; Leech, 2002).

In addition to interviews, I conducted focus groups with 10-15 individuals at each of the TREX study sites, with the exception of the Spanish language event, in which a questionnaire reflecting focus group questions was distributed and later translated. My purpose with the focus groups was to understand participant experience levels, occupation and educational backgrounds, motivations for attending a TREX, and perspectives on prescribed fire, and to create an assessment of TREX effectiveness. The focus group format allowed me to garner perspectives from more individuals than I could have interviewed one-on-one given the format and timing of the TREX events. Aside from this, focus groups were a valuable approach in this context because they allow participants to interact freely in a way that encourages the sharing of ideas (Kitzinger, 1995).

I recorded, transcribed, and coded all of the interviews and focus groups for themes using a modified grounded theory approach (Aberbach & Rockman, 2002; Corbin & Strauss, 2008; Peabody et al., 1990). This iterative process involved identifying themes and developing codes, which are used to label recurrent themes within the transcriptions (Berry, 2002; Charmaz, 2006). I then used recurrent themes to inductively build conclusions that were "grounded" in the data.

In addition to these methods, I was also incorporated into the trainings as a participant during the operations as a firefighter. This allowed for further understanding of the nature of the trainings through the recording of detailed field notes and the incorporation of the opinions of those who were not formally interviewed individually or in focus groups (DeWalt & Dewalt, 2010; Emerson et al.; 2011).

Quantitative Methods: Survey Design

Quantitative analysis, in the form of measurable satisfaction surveys, was integral to understanding the demographic trends, satisfaction levels, and professional backgrounds of participants. I administered these surveys at all of the case study sites as part of the operational "After-Action Review," when participants and trainers reflect upon and evaluate the efficacy of the training. I also emailed the survey to past participants using addresses provided by the FLN. The survey questions were drafted, edited, and finalized using commonly accepted survey guidelines, and they were offered in both English and Spanish (Vaske, 2008). These quantitative methods served to build findings that were generalizable beyond the four case studies.

The paper-based survey distributed at the case study sites received a 100% response rate of individuals present during the review process, for a total of 116 on-site survey responses. The general population survey, or surveys emailed to past participants, received a response rate of 58.5% with 96 completed surveys. Individuals who had attended multiple training events and completed multiple surveys were identified, and duplicates were removed from analysis so that only their most recent survey was included in the final analysis. After removing duplicate surveys from people who had attended more than one of the case study training exchanges, there were a total of 204 respondents, with a combined response rate of 75%. The FLN estimates that between 2008 and 2013 there have been about 590 individuals that have participated in a TREX event; therefore, the 204 survey respondents represent about one-third of the total number of individuals that have participated in a TREX event since 2008. I compared satisfaction rates from paper-based survey results to the email surveys, performing analysis of variance tests between all four on-site and email survey populations independently, as well as *t*-tests between the paper based surveys and the email survey population.

RESULTS

The Design and Target Population of Training Exchanges

As I noted in the introduction, part of the purpose of creating the TREX was to collaboratively involve federal, state, and private fire professionals in an interagency and collaborative training environment. According to TREX designers, engaging non-federal employees particularly was a central purpose of creating the TREX, in light of the lack of adequate personnel in fire management generally and the need to build capacity both inside and outside of the federal government. As a facilitator of one of the TREX events noted, "If we're going to build local capacity, [we have to ask] is there local capacity to burn on non-federal lands in New Mexico?... [Through the TREX], we opened the doors for a lot of local people to increase their experience." Another facilitator from the Northern California Prescribed Burn Council found that in her experience, "[small] NGOs and private landowners really have no access to prescribed burning, either for training or for use on their property…. This kind of program gives those people an opportunity to get hands-on experience, work with federal partners, learn from agencies who have a lot of experience, and build relationships." Therefore, serving non-federal personnel was a niche that the TREX model was designed to fill, and from the numbers in Table 1 showing non-federal participants in these events, it appears to be serving this purpose.

I found that the TREX model incorporates all three key aspects of career preparation for fire professionals, as recommended by Kobziar et al. (2009), albeit to different extents. The first day of a TREX event is reserved for educational sessions that describe the local conditions, including the socio-economic history of the region and ecological objectives of the prescribed

burn to be performed, so that the participants understand the local needs and challenges. These sessions are taught by a combination of university educators and local natural resource managers; they usually include field trips to areas that have been through a restoration treatment or impacted by a wildfire. This aspect of the TREX provides an important, but relatively small piece of the "education" aspect of the professional development triangle, which primarily refers to a formal degree is gained through university level education, not informal educational sessions. The "training" aspect of the professional development triangle refers to NWCG courses, which are a standardized way for firefighters to become introduced to the terminology and concepts that they will need in operations; the NWCG "taskbook" process is the field component to achieve higher certification levels. At TREX events, new firefighters are offered access to the basic NWCG firefighter certifications, while more advanced participants are encouraged to complete "tasks" in their NWCG taskbooks. Finally, participants from different agencies, companies, and schools are put into mixed "squads" during TREX events in order to develop their professional networks and learn different techniques and information. After the squad formation, educational sessions and field trips, the individual squads engage in "crew cohesiveness exercises" or team-building exercises, as well as tool and tactical training. Once the weather permits, the participants conduct the prescribed burn including ignition, holding the fire within the intended boundaries, extinguishing and patrolling the perimeter over the course of the training. This is the "experience" aspect of the triangle. While there is a basic format for the TREX events, the structure is intended to be flexible to the needs of participants and the local conditions.

Demographic composition of these events is diverse (see Table 2). TREX events bring in veteran support staff for safety and to train others; early to mid-career professionals who are

looking to network and develop their NWCG certifications; and inexperienced individuals, often students, who are looking for their first experience in fire operations. As shown in Table 2, most of the participants in TREX events are male, which reflects national firefighter trends, but the proportion of females is increasing in the younger age cohorts. While many individuals had experienced working directly with fire, 21% had never been involved in prescribed fire or wildfire suppression at all.

Table 2
TREX participant demographics

	Sex			
Age Group[1]	Male (%)	Female (%)	Total (%)	Total (*n*)
18-26	74	26	23	46
27-39	86	14	46	94
40-60	88	13	28	56
60+	88	13	4	8
Total	84	16	100	204

[1] Ages were grouped to roughly represent the early career firefighters and traditional student age group (18-26), mid-career professionals (27-39), later career professionals (40-60) and veteran/retired (60+)

Participant Motivation and Satisfaction

The results for participant satisfaction levels were overwhelmingly positive, as shown in Table 3, with an overall composite score of 7.69 out of 9, corresponding to "Very Satisfied;" 99.5% of respondents said they would recommend attending an exchange to a friend.

Table 3
TREX participant satisfaction ratings[1]

Training Feature	Mean	St. Deviation	St. Error
The Location	7.69	1.465	.103
The Curriculum	7.36	1.457	.102
The Trainers	7.86	1.373	.096
Overall Satisfaction	7.87	1.282	.090
Composite Score	7.69	1.198	.083

[1] Scores were reported from 1 (unsatisfied) to 9 (extremely satisfied)

Based on the survey, the motivation for attending a training exchange correlates to the experience level of the participant, and as experience level increases, so does the variation in motivation (see Table 4). Individuals with low experience overwhelmingly want hands-on experience in fire operations. This motivation decreases as experience level increases but was present for individuals at all experience levels. Data from focus groups indicate that the nature of this motivation also changes as experience increases: veteran firefighters want experience in new fuel types and in different terrain while new firefighters simply want to experience putting fire on the ground for the first time. As experience increases so does the desire for taskbook certifications. Highly experienced individuals have the most variation in primary motivation for attending a TREX and the most written-in responses (see Table 4). Commonly written-in responses regarding motivations in this group were networking and a desire to share professional experience and expertise with new firefighters.

Table 4
Reported motivation for attending a TREX event, comparing experience levels [1]

	Participant Experience Level[2]			
	Low Experience (%)	Medium Experience (%)	High Experience (%)	Total (%)
	(*n* = 65)	(*n* = 68)	(*n* = 71)	(*n* = 204)
Getting hands on experience and learning how to conduct prescribed burns	79	50	27	51
Developing my official fire related certifications and job qualifications	8	32	39	27
Gaining an understanding of the legal requirements involved when conducting a prescribed burn	6	10	11	9
Other[3]	8	7	21	12

[1] Experience level were reported from 1 (No Experience) to 9 (Extremely Experienced). The results were recoded into Low Experience (1-3), Medium Experience (4-6), and High Experience (7-9).

[2] The results are significant and typically correlated: $X^2 = 41.524, p$ – value $<.001$, Cramer's $V = .319$.

[3] Respondents were allowed to write in another motivation; the most common write in was "Networking."

With the disparate motivations and experience levels represented in training exchanges, there is opportunity for variation in satisfaction rates; however, I did not find that this was the case. After testing for homogeneity of variance and conducting analysis of variance tests, I found

no statistically significant differences (p-value < .05) between primary motivation for attending an exchange or experience level and the composite satisfaction rate.

Firefighter Perspectives on the Professional Development Triangle

My final objective was to analyze from the perspective of firefighters the importance of training, experience, and education, which are the three parts of the professional development triangle described by Kobziar et al. (2009). I wanted to discover if these components are valued by firefighters, understand the barriers that exist to obtaining all three, and find out if and how the TREX model addresses these barriers.

NWCG Training

In general, the majority of firefighters at TREX events view training courses from the NWCG as useful, though imperfect. "The NWCG standards are exactly that, they are the standards [that we] have been trained in all across the board… [but] interaction facilitates people sharing different perspectives, and that's something you do not necessarily get if you are flipping through that [taskbook]," explained a firefighter in New Mexico. Furthermore, those who had instructed the basic level S-130/190 training certification course, and those who had taken it recently, agreed that its value is heavily reliant on the instructor's motivation and teaching style.

Some NWCG courses can be completed online or in regional fire academies, but the taskbook process cannot be completed without specific opportunities in the field. For this portion of the NWCG training, participants in all of the case studies identified agency affiliation as the

most significant barrier to accessing these training opportunities. Contractors, private landowners, and professionals working with small agencies or municipal fire departments may have experience with fire but often lack the time or funding needed to obtain advanced certifications. Participants noted that experience level also matters. When attempting to fulfill taskbook requirements during a fire operation, there is often competition between firefighters who need to complete the same tasks. As one person explained, "It's more about where you stand, do you have seniority? Is somebody else competing for that same qualification?" An non-governmental organization employee described another important barrier this way: "It is not my [primary] job to [suppress] wildfires… somebody who is on an engine can do a couple of taskbooks in one summer, while I've been working on [one taskbook] for two years now." In summary, without a federal position in wildfire suppression it is difficult to attain new certifications because many tasks can only be completed during wildfire suppression operations, and there may be competition between firefighters for new certifications.

The TREX strategy addresses some of the barriers to NWCG training in two ways. First, the TREX offers training to primarily non-federal firefighters. Secondly, all TREX participants are invited to discuss their training needs with the trainers prior to the prescribed burn operations, so that their needs can be accommodated. "If you are part of the suppression industrial complex, you've got money backing [you], and opportunity for training- but if you are somehow on the fringes of that, you [have to search for] opportunities to work through the NWCG process that does not necessarily exist to support you in any way. So, I think TREXs are very good in that they address this underserved population," explained a focus group participant in New Mexico. This sentiment was reflected by firefighters from many different backgrounds. Nonetheless, although the TREX model is able to overcome some barriers in attaining NWCG taskbook

requirements, the NWCG certification process is still tailored both to those in the federal system and to the suppression-centric model, in that some tasks can only be completed through wildfire suppression. These tasks cannot be easily addressed in a training scenario, because wildfire operations cannot be simulated in order to fulfill taskbook requirements (National Wildfire Coordinating Group, 2013).

Professional Experience and Experiential Learning

While the NWCG training qualification standards are vital for career advancement, young firefighters need experience with fire on the ground. I found that novice firefighters value experience because it allows them to apply concepts that they learned in school and become more comfortable in the field through observation. I also found that veteran fire professionals value opportunities to gain new experiences in different fuel types and unfamiliar regions. A veteran firefighter explained, "If you think you know it all, it's time for you to [retire], because now you are a risk…especially nowadays [because] our climate has changed [and] our fuels have changed." In other words, the experience component of the fire professional development triangle is valued by all firefighters, even the very experienced. The barriers to achieving this on-the-ground experience are similar to those discussed above, in that personnel not in the federal government, with less experience, or with jobs that are not primarily focused on fire, have less opportunities to gain hands-on experience with fire. The TREX offers this for all participants.

In addition to providing this on-the-ground experience, I also found that the supportive learning environment of the TREX was highly valued by attendees. In TREX events, participants are encouraged to ask questions freely, and facilitators are instructed to explain jargon and

refrain from using acronyms without first defining them. At the TREX event in Nebraska, several student participants said that working alongside seasoned veterans and being able to ask questions was a unique and valuable opportunity. One first-time firefighter said s/he particularly valued the chance to do this "in a relatively safe and supportive setting, versus just having done the [S-130/190 basic firefighting course]." S/he went on to say, "[After that course], if my first experience with actual fire [would be] going out on a wildfire? I think that would be terrifying. It's nice to have this middle step." Another participant had five years of experience in fire operations but never had an opportunity to lead or supervise under controlled conditions. When in a trainee-supervisory role at a TREX, firefighters perform their duties with an experienced observer to answer questions and provide support in case of an emergency. "In this training it's pretty exciting because personally I get to work outside of where I'm comfortable," the participant explained. Typically in fire operations there is little discussion of the tactics, strategies, and logic behind the decisions that the upper-level managers make, which means there are fewer opportunities to think critically and learn, while gaining experience; based on my observation and findings, the TREX model encourages this dialogue.

Formal Education

Among TREX participants, I found no consensus on the value of formal education. University students comprise 20% of all TREX participants, which allowed me to incorporate student and non-student perspectives on the importance of education in the fire community. Respondents viewed suppression as a skillset that is dependent solely on experience and training. However, in cases where there is an emphasis on ecological integrity as a management objective

in prescribed fire, some participants said formal education was more valuable. “I think the degree, depending on what you study, will give you an understanding of [the ecological] processes that are happening on the landscape... But directly fighting fire? I don’t see why [a degree matters],” explained a contractor. I observed that this variation in perspectives on education causes discord in the firefighting community represented at TREX events. A federal participant with a graduate degree described working alongside firefighters “whose focus was suppression, and I remember they would make fun of me because I was into prescribed fire [for the] ecological benefits.”

Participants explained that there are significant barriers to attaining a formal education, because it is often difficult to develop operational experience and training qualifications while pursuing a degree. Similarly, people noted that it can be challenging to attain a degree as a career firefighter. As one person said, “There is the academic track and the operational track, and it is hard to move up without following one of those tracks wholeheartedly. Especially when trying to get into a fire management position without a ton of fire experience, you need some really strong [NWCG qualifications], and that is really hard to achieve if you are simultaneously attending school.” I found that students and federal employees were more accepting of educational standards, while contractors and municipal firefighters were not, because it holds them back from career advancement in the federal system that dominates fire management.

The TREX serves to bridge some of the gaps between populations with either more education or experience. Some participants indicated the diversity of attendees at TREX events, which involve people both formally educated in fire science and not, helps to facilitate learning, dialogue, and increased respect across these populations. Furthermore, university students attending TREX events are able to supplement their education with field experience. TREX

designer Jeremy Bailey explained that "university students are already in an academic environment and are already getting lots of great knowledge from excellent instructors…. So we're trying to give them as many days of fire experience as possible." Also, the educational sessions are an important component to the TREX model, designed to introduce all of the participants to the local context, and provide a basic understanding of fire ecology for those without an educational background in the subject. However, participants from the suppression world did not always appreciate these sessions. One training facilitator explained that the "tone set by the fire suppression-oriented folks was 'glad we got the [educational sessions] out of the way, now let's go do something.'"

While the satisfaction scores were very high in all categories, the curriculum was rated lower than other training components. The surveys allowed respondents to provide open-ended suggestions for training improvement, and the educational sessions were frequently the subject of these comments. However, responses ranged from those who wanted their complete elimination to those who wanted more and longer educational sessions. This disparity in preference and approval would be challenging to address, given the diverse makeup of participants and disparate training desires.

DISCUSSION

Though there are several barriers to increasing the use of prescribed fire, one of the most important is a lack of qualified personnel with the skills needed for ecologically-based management. In order to conduct prescribed fire at the scale needed for management at the landscape level, it is necessary to build up a capable, national workforce for fire management outside of the federal government. Federal agencies cannot operate in the same way on private and state lands as they do in their own jurisdictions, and with dwindling federal budgets, agencies need to leverage a wider variety of resources. One way to accomplish this is for federal and non-federal organizations--especially boundary organizations that can work across jurisdictions and populations--to provide training to non-fire natural resource professionals such as foresters, ranchers, loggers, students, and researchers. Providing training to municipal fire departments can be especially valuable, because they have access to specialty vehicles and equipment. My findings indicate that TREX is fulfilling this niche to some degree by providing the necessary training to a primarily non-federal workforce.

Though the TREX format is able to accommodate non-federal firefighters to some degree, there are persistent barriers to career development for these fire professionals because the NWCG standards are not accommodating to non-agency personnel. Virtanen et al. (2003) observed that there is an enduring inequality between permanent and contingent workers that results from training opportunities that are offered to the permanent workforce but are not as accessible to the contingent workforce. The divide between federal firefighters, who serve as the primary workforce in fire suppression, and non-federal firefighters, who generally act as the contingency workforce, was evident in my research. Even if a firefighter can complete the tasks

required to advance, the taskbook itself needs to be issued and certified by an NWCG compliant agency.

My focus group and survey results demonstrate that the TREX strategy is effectively meeting the a variety of professional development needs across students, contractors, municipal fire departments, federal, and state agency employees, whether they are seeking official NWCG qualifications, a first experience with prescribed fire, or familiarity in new fuel types. As a flexible training strategy that allows participants to discuss their training desires and learn from each other, the TREX strategy is able to accommodate the needs of a diverse group of trainees. This flexibility was intentionally built into the TREX. Lynn Decker, director of the FLN, explained that the training model "is not a program, it is a strategy, which means it has to be nimble, and it is not always the same tool." The high satisfaction rates indicate that the flexibility of the TREX strategy is serving the needs of a diverse set of participants. The results also suggests that a standardized training model, such as the NWCG training format, is useful but insufficient on its own to adequately prepare fire professionals for their careers.

The key aspect of Kobziar et al.'s (2009) critique of the current paradigm for professional development in fire management is the difficulty in accessing education, training, and experience at varying points in a person's career. By incorporating NWCG training with experiential learning and ecological education sessions, the TREX strategy has developed an approach that includes key features of the fire professional development triangle model. I found that several aspects of the TREX offerings are of particular value to participants. For instance, the TREX events offer operational experience, which my findings indicated is desired by all levels of participants, from the most experienced veterans to the most inexperienced firefighters. However, while acquiring experience in a learning environment may be valuable to all

experience levels, it is especially important for the new firefighters. As Kobziar et al. (2009) note, it can be particularly difficult for those with education to get the appropriate experience and training they need to be adequately prepared for a career in fire. My findings suggest that TREX provides important access to experience for students, who comprise an important and growing proportion of TREX attendees. In this way, the TREX is a valuable strategy for meeting some of the challenges highlighted by Kobziar et al. (2009). Not only does this experience help with professional development for students, it also has implications for firefighter safety. Due to the intense fear of stigmatization, inexperienced firefighters are reluctant to ask questions during fire operations and thus they rely on the squad for their safety; this puts them at risk (Lewis et al. 2011). Therefore, providing experience in an open learning environment can increase a squad's collective expertise and increase firefighter safety.

Indeed, the opportunity provided to students may be one of the most significant benefits of the TREX. If ecologically-oriented outcomes are the management objectives, as they are in the National Fire Plan, and prescribed fire is a tool that can be used to meet these goals, then fire professionals need to be prepared with an adequate educational background (Kostishack & Rana 2002). While university degree requirements are controversial amongst firefighters, the historical suppression model appears to be a driving force behind the disparity. Nevertheless, ecological integrity is becoming an increasingly dominant management priority, and if prescribed fire is to be used to meet restoration objectives, it becomes more important that fire professionals have a university-level education in fire and forest ecology. TREX designer Jeremy Bailey observed that, "When we have entire operating units [such as national forests] who only have one fire ecologist at the regional level, what kind of model is that? … We need a fire ecologist on every district." Formal college education is not an outcome of the TREX training model, but by

integrating Student Association for Fire Ecology chapters, a substantial number of students are able to get field experience and develop NWCG certifications; in fact, forestry, fire science, and ecology students were present at all of the case studies except for the international Spanish language event. Campbell (1997) suggested that career development programs need to consider the environmental, political, and economic realities that the next generation of workers will encounter. If fire management is to focus less exclusively on suppression, then training strategies need to integrate the educated natural resource professionals while providing education to the already integrated firefighters.

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APPENDIX I:

POLICY LEARNING THEORY AND

THE PRESCRIBED BURN TRAINING EXCHANGE MODEL

This research set out to examine several conceptual frameworks. In addition to the concepts that I used in the main body of this thesis, such as boundary organizations, the implementation gap, and the fire professional development triangle, I also examined the policy learning theory. The qualitative and quantitative tools I used in this research included questions designed to investigate whether and how policy learning was occurring; these questions are shown in detail in Appendix II. This appendix explains these concepts and how they were applied; it also provides a brief summation of my findings.

The Policy Learning Theory

Learning is important to natural resource management because there is a complexity in natural systems; ideally, the policy decisions that influence management strategies change as new information becomes available (Lauber & Brown, 2006). For instance, as natural resource professionals have learned more about the ecological role that fire plays in the landscape, decision makers have attempted to change the relevant policies. The policy learning framework is a useful conceptual framework in that it describes how this learning process impacts policy changes over time. It explores learning feedback loops, their role in increasing knowledge, improving the application of research, and contributing to long-term policy change (Sabatier, 1988). If there is a desire to improve the decisions that a manager makes there should be a back and forth exchange between the researchers developing the science and the managers that use it. This forms a cycle in which managerial experience feeds back to the researchers in a constant state of improvement (McNie, 2007).

There are three important types of learning that occur and drive changes in policy over time according to the policy learning theory: social, conceptual, and technical learning. Different

opinions exist in the literature regarding which type of learning occurs when and in which order, but I used the structure proposed by Lauber and Brown (2006) and Lauber et al. (2011). Social learning is the establishment of trust between individuals that can overcome differences in deeply held beliefs. These generally unchangeable beliefs often act as roadblocks to change (Lauber & Brown, 2006; Lauber et al., 2011). The trust built through social learning is essential to policy change when there are fundamental differences between parties, and the other two categories of learning hinge upon the success of social learning. Conceptual learning pertains to beliefs that may or may not be deeply held, but can be altered, such as the way in which we prioritize our values rather than attempting to change them entirely. Because this concept refers to changeable attitudes, it is not in the same realm as the fundamental beliefs addressed by social learning (Fiorino, 2001). Through conceptual learning we can develop new objectives and find new ways to define problems. In natural resource management, conceptual learning can mean selecting and prioritizing areas in need of action and the desired results (Lauber et al., 2011). Once a common vision and common agenda have been established through social and conceptual learning, technical learning is the process of deciding how best to achieve the desired conditions. It is here that the methods are agreed upon and implementation begins (Lauber et al., 2006).

FINDINGS AND DISCUSSION

I applied the three types of learning described in the policy learning theory in this research in three distinct ways. Social learning applied to the split between firefighters with and without formal education because it is an entrenched division. I used conceptual learning to investigate the importance of fire management issues to TREX participants, as well as the relative importance of wildfire suppression versus prescribed fire application. Finally, I applied technical learning to the fire management strategies and tactics that were implemented by the trainers and facilitators at TREX events.

Social Learning and the Educational Divide

There is considerable diversity in the firefighting community that results from varied educational backgrounds, occupational affiliations, and experience levels, and this diversity can lead to tension. Education is an institution that separates people at a very deep level; as such, I applied the concept of social learning to understand the barriers to cooperation between groups with different education levels in the fire community. While experience is required for those with and without higher education, careers are built on either training qualifications alone or a combination of education and experience. Some of the training participants completely lack higher education, while others have attained or are in pursuit of undergraduate and graduate degrees in natural resource fields. Firefighters with advanced education spoke frequently about their operational experiences and acknowledged that there is friction. As one person said, "You could definitely tell they resented the fact that I was a master's student… a lot of people who

have been in fire for a very long period of time have been treated in such a way to come to resent the academic community." Another individual discussed their experience training alongside a squad, "whose focus was suppression, and I remember they would make fun of me because I was into prescribed fire [for the] ecological benefits." These sentiments reflect the environmental tribalism discussed by Kysar and Salzman (2003), in which groups may have common ground, but are kept apart by political and ideological divides that often result from dissimilar education and training experiences.

Even very late into a career, the level of education a person has is a better predictor of their position in an organization than their experience level, and this is especially true in the civil service (Meyer, 1977). The divide between groups was apparent in the focus groups and interviews, but individuals who may be separated by educational levels often work together in their day-to-day careers. "Your overeducated folks come out here and think that they can manage us and the land and tell you that you're managing the land wrong… I deal with this on a daily basis," said one experienced firefighter. Such deep-seated divisions would be extremely difficult if not impossible to repair in a week or two of integrated training, but working side-by-side in a training scenario is meant to encourage cooperation, not perfect union.

Participants from different agencies, companies, and schools with varied educational levels are separated into mixed squads in the TREX events; this encourages them to develop their professional networks with different types of people and enhances the learning experience. In order to see if this strategy is successful, survey respondents were asked if they had developed social networks through the training exchanges and if those networks had been important to their professional or academic careers; the results are found in Table 5. While this survey did not measure if those networks were comprised of people with different educational backgrounds than

the respondent, results indicate that there is social networking occurring at exchanges. A total of 76.2% of participants from all background stayed in contact with people that they had met through training exchanges. Of those individuals, the vast majority had found the network that they developed useful; in fact 99.5% of all survey respondents would recommend attending a training exchange to a friend. Finally, the satisfaction ratings indicate that the format is successful, as seen in Table 3 (above, p. 19).

Table 5
Survey questions indicating social learning concepts between TREX participants

Survey Question	Yes	No
Have you kept in contact with any of the people that you met at the training exchange(s)? [1]	76.2%	23.8%
If so, has the network been helpful to you (career, academic or otherwise)?	92.2%	7.8%
Would you recommend attending a FLN Training Exchange to a friend?	99.5%	0.5%

[1]Respondents were asked to check "not applicable" if they attended only one training exchange and it was within the last month, these individuals were removed from analysis to reflect longer term effects.

Conceptual Learning

One aim of my research was to find out if participants gained new perspectives or had their priorities shift as a result of a TREX event, the conceptual learning idea applies to this question. As anticipated, firefighters who attend TREX events consider fire management a top priority, but that priority can have slightly different focuses. Table 6 shows that on a scale of 1 to

9, participants ranked fire management as 8.24 out of 9, or "extremely important." Conceptual learning applies to the process of shifting priorities into alignment, but this seems to be unnecessary in this case because firefighters are already in agreement on the need for more prescribed fire. While participants agreed that fire management is important, data from focus groups showed that there was some disagreement on why prescribed fire is an important tool. The dominant theme was that fire is an important natural process and that forest health is in decline; this sentiment was common across educational backgrounds and agency affiliations; "When you really love a place, you kind of want to burn it, but seriously, you care about the land management, and often times that means restoring kind of 'semi-natural' fire regimes." Other responses included protection of life and property in the Wildland Urban Interface and the economic efficiency of prescribed fire compared to mechanical treatments, but these responses were in the minority.

I wanted to find out if participants had their priorities shift as a result of a training exchange, but the results showed again that participants already understand the role of fire in the environment and consider it a personal priority. Survey participants were asked "Has your experience with the Training Exchange program changed how you view the role of fire and fire management in the natural environment? If yes, please describe your point of view and how the training changed it. If no, please describe your previously existing point of view." This open ended question was intended to allow for a more comprehensive response than a simple yes or no. The participants were evenly split, with a total of 53.2% reporting that their participation in a TREX event did change the way that they see fire and 46.8% reported that it did not. However written responses indicated that these seemingly disparate groups were actually unified. The vast majority of respondents that did not have their perspective changed described that they already

had a strong understanding of fire's ecological function before the exchange and had "jumped on the prescribed fire band wagon long ago." The participants that did have their perspectives changed often described much the same idea, but found that their perspectives on fire management were reinforced through their participation in a TREX event.

Table 6
Survey questions indicating conceptual learning concepts between TREX participants

	Mean	Standard Deviation	Standard Error
In terms of the many natural resources and management concerns, how important are fire management issues to you?	8.24[1]	1.033	.72

[1] Scores were reported on a positive scale from 1 (not at all important) to 9 (extremely important)

Technical Learning

Once a common vision and common agenda have been established through social and conceptual learning, technical learning is the process of deciding how best to achieve the desired conditions (Lauber et al., 2006). Many of the simple concepts related to technical learning were present at TREX events; tool and tactical training were a part of the curriculum at each study site, and this was explored in the main body of this thesis. According to the literature, technical learning should be a simpler subject compared to social and conceptual learning and the barriers that they are meant to overcome. However, discord arose between the firefighters who were habituated to fire suppression, and those who were concentrated on ecosystem restoration. This

was most obvious at the Black Lake operations in New Mexico. The Forest Guild, the non-governmental organization that had planned and hosted the TREX, was operating with a tight budget, and they contracted the burn operations out to a group of individuals from the suppression community. According to other facilitators, Jeremy Bailey, the TREX designer "recommended something that was very low-tech as an option, and it was scoffed at because it wasn't like fire suppression tactics…. [Jeremy's suggestion] was an opportunity missed." The idea was to have a group of inexperienced students use regular butane lighters as part of the ignitions operations to discover what can be achieved using small, inexpensive tools. "That seemed like a good opportunity but if you come from pure fire suppression all the time, you don't entertain those ideas," explained the facilitator. This finding illustrates and confirms the results described earlier; the mindset and tactical approach of the fire suppression community is difficult to integrate with those who are attempting to address the scale and ecological need that exists.

The policy learning theory is a useful concept, and according to the theory, social learning is followed by conceptual and finally technical learning, with each successive phase becoming less complex due to the success of the previous phases. The social learning occurring in the TREX model successfully integrates individuals with and without formal education and they have been able to work together to achieve objectives. There was seemingly little need to shift the priorities of participants through conceptual learning because there is broad agreement that prescribed fire is good, and that there is a need to restore fire-dependent ecosystems. During the technical learning phase, people should be able to agree on tactics because they have agreed on the desired outcomes during the previous phases according to the literature. However, I observed more tension and conflict during the technical learning phase than I anticipated. This

indicates that trainers should focus more on conceptual learning prior to technical training in order to reinforce the scale of the fire management problem. The priority would become the scale of achievement in terms of the cost and return, rather than total acres treated regardless of costs. This may better prepare participants to learn innovative techniques that could increase the application of prescribed fire in the longer term.

APPENDIX II

RESEARCH MATERIALS

INTERVIEW GUIDE

1. Who attends the training programs and what is an effective combination of people and backgrounds? How are FLN trainings structured to encourage learning across these social and organizational boundaries?

- Are the training events marketed? To who, where and why?

-How many people attend the average training event?

-What tends to be the skill level of attendees? Where are they on the scale from no experience to a seasoned professional?

-Have there been attendance trend changes over the years?

-When the training is happening, how do individuals interact with each other, with the leaders and how do you influence that?

-How have the attendees interacted in the past? Have you noticed anything interesting in the interaction between the federal, private, university and general public attendees?

-How do interactions between the attendees play into your overall objectives?

2. What barriers are encountered in altering peoples' perception of prescribed fire, how have they been mitigated and to what extent? Who does the FLN need to influence: attendees, the public, government, organizations, land owners etc.?

-Do the attendees come into trainings with perspectives that need to be altered, like what?

-To what degree do you work with the general public/local stakeholders while planning or engaging in a training event?

-Do people at the events understand the role of fire in an ecosystem?

-How much of the training is dedicated to wildfire or ecological concepts and how much is directed to technical skill building?

-Do you have to address the legal framework with attendees like air quality, liability, risk of escape etc.?

-Are people generally attending these trainings with wildfire prevention in mind or ecosystem restoration?

3. What is different about FLN training than other methods? The Forest Service has extensive training programs already so what need is not being met, what are the differences and what has been advantageous about the FLN style?

-What gaps were recognized before the FLN, what was the need for a program like this?

-How does the FLN training program fill those needs?

-Please describe the average training event and the structure. Are there classroom sessions, field sessions, or combinations that you've found to be particularly effective?

-Are all trainings designed in roughly the same manner or are there a lot of regional differences?

-Who designed the training system, what was it modeled on?

-What do you think still needs to be done, what improvements are needed?

-What should someone expect when attending, are there prerequisites?

-How does training fit into the overall goals of the FLN, how is it prioritized?

-What does an attendee gain from training and how can they use their training later?

4. Supplemental/ trainer profile questions.

-Tell me a little bit about yourself: your education level, career background, experience level with wildfire and prescribed burns, and why you are here.

-Is this your first TREX event? How many/which ones have you been to?

-(If they have been to multiple events): Do you see a consistent model in these events, or have you noticed any particular differences in the way that these trainings are designed?

-What do you think is the value of a program like this, do you think it fills any gaps that you've noticed?

-How does the TREX compare to other training programs, does it stand apart in any ways?

-How do you see the interaction between this training exchange and training opportunities offered through the NWCG, like S130-190, etc.?

-It has been said that a firefighter needs education, training and experience to be effective and develop in their career; do you think this is true? Please elaborate.

-What do you think are the main hurdles to putting fire on the ground?

-Has this event changed the way you see fire, or given you any new insights into the fire community?

-Have you learned anything new here that you weren't aware of before?

-Do you have any suggestions for improvement of the training, have you noticed any weaknesses?

FOCUS GROUP GUIDE

-What is your name, please describe your career, what agency/organization/university etc. you represent and what is your age?

-What is you educational background, have you studied Natural Resource Management, Forestry, or Fire Sciences? To what extent/ degree level?

-Describe your experience level with fire, have you worked wildland fire suppression or performed a prescribed burn before?

-How did you hear about the Training Exchange program and this event in particular?

-Have you ever attended a TREX event before, when and where?

-Why did you come to this exchange, what do you want to get out of it?

-What do you think about the role of fire in the environment?

-How important is fire management to you? What is the most important thing about this job to you, protecting homes and property, restoring ecosystems, just getting to work outside, etc?

-Have you ever hit any hurdles in your career, something like an educational, training or experience requirement for a job that you couldn't get?

-Do you think there is a problem right now with the way that we manage fires as a country or state?

-What do you think we should do about the problem?

-How many of you have taken one of the federal training programs like S-130/S-190?

-What do you think about those types of federal trainings, what do you like or not like about them?

-Have you noticed any weaknesses in this event, or do you have any suggestions for improvement?

ENGLISH LANGUAGE SURVEY

Thank you for taking the time to fill out this survey. You have been asked to participate because you attended a Fire Learning Network Prescribed Burn Training Exchange from The Nature Conservancy. The results from this survey will be used by researchers from Colorado State University's Department of Forest and Rangeland Stewardship to understand the program's effectiveness.

---

1. When attending the Fire Learning Network Training Exchange program, were you (Check all that apply):
   - ☐ A university/technical college student or recent graduate
   - ☐ Working in a wildfire related field (seasonally or otherwise)
   - ☐ Working in another natural resources related position
   - ☐ Working in a non-natural resources related position
   - ☐ Unemployed
   - ☐ Other_____

2. At the time of your first Training Exchange program, had you previously worked in wildfire suppression?
   - ☐ Yes
   - ☐ No

3. At the time of your first Training Exchange program, had you previously experienced performing a prescribed burn?
   - ☐ Yes
   - ☐ No

4. How would you characterize your experience level with fire management when coming into your first training?

Not at all		*Somewhat Experienced*		*Experienced*		*Very Experienced*		*Extremely Experienced*
1	2	3	4	5	6	7	8	9

5. Please list **all** of the States and the years in which you have attended Prescribed Burn Training Exchanges (including this one):

	State	*Year*
1.		
2.		
3.		
4.		
5.		

6. On a scale from 1 to 9, how satisfied have you been with the event(s) overall? (Please circle one number per row)

	Unsatisfied		*Somewhat Satisfied*		*Satisfied*		*Very Satisfied*		*Extremely Satisfied*
The Location(s):	1	2	3	4	5	6	7	8	9
The Curriculum:	1	2	3	4	5	6	7	8	9
The Trainers:	1	2	3	4	5	6	7	8	9
Overall:	1	2	3	4	5	6	7	8	9

7. Has the experience you gained at the Fire Learning Network training been useful to your career, academic or otherwise?

Not at all		*Somewhat Useful*		*Useful*		*Very Useful*		*Extremely Useful*
1	2	3	4	5	6	7	8	9

8. In terms of the many natural resources and management concerns, how important are fire management issues to you?

Not at all		*Somewhat Important*		*Important*		*Very Important*		*Extremely Important*
1	2	3	4	5	6	7	8	9

9. What was the **most** useful aspect of the training? (Check only one)
   - ☐ Getting hands on experience and learning how to conduct prescribed burns
   - ☐ Developing my official fire related certifications and job qualifications
   - ☐ Gaining an understanding of the legal requirements involved when conducting a prescribed burn (including any issues regarding air quality or working between private, federal and state property boundaries)
   - ☐ The training was not useful
   - ☐ Other:_____

10. Has your experience with the Training Exchange program changed how you view the role of fire and fire management in the natural environment?
   - ☐ Yes (Please describe your point of view and how the training changed it below)
   - ☐ No (Please describe your previously existing point of view below)

_____

_____

_____

_____

11. Have you kept in contact with any of the people that you met at the training exchange(s)?
(Please check "Not Applicable" if you have attended only one training and it was within the last month)
   - ☐ Yes
   - ☐ No
   - ☐ Not Applicable

12. If you checked yes to question 11, has the network been helpful to you (career, academic or otherwise)?
   - ☐ Yes
   - ☐ No
   - ☐ Not Applicable

13. Would you recommend attending a FLN Training Exchange to a friend?
   - ☐ Yes
   - ☐ No

14. What is your sex?
   - ☐ Male
   - ☐ Female

15. What was your age at the time of your first Training Exchange? (Please specify) _____

16. What is your zip code? (Please write) _____

17. Please share any final thoughts on the program's effectiveness and any recommendations for improvement.

_____

_____

_____

Thank you very much for completing the survey. Please return completed surveys to Andrew Spencer in person or at:

Forest and Rangeland Stewardship
Colorado State University
Attention: Andrew Spencer
1472 Campus Delivery
Fort Collins, CO 80523-1472

If you have any questions or would prefer an email version of this survey, please contact us at TREXSurvey@gmail.com

SPANISH LANGUAGE SURVEY

Le agradecería si usted tomara el tiempo para llenar esta encuesta. Le solicito su participación ya que usted asistió a un Intercambio y Entrenamiento en Quemas Prescritas de la Red de Aprendizaje de Fuego de The Nature Conservancy. Los resultados de este estudio serán utilizados por los investigadores del Departamento de Manejo de Bosques y Pastizales de la Universidad Estatal de Colorado para entender mejor la eficacia del programa.

1. Cuando participaste en el Intercambio y Entrenamiento de la Red de Aprendizaje de Fuego eras (Marque **todo** lo que corresponda):

- ☐ Estudiante universitario / técnico o graduado reciente
- ☐ Trabajador en un ámbito relacionado con los incendios forestales (estacional o de otra manera)
- ☐ Trabajador en otra posición relacionado con los recursos naturales
- ☐ Trabajador en una posición no relacionado con los recursos naturales
- ☐ Desempleado
- ☐ Otro (especifique aquí):_____

2. Después de que participaste por primera vez en el Intercambio y Entrenamiento (TREX), ¿ha trabajado previamente en supresión de incendios forestales?.

- ☐ Sí
- ☐ No

3. ¿Ha realizado quemas prescritas después de su participación en el TREX?.

- ☐ Sí
- ☐ No

4. En una escala de 1-9, ¿Cómo describiría su nivel de experiencia con manejo del fuego al entrar en su primer entrenamiento?

Nada		*Algo Experimentados*		*Experimentados*		*Muy Experimentados*		*Extremadamente Experimentados*
1	2	3	4	5	6	7	8	9

5. Enumere todos los Estados en los E.U.A. y los años en los que ha participado en estos Intercambios y Entrenamiento en Quemad Prescritas (por ejemplo: "NM, 2013").

	Estado	*Año*
1.		
2.		
3.		
4.		
5.		

6. En una escala del 1 al 9 (1 significa "insatisfactorio" y 9 siendo "extremadamente satisfactorio"). ¿Qué grado de satisfacción ha tenido con el evento (s) en general? (Por favor, circule un número en cada categoría).

	Insatisfecho		*Algo Satisfecho*		*Satisfecho*		*Muy Satisfecho*		*Extremadente Satisfecho*
El Lugar(s):	1	2	3	4	5	6	7	8	9
El Plan de Estudios:	1	2	3	4	5	6	7	8	9
Los Entrenadores:	1	2	3	4	5	6	7	8	9
En general:	1	2	3	4	5	6	7	8	9

7. ¿De qué manera la experiencia que obtuvo con la Red de Aprendizaje de Fuego ha influenciado su carrera académicamente o de qué otra manera?. (Por favor, circule un número).

Nada		*Algo útil*		*útil*		*Muy útil*		*Extremadamente útil*
1	2	3	4	5	6	7	8	9

8. Qué importancia le da usted a los problemas de manejo de incendios?.

Nada		*Algo Importante*		*Importante*		*Muy Importante*		*Extremadamente Importante*
1	2	3	4	5	6	7	8	9

9. ¿Cuál fue el aspecto **más** útil del entrenamiento?. (Marque sólo uno).

- ☐ Obtener experiencia práctica y aprender cómo llevar a cabo quemas prescritas
- ☐ La obtención de certificaciones oficiales relacionadas con el fuego y calificaciones para el trabajo
- ☐ Entender sobre los requisitos legales relacionados con quemas prescritas (por ejemplo, la calidad del aire, trabajo entre límites tanto de propiedad privada, límites federales y estatales).
- ☐ El entrenamiento no fue útil
- ☐ Otro (especifique aquí)::_____

10. ¿Ha cambiado su experiencia con el programa de Intercambio de Entrenamiento la forma en que ve el papel del fuego y control de incendios en el ambiente natural?.

- ☐ Sí (Por favor describa su punto de vista y cómo lo cambió el entrenamiento):
- ☐ No (Por favor describa su punto de vista ya existente):

_____

_____

_____

11. ¿Ha mantenido contacto con alguna de las personas que conoció en el intercambio(s) y entrenamiento? (Por favor, marque "No aplica" si ha asistido a un solo entrenamiento y fue en el último mes).

- ☐ Sí
- ☐ No
- ☐ Not Aplicable

12. Si contestó sí a la pregunta 11, ha sido útil la red de aprendizaje de fuego para usted?. (¿de manera profesional, académica o de otra manera?).

- ☐ Sí
- ☐ No
- ☐ Not Aplicable

13. ¿Recomendaría a un amigo que asista a un Intercambio y Entrenamiento?.

- ☐ Sí
- ☐ No

14. ¿Cuál es su género?.

- ☐ Masculino
- ☐ Femenino

15. ¿Cuántos años tenía en el momento de su primer intercambio de entrenamiento?. (Por favor especificar): _____

16. ¿Cuál es su apartado o código postal?. (Por favor escriba): _____

17. Por favor comparta cualquier reflexión final sobre la eficacia del programa y sus recomendaciones para mejorarlo:

_____

_____

_____

Muchas gracias por completar la encuesta. Por favor envía las encuestas completas a Andrew Spencer en TREXsurvey@gmail.com

Forest and Rangeland Stewardship
Colorado State University
Attention: Andrew Spencer
1472 Campus Delivery
Fort Collins, CO 80523-1472

APPENDIX III

OPPORTUNITIES FOR FURTHER RESEARCH

Media outreach has a strong presence at TREX events, but the effectiveness of this outreach was not measured in this research project. The training exchange model has been used primarily in the Great Plains and West, areas without the longstanding prescribed fire councils, training centers or the general fire culture that exist in the Southeast where the PFTC operates. In order to develop acceptance of prescribed fire in these areas, the FLN leverages media exposure which familiarizes the public with prescribed fire and publicizes successful burns. Participants are given key messages about the goals of the prescribed fire and they practice being interviewed by the press, reporters are then invited to observe the operations, take photos and interview firefighters. In this way, each event is a demonstration project intended to influence the local public's perception of fire. The goal is to show risk-adverse managers that there are creative ways to address prescribed fire hurdles and to publicize a successful operation to residents. As Jeremy Bailey explained, "if our public outreach and our integration of media into our daily activities goes well, it's possible that we will have communicated to thousands or tens of thousands of people… The 200 acres is a drop in the bucket." The necessity for this type of approach is well documented and the TREX approach would be an interesting case study on the effectiveness of public outreach at the local level. The public rarely hears about successful prescribed burns, only the ones that escape; this lack of communication is the primary deterrent to trust between agencies and the public (Loomis et al., 2001; Winter et al. 2004)

APPENDIX IV

LIST OF ACRONYMS

Acronym	Meaning	First shown (page)
FLN	Fire Learning Network	1
NWCG	National Wildfire Coordinating Group	1
PFTC	Prescribed Fire Training Center	10
SAFE	Student Association for Fire Ecology	9
TNC	The Nature Conservancy	8
TREX	Prescribed Fire Training Exchange	1
USFS	United States Forest Service	8