THE METHODS OF COMMUNICATION AND EDUCATION USED TO TRAIN FOREST AND FIRE PERSONNEL THROUGH THE SWANTON PACIFIC RANCH

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ABSTRACT

The methods of communication and education used to train forest and fire personnel at Swanton Pacific Ranch

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California does not have a cohesive curriculum for educating and training forest and fire professionals. The Swanton Pacific Ranch Fuels Management Training Program is Cal Fire affiliated and provides online and in person training to assist in equipping fire and forest professionals throughout California with the necessary skills to be successful fire and forest practitioners and managers. An exit survey was offered to all workshop participants after the Swanton workshop concluded. The survey was answered by 331 Swanton workshop participants to assess the effectiveness of the training program, the educational practices used to teach participants, and what factors of a participant's background influence their change in knowledge. Analyses indicate that specific elements of a Swanton workshop participant's background (i.e., gender and years of experience) as well as workshop type strongly correlate with their overall change in knowledge. Swanton workshop participants identified five best educational practices for their learning experience that also aligned with best practices identified in the literature. These practices included personal experiences, engaging instructors, presentations, explanations, external resources, detailed definitions, and a facilitated question and answer portion. Multiple instructors during hands-on and online Zoom sessions were beneficial for engagement and organization. The workshop's accessibility benefits those in the industry thus making it helpful. The employment of the five best practices also showed significant correlation with greater changes in workshop participant's change in knowledge. The results also indicate that the Swanton Pacific Ranch Fuels Management Training Program is effective due to a consistent increase in knowledge obtained after the workshop. These results can be used to create a cohesive training curriculum for the state of California to ensure that well rounded fire and forest personnel are maintaining California forests. The results can also assist in creating a cohesive framework for all Swanton workshops to follow to maintain effectiveness.

Keywords: [California forest maintenance, educational tactics, fire training, forest professionals, Swanton Pacific Ranch, Cal Fire, forest training, forest fuel management]

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Chapter 1

INTRODUCTION

Climate change is causing the scale of large wildfires to increase worldwide (Pechony & Shindell, 2010). This is due to rising temperatures that cause an increase in heat stress on trees, critical fire weather days, drought periods, and the frequency of lightning storms. Drought periods exacerbated by climate change can lead to an increase in flammable vegetation that fuels wildfires. Climate change is also predicted to change wind patterns from land to sea, leading to stronger winds that provide more oxygen for wildfires (Xu et al., 2020). An increase in the frequency and intensity of extreme heat days from climate change provides an increase in ignition sources for wildfires (Xu et al., 2020). These factors contribute to longer fire seasons and more frequent wildfires in California (Boegelsack et al., 2018). Unprecedented wildfires and the risk of wildfires is a specific issue in California that leads to destruction that impacts humans, animals, and ecosystems (Boegelsack et al., 2018).

To mitigate the effects of unprecedented wildfires in California, forest fuel management strategies such as prescribed burns and mechanical thinning are used. Forest fuel management strategies are implemented by forest fuel managers and personnel. Forest fuel managers are given the task of meeting fuel management objectives, reducing fire risk, communicating with the public (Husari et al., 2006), and making complex fire decisions all while preventing, suppressing, and detecting fires (Martell, 2015). Fire managers have the responsibility of trying to find the balance between the benefits and harmful

impacts of fire (Martell, 2015). Additionally, the wildland-urban interface (WUI) is the area between California forests and homes. Fire managers must communicate with WUI residents when performing fuel reduction programs inside of the WUI. Due to this, communication skills are essential to a fire manager's job. Moreover, forest managers must also communicate with scientists and researchers to inform their management decisions (Ryan & Cerveny, 2011). These tasks, in addition to changing wildfire dynamics in California, present a need for managers to be equipped with the most current knowledge to inform their decisions and management tactics. Therefore, forest managers must be properly trained to be successful.

The different methods used to train fire personnel include online and blended training courses (McGranahan et al., 2022). Online workshops, courses, and certifications are accessible and affordable methods of training for midcareer professionals (Kobizar et al., 2009). In California, Cal Fire has free online Zoom workshops for fire and forest professionals that focus on the necessary skills for California forest maintenance. Blended training combines online coursework with hands-on development to create well-rounded fire personnel who understand forest and fire dynamics and implementation measures. (McGranahan et al., 2022). Moreover, another method of training forest and fire professionals is through higher education in person and online courses. Universities outside of California have undergraduate and graduate programs that utilize both hands-on and online training and education. Online instruction has become an accessible method for students seeking training in the fire and forest industry. Best practices

for online education have emerged to assist in online instruction. These include course organization (Sun & Chen, 2016), a maintained teaching presence (Lewis & Abdul-Hamid,2006), supplementary course materials (Kostova & Atasoy, 2008), and shared experiences (Lewis & Abdul-Hamid, 2006). These have been viewed as the best practices for successful online learning and course instruction.

Despite the variation in training programs and different training methods there have been minimal evaluations and analysis done to determine if the programs are effective and what elements are contributing to the effectiveness of the programs. Training programs and events provide professional development and operational experience (Spencer et al., 2015). Training programs also provide an opportunity for landowners and non-federal fire professionals to be trained, contributing to a more diverse population of fire officials (Spencer et al., 2015). Cal Fire hosts a training program through the Swanton Pacific Ranch for forest and fire professionals within the state of California. Swanton Pacific Ranch utilizes different approaches for online and hands on instruction. Analyzing the performance of the Swanton Pacific Ranch forest and fire training programs could determine if the program is utilizing the best practices from existing literature and if the lack of implementation is affecting the training and knowledge of forest and fire professionals. This could contribute to developing a comprehensive model of training approaches for the state of California.

This project tracks the effectiveness of the applied research and training program done by the NRES department at Cal Poly and Cal Fire. The research

and training program at Swanton Pacific Ranch in California is designed to bridge the gap between the limited personnel that inhibits forest fuel management on a larger scale. Internet-based exit surveys were given to the forest fuel management workshop participants to track the program's effectiveness. The exit surveys include a set of questions about the experience of the participants and what they have learned. The exit surveys provide the NRES department and Cal Fire with the opportunity to assess if the methods of communication and training are leading to successful forest personnel and managers. The goal of this project is to determine what educational methods are most effective in creating a cohesive and effective forest and fire training program, what are the perceived best practices identified by participants and do they impact their change in knowledge, and finally what elements of a Swanton workshop participants background effects their change in knowledge. It is hypothesized that there will be a correlation between years of experience and change in knowledge. As the years of experience of a Swanton participant increases their change in knowledge will decrease or be less than a person who has minimal years of experience. It is also hypothesized that visual aids such as presentation materials will be an identified effective practice.

Chapter 2

LITERATURE REVIEW

This literature review discusses the responsibilities and training of forest and fire professionals. Forest fuel managers are responsible for understanding forest fuel management objectives and implementing fuel mitigation such as prescribed fires and mechanical thinning. Additionally, forest and fire professionals must have a basis for informed decision making when deciding on what type of fuel mitigation technique to use and the effects of its implementation (Husari et al., 2006). Fire managers must also communicate effectively with the public, wildland-urban interface residents, and their fire crews (McGranahan et al., 2022; Paveglio et al., 2009). To have this advanced skill set, fire managers are trained through different methods such as online instruction, hands-on training, blended and experiential learning, and higher education courses.

Responsibilities of Forest and Fire Personnel

Management objectives

One of the responsibilities of forest fuel managers is to understand and meet forest fuel management objectives. Husari and colleagues (2006) outlined the different responsibilities of forest fuel managers and the goals of management objectives and treatment plans. The goal of fuel treatments is to modify potential fire behavior and fire effects. By reducing fire behavior, risks, and effects it protects human communities and assists in ecosystem health. Management objectives have the priority of decreasing fire intensity, severity, and rate of spread. To achieve fuel management objectives, forest fuel managers

perform two types of fuel management treatments: fire treatments and mechanical treatments. These treatments manipulate and decrease the amount of fuel biomass in a wildland ecosystem which mitigates the behavior, spread, and intensity of wildfires (Husari et al., 2006). Fire managers must also assess the ecological impacts of the fuel technique that is going to be used. In most cases, managers are asked to consider mechanical treatments before prescribed fires. This adds another layer because managers then must determine what wildland fuels to remove as well as how much. In addition, fire managers must also evaluate the consequences of fuel management action and inaction. The evaluation of impacts must be in depth to mitigate the amount of controversy that is associated with fuel programs (Husari et al., 2006).

After the management objectives are met, forest fuel managers are also responsible for the restoration and maintenance phase of forest fuel management objectives. Agencies and forest fuel managers assess the cost and frequency of restoration and maintenance. Their next responsibility is to use spatial data to quantify the magnitude of fire hazards and their potential as a problem. The cost as well as the scope of the problem inform the rest of the forest fire management plan and the degree in which it is performed (Husari et al., 2006).

Components for Effective Decision-Making Skills

Decision making is another part of a forest fuel manager's job. There are a plethora of unpredictable factors associated with the management of forest ecosystems (Pacheco et al., 2015). Unpredictable factors include weather

forecasts, suppression resource performance, and fire behavior spread (Pacheco et al., 2015). Peterman and Peters (1998) discuss how natural variability in ecology and human behavior affects management decisions, making it difficult for managers to forecast responses to management implementations or practices. Ecological uncertainties such as the growth rate of trees or the emergence of new species create an area for unsound decision making and prevent accurate depictions of outcomes for a particular management action. Peterman and Peters (1998) also describe how sampling techniques can have uncertainties. Sampling techniques create uncertainty by estimating inaccurate quantities such as the density of a bird species or a species mortality. This could cause managers to forecast or make decisions with inaccurate information. Lastly, management objectives and treatment plans can create uncertainty within by being vague or constantly changing during the implementation process. These uncertainties and unknown ones are at the forefront of management decision making and thus complicate management actions.

Climate change is likely to affect the risks and uncertainties associated with forest fuels management (Yousefpour et al., 2012). Climate information is a key component of mitigating risk for fuel treatments and wildland fire use incidents (Kolden & Brown, 2010). The use of climate science and science in general to inform decision making is limited in forest management agencies. This is due to limited research being done on the application of fire science for wildland fire management (Hunter et al., 2020). Consulting the available science benefits both fuel and wildfire managers because that information can be used to

plan fuel treatments that reduce wildfire risk while supporting wildlife habitat (Hunter et al., 2020). However, the use of scientific information is unevenly used by managers (Kolden, 2019). A survey conducted by Kolden and Brown (2010) found that wildland fire use managers consider climate science and information in their planning. However, prescribed fire managers do not usually consider climate information in their planning activities. Moreover, prescribed fire managers stated that barriers to using climate information include a lack of availability and conflicting agency directives (Kolden & Brown, 2010). These findings agree with Hunter et al. (2020) that found fire science is used in the planning and forecasting of wildland fire management rather than assessment and policy. Additionally, fire science usage is predominant in wildland fuels management rather than wildfire management. There is also a decrease in fire science use due to managers being unaware that relevant fire science data exists and having a limited understanding of the science. These factors inhibit the use of fire science in decision making (Hunter et al., 2020).

Furthermore, there is a lack of climate change information agency training. Kolden and Brown (2010) discuss how the lack of agency climate change training and limited decision-support tools are causing climate information to be left out of the planning and implementation of fire management. There are not any federal or governmental policies that mandate fire managers to use any specific or published sources on climate information in their management planning. Moreover, there is no integration of climate training or decision support systems in United States fire management. This presents a gap between applied science

and the United States fire policy's priorities (Kolden & Brown, 2010; Kolden, 2019). In addition to policy limitations, only thirty-two percent of survey respondents said that they had in-depth climate training or education in climatology. However, fifty percent of surveyed respondents disclosed that they received a passable amount of training through agency training courses. Overall, prescribed fire managers felt they needed supplemental climate information training to better incorporate it in their decision-making (Kolden & Brown, 2010). To mitigate the effects of climate change on forest and wildland ecosystems climate change should be considered in forest management from a local to federal level (Kolden & Brown, 2010; Kolden, 2019).

The last element to climate change decision making is adaptive climate management. To efficiently adapt to climate change, forest managers must understand the effects of climate on forests (Keenan, 2015). Adaptive management integrates knowledge on alternative management practices that can be used under changing climate conditions in forest management (Yousefpour et al., 2012). This is done through monitoring and anticipating change in climate conditions while avoiding negative consequences associated with change (Levina & Tirpak, 2006). Adaptation actions include reducing vulnerability, increasing resilience and capacity to respond to climate extremes, and anticipating future changes in climate. Adaptation actions are a systematic process that continuously improves management policies and practices while reacting to changing conditions. One form of adaptive management is through modeling approaches. Risk analysis in decision-making models assists in

adaptive management. Through modeling potential forest risks under climate change and their outcomes, managers can create plans to adapt to different outcomes (Yousefpour et al., 2012). Adaptive management can lead to better decisions regarding sustainable forest management in climate change.

Communication Skills

Forest fuel managers are also responsible for having well developed and effective communication skills. For management plans to be done efficiently, managers are responsible for communicating the treatment plans effectively to their team or group (McGranahan et al., 2022). Forest fuel managers are also responsible for communicating the fundamentals of fuel and fire behavior in both social and ecological contexts (Paveglio et al., 2009).

Fire fuel managers are also responsible for risk communication which is communicating information to people who live near a type of hazard including WUI residents (Paveglio et al., 2009). The WUI is the area between forests and homes. As the WUI expands further into the wilderness, homes and residential lives are put into danger which could potentially lead to loss of life and property (Safford et al., 2009). Paveglio et al. (2009), interviewed WUI residents who stated that communication was the primary responsibility of managers. Consistent manager communication is the most effective way to communicate about issues regarding risk to the area. It also establishes trust between WUI residents and the public (Paveglio et al., 2009). Most importantly this type of relationship should be established before disasters (Palenchar et al., 2002). As the frequency of wildfires continues to rise due to climate change (Pechony &

Shindell, 2010) risk communication will be crucial to fire management in the upcoming decades (Paveglio et al., 2009).

Forest fuel managers must also effectively communicate with researchers about their decision making. Ryan and Cerveny (2011) found that managers must be active in discussions and the development of research for more effective management planning. Additionally, managers must communicate their concerns and needs effectively for researchers and scientists to be responsive to them (White, 2004). Ryan and Cerveny (2011) found that managers had a greater ability to communicate with researchers in their own agency as opposed to other federal, state, local or academic institutions. This displays that an established connection between researchers and managers leads to more efficient information flow and concern communication. Communication between researchers and managers is important because these conversations inform their decision making about management plans and implementation.

Forest and fire personnel training

Training, experience, and education are the basis for effective career development in fire (Kobziar et al., 2009). Well-rounded fire and forest personnel must have a strong background in training, experience, and education (Kobizar et al., 2009). Having a thorough background in these areas equips forest and fire professionals to handle the various aspects of their job. A thorough background in training provides forest and fire professionals with the hands-on development to carry out and meet management objectives. Additionally, experience provides fire and forest professionals with the development of communication and

effective decision-making skills. Education is a critical component to the effective career development of fire and forest professionals. An educational background provides forest and fire professionals with ecological, environmental, fire science, GIS, and climate change knowledge to supplement their training and contribute to their experience. There are different methods of training to accomplish a solid backing in this (Kobizar et al., 2009).

Existing fire and fuel training programs

Hands-on learning techniques are an effective way to reach adult audiences (Parkinson et al., 2003). In a study done at The Nature Conservancy's Dunn Ranch Prairie in northern Missouri, McGranahan and colleagues (2022) found that hands-on learning was an important part of training wildland fire professionals. Participants experienced prescribed fire burns and switching squad roles in fire crews. The program was designed to be as hands-on as possible for participants to learn from instructors as well as other participants. This was coupled with online course work to create a blended training program.

In addition to blended learning, higher education programs and courses are another form of fire management training. An example of this is Oklahoma State University's prescribed fire courses. Oklahoma State University utilizes a lecture and field-based experiential approach to teaching prescribed fire courses to undergraduate and graduate students. Furthermore, Oregon State University educates land managers through its combination of resources, faculty, hands-on experience, and program structure positions. The unique element of Oregon State University is its ability to use the forests located in Oregon as a mechanism

to adapt to emerging forest trends as well as providing students with firsthand observation of forest management practices. The Oregon State University Forest Management major is adaptive and keeps up with the changing needs of employment in natural resources management. The curriculum is consistently updated to match current trends.

Moreover, Arizona State University has an online Master of Public Safety Leadership and Administration with a concentration in Executive Fire Administration. This online program offers classes to students that aim to develop the necessary skills of fire managers such as leading fire teams, data analysis, and public policy and administration. The master's program includes a professional project that links the theory of the class coursework with hands on experience and practice (ASU Master of Public Safety Leadership and Administration – Executive Fire Administration, 2023).

In California, Cal Fire offers free online workshops for beginner to midcareer professionals to train them in specific fire related topics (Swanton Pacific Ranch Cal Poly, 2023). Additionally, California Polytechnic University San Luis Obispo currently has an in-person Master of Science in Fire Protection Engineering. Cal Poly San Luis Obispo utilizes a "Learn by Doing" approach to equip graduate students with the necessary knowledge to understand fire safety codes, flammability characteristics, basic fire science, engineering, and structural fire protection to achieve specified fuel management objectives (Cal Poly College of Engineering, 2023).

Analysis of current training programs

Despite the existence of the aforementioned programs there are few post-program analyses to assess if they are effective in training and equipping forest and fire professionals. The Nature Conservancy's Dunn Ranch Prairie in northern Missouri is a current example of forest and fuel personnel training that combines hands on development with online coursework (McGranahan et al., 2022). Through this program McGranahan and colleagues (2022) stated that online certification by itself without in person experience leads to incomplete professional development. Instead of being equipped with hands-on experience, fire crews are paper ready instead of hands-on ready. When online coursework is coupled with simulations or done before in person workshops it contributes to active learning. Students came to workshops with questions from doing the coursework online beforehand which led to a greater focus on synthesis and application. The success of blended learning in this program shows its applicability to other areas of fire workshops and training (McGranahan et al., 2022).

In addition, Scasta and colleagues (2015) assessed undergraduate training methods at Oklahoma State University. Students taking the course had increased confidence in planning and leading a prescribed fire program and operating a drip torch. It was also found that experiential learning ranked higher in utility than passive learning such as lectures. Students also stated that conducting prescribed fires was the most useful instructional activity. Furthermore, Oregon State University also utilizes experiential learning and

agrees with Scasta et al. (2015). Fisher (1996) found that Oregon State University's location is a mechanism to adapt to emerging forest trends as well as providing students with firsthand observation of forest management practices. This contributes to graduates having the necessary skills of the current job market.

Kobizar and colleagues (2009) discussed the challenges associated with higher education programs. Academic calendars overlap with seasonal prescribed burning and wildfire suppression employment, which causes students and fire practitioners to have difficulty gaining experience. Additionally, there is a disconnect between educational goals and what is necessary for entry-level agency positions. Higher education is focused on preparing graduates for management positions, however, without agency sponsored training or fire experience graduates cannot achieve higher ranks or permanent entry level positions. This correlates to experience being valued higher than education. Moreover, the incorporation of training and experience in academic programs is not recognized as meeting training qualifications if it is not taught by approved instructors. Two-year technical degree program students face the same barrier of obtaining experience during the overlap of the academic calendar. However, technical degrees focus more on technical education and training skills which causes them to have an advantage for entry level and seasonal employment. The disconnect between higher education courses and agency requirements limits the opportunities for higher education fire science program students (Kobizar et al., 2009).

Furthermore, there has been a shift in the criteria for federal agency fire professionals to have some type of college education to advance to senior positions. This causes current midcareer professionals to be ineligible to advance to senior level positions. Receiving a college education as a midcareer professional may not be accessible due to being unable to adjust work schedules, financial inaccessibility, and being able to attend courses in person (Wells, 2011). Online workshops serve as an accessible and affordable method to train midcareer fire professionals that may not conflict with their current work or agency (Kobizar et al., 2009). Additionally, online college courses incorporate readings, discussions, and hands-on course work and are accessible (Wells, 2011). In California, Cal Fire offers free online workshops for beginner to midcareer professionals to train them in specific fire related topics (Swanton Pacific Ranch Cal Poly, 2023). Coursework may be designed to meet the GS-0401 (Fire Management Specialist position) standards required for GS-0401 level positions. These standards include fuel management and planning, assessing fire effects, fuels inventory and mapping, remote sensing of fire and postfire effects, wildland fire ecology management, rangeland resources, and GIS applications (Wells, 2011). As current GS-0401 employees retire there will be a need to find qualified employees to fill these positions. Online fire and forest education serve as a viable option to bridge this gap.

The challenges and analysis of current training do not evaluate if the usage of effective educational practices is influencing the education and training of forest and fire professionals. The employment of effective educational

practices within the training curriculum could have a positive influence on educational effectiveness and the training and success of forest and fire personnel.

Effective Education Tactics

Course organization and structure is an effective educational tactic for online learning and teaching. Time that is invested in planning and organization of online courses contributes to the overall success of online courses (Major, 2010)**.** Instructors who teach online courses and workshops should do pre-course planning and maintain organization throughout their presentations and course instruction. In addition, facilitating online course discussions, questions, and keeping a structure throughout the class period creates a successful online course (Lewis & Abdul-Hamid, 2006).

In like manner, instructor presence and engagement are another effective educational tactic that contribute to the success of online education. Having an increased teaching presence (Anderson, Rourke, Garrison, & Archer, 2001; Gorsky & Blau, 2009) and social presence (Richardson & Swan, 2003; Thurmond, Wambach, Connors, & Frey, 2002) contributes to perceived learning and the development of cognitive and social skills in students (Gorsky & Blau, 2009). Teacher presence must also be maintained throughout the duration of the presentation and throughout the course or workshop. This can be accomplished through remaining energetic and maintaining a visible persona when teaching online (Lewis & Abdul-Hamid, 2006). It also incorporates being engaged with the material that is being presented. Social presence can be accomplished through

frequent acknowledgements, timely feedback, friendly greetings, using first names, and expressions of emotion and empathy (Whipp and Lorentz, 2009). Social presence can be maintained through frequent instructor-student interactions causing students to be more engaged with their courses (Rao & Tanners, 2011). Developing teaching and social presence contributes to cognitive engagement and the success of online teaching (Sun & Chen, 2016).

Furthermore, learning objects are an effective educational tactic that influences the success of online education and combines the aforementioned elements. Learning objects can take the form of shared experiences, responding promptly to discussion questions, providing presentation materials before lecture, video clips, and other digital resources that can complement the online course structure (Kostova & Atasoy, 2008). Personal experiences and perspectives can contribute to active engagement with the course content (Brown, 2001; Wilson & Ryder, 1996). Learning objects can facilitate organization during instruction and increase engagement with students and instructors. Providing course materials such as direct links, articles, and presentation slides can contribute to organization (Sun & Chen, 2016). Sharing experiences to supplement the lecture material can lead to having an increased teaching presence and a unique persona. It can also contribute to creating engagement with the material as well as the participants in the class (Lewis & Abdul-Hamid, 2006).

The different forms of training have contributed to a gap in a comprehensive and coordinated approach to training the next generation of fire and forest professionals. As outlined in the aforementioned paragraphs, the

duties of United States fire professionals have become increasingly complicated due to fuel load accumulation, climate change, and the wildland-urban interface. The education and training methods are all different causing them to have both strengths and weaknesses. The systems that produce fire professionals have not developed an organized and coordinated approach to prepare future fire professionals. There is a lack of common vision and coordinated approach in the United States when it comes to the education, training, and experience of fire professionals (Kobizar et al., 2009). The United States has acknowledged the need to improve education and training in fuels, fire behavior, and management. However, a cohesive science and practice of wildland fire use curriculum has not been made (McGranahan et al., 2022). Due to this, there is a lack of adequately trained fire professionals that understand ecological objectives (Kobizar et al., 2009). Fire training programs and events provide professionals with development and operational experience. Additionally, opening training programs to nonfederal fire professionals such as private landowners increase the number of people involved in fire fuels management. A comprehensive fire training program for California would benefit the state (Spencer et al., 2015).

Conclusion

The responsibilities of fire and forest professionals will continue to become more strenuous under a changing climate and environment (McGranahan et al., 2022). Therefore, it is important that forest and fire professionals undergo extensive training to be able to have effective decision-making skills, communication skills, an understanding of management objectives, as well as

technical hands-on operational experience. Fire personnel must be equipped with fire and ecological literacy and hands-on development to implement fire techniques under various barriers and conditions (Husari et al., 2006). Fire and forest professionals must also consider a multitude of uncertainties present in forest ecosystems and habitats (Peterman & Peters, 1998). They must also effectively communicate risk with residents, the public and the WUI (Paveglio et al., 2009). The knowledge gap identified in this literature review is what methods constitute an effective forest and fire training program. Online certification, blended learning (Mcgranahan et al., 2022), experiential learning (Scasta et al., 2015), as well as the variation in higher education curriculum (Scasta et al., 2015; Kobziar et al., 2009; Sample et al., 1999) has created a myriad of training methods that prioritize different elements causing a lack of cohesion. The Swanton Pacific Ranch applied research and training program in California serves as an opportunity to track the effectiveness of the methods of communication and education used to train fire and forest professionals. Analyzing the learning and communication methods could contribute to a comprehensive fire training curriculum for the program and state. It can also aid in establishing the best teaching practices for effectively educating fire and forest professionals and identify areas of improvement for the Swanton workshops. Through an internet-based exit survey the Natural Resource Management and Environmental Studies department at Cal Poly San Luis Obispo and Cal Fire can assess if the participants are receiving the necessary components to become successful and effective fire personnel.

Chapter 3

METHODS

Introduction

This study determines the effectiveness of the research and training programs done by the Swanton Pacific Ranch Fuels Management Training Program. Exit-based internet surveys were sent to participants of various research and training programs conducted by professionals at Swanton Pacific Ranch. The questions in this survey collect information regarding participants' background, their knowledge before and after, and their feedback on what worked well in each training program.

Sampling

The sample consisted of all participants who responded to the exit survey and gave feedback on the training programs they attended. The training programs participants attended were either webinar-based (hosted over Zoom) or were in-person trainings hosted at Swanton Pacific Ranch in Davenport, California. The participants of the training programs are professionals who come from fire or forest related industries, are seeking additional training to increase their knowledge, and signed up to participate in specified training. After the program concluded, surveys were sent to the email associated with the participants. Each enrolled participant receives a survey regardless of how long they attended the workshop. The survey results consisted of workshop participants' responses from 21 programs between October of 2022 through July 2023. The 21 workshop titles are in Appendix B.

Data Collection & Survey Design

Data was collected through a survey sent out through Microsoft Forms. Consent was received from all respondents, responses were anonymous, and approval was given from the Institutional Resource Board (IRB Approval Number 2023-116). The survey link was sent out through email to workshop participants with an attached thank you note. The participants then had a week to complete the survey before it closed. A reminder email was sent out either one day before the survey deadline or the day of the survey deadline. Reminding participants of email-based surveys has demonstrated an increase in email-based survey responses (Van Selm & Jankowski, 2006). This resulted in a sample size of 331 survey respondents across the 21 different workshops. A sample size of 331 respondents allowed for an in-depth analysis of the effectiveness of the training programs and what methods lead to better educational development.

The distributed survey consisted of eleven questions that are in Appendix A. The survey questions aimed to understand the background of participants, their knowledge before and after, and what worked best throughout the workshop. Questions consisted of Likert scale, multiple choice, and free response questions.

Dependent Variables

The dependent variable for the survey design is the effectiveness of the workshop training program. The effectiveness of the training program can vary based on factors that can influence how effective each workshop participant found the program to be. The rate of effectiveness of the workshop was

constructed by subtracting the survey participant's before and after knowledge to establish a change in knowledge (after knowledge – before knowledge = change in knowledge).

Data Entry & Archiving

Once the survey concluded the data was downloaded into an Excel sheet. Each workshop had its own Excel sheet and therefore each program's data was compiled into one master Excel sheet to run statistical analysis and qualitative analysis. Each program was coded with a number to differentiate the data based on workshop type. Incomplete responses also placed restraints on the survey data. Incomplete responses were treated as outliers and omitted. Additionally, negative values for change in knowledge happened twice causing it to be a rare case and thus omitted Data from the survey was stored in a password protected shared One Drive folder with the Swanton Pacific Ranch professional staff.

Data Analysis

Statistical analysis was performed on the survey data. The first step in this process was giving each workshop a number to differentiate the workshops in the data set. Next, years of experience, gender, workshop type, organizational affiliation, and geographic location were coded with numbers for statistical analysis. The codebook for these values is in Appendix B. Descriptive statistics were run in Excel to find the mean, standard deviation, range, and variation (Weaver et al., 2017; Elliot et al., 2006). This summarized the basic features of the data set. Comparisons were then made amongst the different workshops based on the descriptive statistical values. The comparisons were done to

assess if a specific workshop had higher descriptive statistics than the other workshops included in the data set. Additional statistical analyses were also run in R (4.2.2). A Nonparametric Spearman Correlation test was done to determine if there was significance between years of experience and change in knowledge. An ANOVA test was run between gender, workshop type, organizational affiliation, and geographic location and change in knowledge to test for statistical significance. Statistically significant ANOVA results were followed with a Tukey's HSD test to assess where significance lied. Additionally, an auto-correlation was run between variables identified as significant in the bivariate analyses. Furthermore, a multiple ANOVA was run to assess for statistical significance between years of experience and workshop type.

Qualitative data analysis was done on the free response portion of the survey for each workshop. The three free response questions were exported from the master Excel sheet into an individual Excel sheet for qualitative analysis. The type of qualitative analysis used was thematic analysis. Themes were determined based on their ability to answer the survey question and the overall research question of the study. This type of analysis generated descriptive and explanatory information about areas of improvement for the different workshops (Presier et al., 2021).

The themes identified through thematic analysis were named best practices one through five and were statistically analyzed to determine if they influenced a participant's change in knowledge. If a participant mentioned the usage of any of the best practices the entire workshop was coded to reflect that

the instructor employed the practice. The use of one of the best practices generated a workshop-level variable. A Paired t-test was performed to assess statistical significance amongst the identified best practices and change in knowledge. An ANOVA test was also conducted in R (4.2.2) between the number of best practices used and workshop type. Lastly, a Spearman Correlation test was conducted between the sum of best practices and the change in knowledge.

Limitations

There are limitations associated with internet-based surveys. Survey deadlines placed a limit on how many total survey responses were collected. The number of surveys sent, and responses received was also a limitation of this study. Not all workshop participants answered the survey which placed a limit on the total survey responses for a given workshop. In addition, the main limitation of this study was that change in knowledge was self-reported. Workshop participants were responsible for accurately depicting their current knowledge and knowledge attained after the workshop. These limitations restricted creating a holistic view of what worked best during the workshop and workshop effectiveness (Roztocki, 2001).

Chapter 4
RESULTS

Results

Surveys were administered to 331 workshop participants to understand the current performance of the Swanton Fuels Management Training Program. The survey responses also aid in determining which factors relating to the participants' background (gender, organizational affiliation, geographic location, workshop type, and years of experience) may influence their perception of workshop effectiveness. Additionally, the survey responses assisted in understanding which educational practices are improving the overall experience and knowledge of the Swanton workshop participants.

Descriptive statistics are presented in Table 1 and were done for 21 workshops to display the distribution of years of experience, before and after knowledge, and change in knowledge. Table 1 also displays the number of participants for gender, organization, location, years of experience, and workshop type change in knowledge. Out of the 320 workshop participants who answered the survey question of *Gender* 52.50% were Female, 44.38% were Male, and 3.13% selected Other. Regarding geographic location, 52.45% of the Swanton workshop participants selected Central Coast (25.17%), Sierras (Central, Northern, and Southern,18.65%), or Statewide (14.68%) as their location. Furthermore, 56.23% of the Swanton workshop participants selected NGO (19.81%), private business (19.49%), or state government (18.21%) as their organizational affiliation.

Experience is the years of experience that a Swanton workshop participant has in their respective forest or fire related industry (0-2, 2-5, 5-10, 10+). The overall mean experience for a workshop participant was approximately 2.54. Before knowledge was the amount of knowledge a Swanton workshop participant selected on a scale of one to ten prior to the workshop. The overall mean for before knowledge was 4.55. After knowledge was the amount of knowledge a Swanton workshop participant had after the workshop concluded on a scale of one to ten. The overall mean for after knowledge was 7.24. Change in knowledge was constructed by subtracting after knowledge from before knowledge (after knowledge - before knowledge=change in knowledge). The mean for change in knowledge was 2.72. The twenty-one workshops were divided into six topics based on their title: *Cal VTP*, *fire fighter training course*, *prescribed burns*, *grants*, *fuel treatments*, and *grazing*. The *Grants* workshop had the highest overall mean change in knowledge ($\overline{x}$=4.02, *SD*=1.80), while *grazing* had the lowest overall mean ($\overline{x}$ =1.93, *SD*=1.64).

Table 1

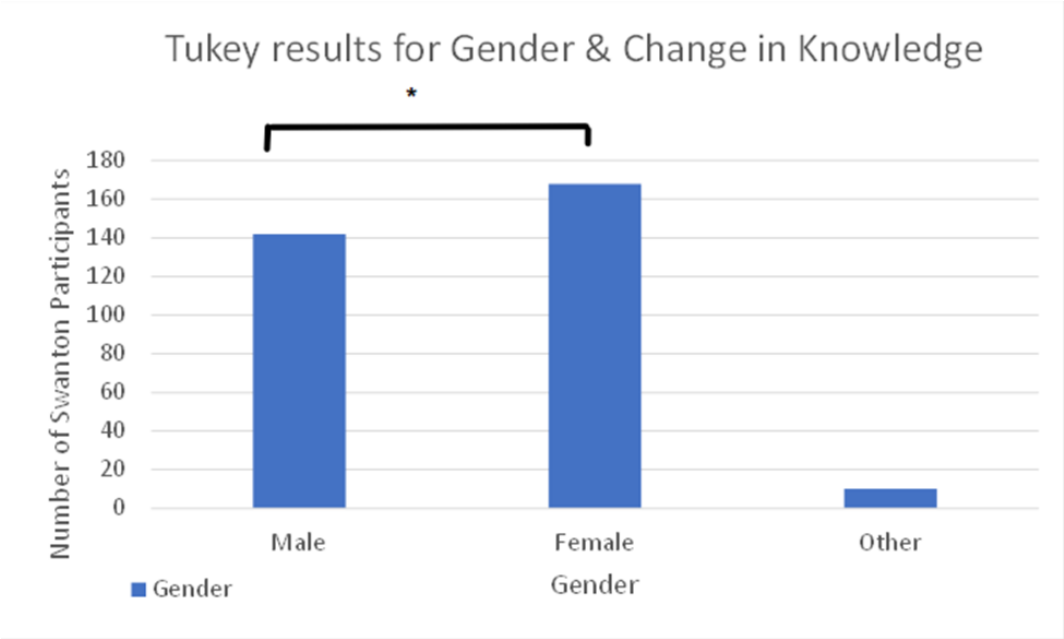
Swanton Survey Characteristics N=331

	Variable Type	N (%)	Mean	Median	Mode	SD	Min	Max
Gender	Female	168(52.50)						
	Male	142(44.38)						
	Other	10(3.13)						
Location	Bay/Delta	44(10.26)						
	Central Coast	108(25.17)						
	Sierras	80(18.65)						
	Deserts	5(1.17)						
	Klamath/North Coast	54(12.59)						
	Modoc Plateau	2(0.47)						
	Valleys	40(9.32)						
	South Coast	33(7.69)						
	Statewide	63(14.68)						
Organization	Applying for FF Jobs	1(0.32)						
	Community	33(10.54)						
	Federal Government	6(1.92)						
	Fire Response	13(4.15)						
	Municipal Government	11(3.51)						
	NGO	62(19.81)						
	Private Business	61(19.49)						
	Regional Government	32(10.22)						
	Resource Conservation District (RCD)	3(0.96)						
	State Government	57(18.21)						
	Tribal	3(0.96)						
	University/College	31(9.90)						
Experience	0-2	96(29.0)	2.54	3	4	1.25	1	4
	2-5	55(16.2)						
	5-10	51(15.5)						
	10+	106(32.10)						
Before Knowledge			4.55	4	1	2.56	1	10
After Knowledge			7.24	8	8	1.84	1	10
Change in Knowledge			2.72	2	2	1.86	-3	9
Workshop Type Change in Knowledge	Cal VTP	79(23.87)	3.09	3	2	1.74	0	8
	Fire Fighter Training Course	8(2.42)	2.43	2	2	2.99	0	9
	Prescribed Burns	58(17.52)	2.59	2	4	1.85	0	7
	Grants	51(15.41)	4.02	4	4	1.8	0	7
	Fuel Treatments	77(23.26)	2.23	2	2	1.62	-3	7
	Grazing	58(17.52)	1.93	2	2	1.64	-1	7

An ANOVA test identified that gender has a significant effect on change in knowledge, $F(1,293) = 4.21$, $p=0.016$. A Tukey's HSD test for multiple comparisons found that the mean value of *Gender* was significantly different between Male and Female ([p=0.015], 95% C.I. = [-1.11, -0.016]). There was no statistically significant difference in mean between Other and Female (p=0.45) and Other and Male (p=0.93). Figure 2 is a representation of the Tukey results for *Gender* and change in knowledge. The relation with an asterisk means that there is a statistically significant difference between Female and Male.

Figure 1

Tukey's HSD results for Gender and Change in Knowledge



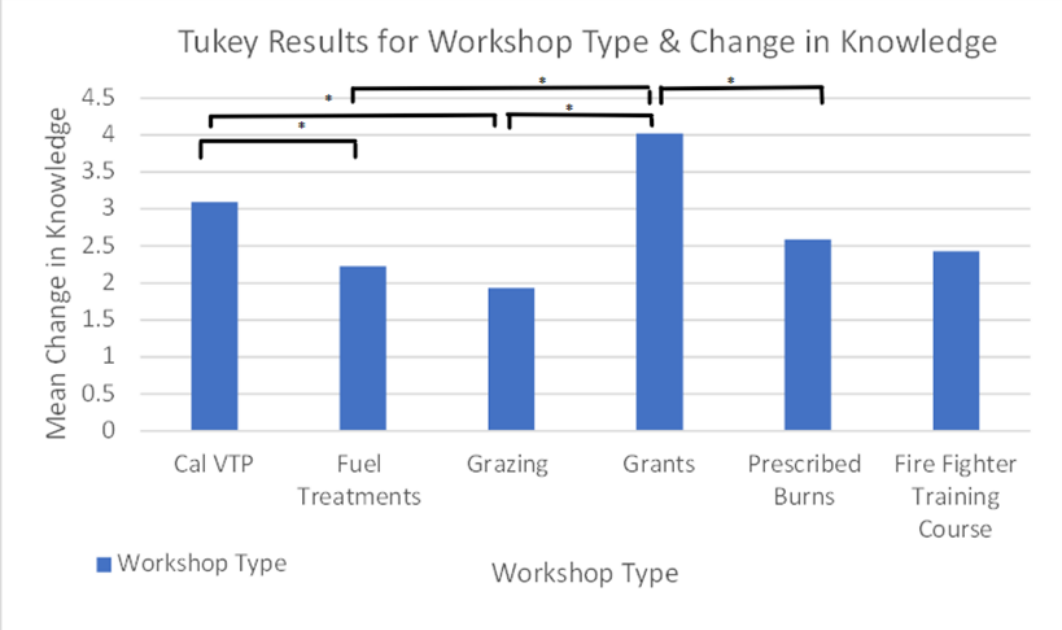
Location and organization were tested for statistical significance. Through an ANOVA test it was found that the organizational affiliation of a Swanton participant does not significantly correlate with a workshop participant's change in knowledge (p=0.13). Through an ANOVA test it was also found that the

location of a Swanton participant does not significantly correlate with a workshop participant's change in knowledge (p=0.76).

An ANOVA test determined that there is significance between workshop type and change in knowledge, $F(5,278) = 7.78$, $p=0.006$. A Tukey's HSD test for multiple comparisons found that the mean values of workshop type was statistically significant between *fuel treatments* and *Cal VTP* ([p=0.03], 95% C.I. = [-1.69, -0.05]), *grazing* and *Cal VTP* ([p=0.03], 95% C.I. = [-1.89, -0.07]), *grants* and *prescribed burns* ([p<0.001], 95% C.I. = [0.542, 2.63]), *fuel treatments* and *grants* ([p<0.001], 95% C.I. = [-2.68, -0.82]), and *grazing* and *grants* ([p<0.001], 95% C.I. = [-2.87, -0.85]). Figure 1 is a representation of the Tukey results for workshop type and change in knowledge. The relation with an asterisk means that there is a statistically significant difference between the workshop types.

Figure 2

Tukey's HSD results for change in knowledge and workshop type



Experience and change in knowledge were examined. Experience is the years of experience that a Swanton workshop participant had in their respective forest or fire related industry (0-2, 2-5, 5-10, 10+). The survey answers were coded and assigned values of one to four, one being 0-2 years of experience and four having 10+ years of experience. A Non-Parametric Spearman Correlation test was conducted to test for significance between experience and change in knowledge. The results indicated that there is statistical significance and a negative correlation between the two variables, $r(329)= -0.27$, $p < 0.001$. An auto-correlation was used between all significant predictor variables (gender, workshop type, and years of experience). The auto-correlation from a multiple ANOVA indicated that there is not an auto-correlation between experience and workshop type ($p=0.64$), experience and gender ($p=0.90$), and workshop type and gender ($p=0.11$). In addition, a multiple ANOVA was performed between experience and workshop type and change in knowledge. Gender was not included in this multiple ANOVA because the purpose of this test was to determine if an unbalanced number of experienced individuals dominated a workshop type which would influence change in knowledge. The results indicated that both experience, ($F(1,303)=23.97$, $p < 0.001$) and workshop type, ($F(1,303)=9.39$,$p=0.002$) are significant predictors of change in knowledge and there is not an auto-correlation between experience and workshop type ($p=0.64$).

Qualitative

Through thematic analysis, Swanton workshop participants identified the best educational practices for their learning experience. Best practices identified in no specific order include:

1. Personal experiences, stories, and testimonies were seen as valuable and highly interesting to workshop participants (N=41)
2. Instructors who engaged with the workshop participants, encouraged participation, engaged in the lecture, kept a positive attitude, and were knowledgeable were seen as effective aspects of the workshop (N=74)
3. Presentations, explanation of concepts, external resources, detailed definitions, and a facilitated question and answer portion were beneficial to the participants and the effectiveness of the workshop. (N=73)
4. Having multiple instructors during the hands-on portion of the workshop and in the online Zoom format was seen as beneficial, encouraged engagement, and contributed to workshop organization (N=84)
5. Participants noted that the workshop being free made it accessible in addition to being informative, helpful, and the whole series being beneficial to those in the industry (N=50)

Furthermore, if any of the Swanton workshop participants mentioned that an instructor used the aforementioned practices the entire workshop was coded to reflect this. If the best practice was not mentioned, then the entire workshop was coded to reflect this as well. A Paired t-test was then conducted between each of the identified best practices and change in knowledge. Best practice 1 and

change in knowledge was statistically significant, $t(329) = -17.40$, $p < 0.001$. Best practice 2 and change in knowledge was statistically significant, $t(329) = -17.04$, $p < 0.001$. Best practice 3 and change in knowledge was also statistically significant, $t(329) = -17.40$, $p < 0.001$. Best practice 4 and change in knowledge was statistically significant, $t(329) = -17.04$, $p < 0.001$. Best practice 5 and change in knowledge was statistically significant, $t(329) = -18.03$, $p < 0.001$.

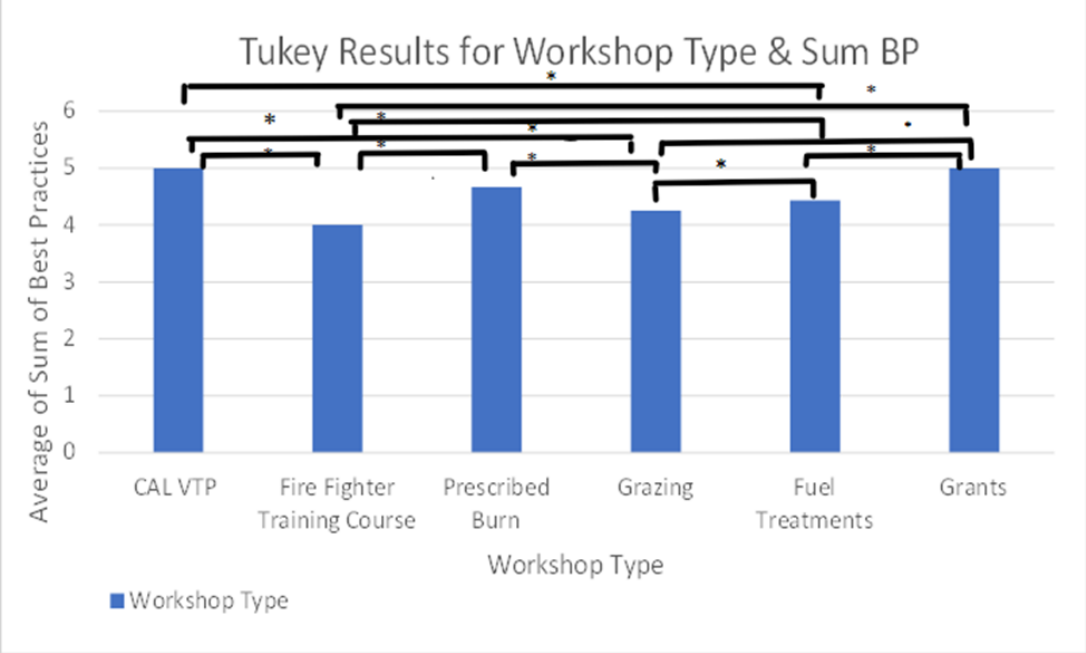
The five best practices were also evaluated to examine if the usage of more than one at a time influenced change in knowledge among workshop participants. Values were assigned by workshop based on the number of best practices used during that workshop. An assigned value of one indicated the usage of one best practice during a workshop and five being that all five of the best practices were implemented and used. The sum of best practices and change in knowledge were examined through a Pearson's Correlation Test which indicated statistical significance and a positive correlation, $r(329) = 0.18$, $p = 0.001$.

An ANOVA test also indicated that the sum of best practices and workshop type had statistical significance, $F(5,289)=13.99$, $p < 0.001$. A Tukey's HSD test for multiple comparisons found that the mean values of workshop type was statistically significant between *fire fighter training course* and *Cal VTP* ([p < 0.001], 95% C.I. = [-1.64, -0.36]), *grazing* and *Cal VTP* ([p <0.001], 95% C.I. = [-1.05, -0.42]), *prescribed burns* and *fire fighter training course* ([p = 0.003], 95% C.I. = [0.20, 1.52]), *grants* and *fire fighter training course* ([p<0.001], 95% C.I. = [0.35, 1.65]), *fuel treatments* and *fire fighter training course* ([p=0.04, 95% C.I. =

[0.02,1,30]), *grazing* and *prescribed burns* ([p < 0.001. 95% C.I. = [-0.95, -0.24]), *fuel treatments* and *grants* ([p = 0.03, 95% C.I. = [-0.66, -0.02]), *grazing* and *grants* ([p < 0.001. 95% C.I. = [-1.08, -0.39]), *grazing* and *fuel treatments* ([p= 0.005, 95% C.I. = [-0.71, -0.08]), *and fuel treatments* and *Cal VTP* ([p<0.008], 95% C.I. = [-0.62, -0.06]).

Figure 3

Tukey's HSD results for sum of best practices and workshop type



Content versus delivery was also analyzed to determine if the usage of best practices was driving change in knowledge or if the content/topic was driving change in knowledge. Due to having only 21 workshops grouped into 6 categories by topic this could not be tested for statistical significance. The number of best practices and mean change in knowledge between workshops of a given topic were compared. Workshop topics that did not have more than one training could not be compared (*Fire Fighter Training Course* and *Grants*).

Additionally, workshop topics that utilized all five best practices for all workshops under the topic and did not utilize less than five best practices could not be analyzed (*Cal VTP*). Figure 4 displays the average of best practices used for each workshop type. Table 2 includes *Prescribed Burns*, *Fuel Treatments*, and *Grazing* that were able to be analyzed for if content or delivery is impacting change in knowledge. The yellow highlighted sections within Table 2 indicate where less than five best practices were used within a workshop type. The red highlighted sections indicate where the usage of five best practices did not lead to a higher change in knowledge. In three out of the five yellow highlighted sections the usage of less than five best practices lead to a lower change in knowledge than best practices that utilized all five. For prescribed burns the two workshops that utilized all five best practices had a higher change in knowledge than the workshop who utilized four best practices. However, for fuel treatments and grazing some of the workshops with 5 best practices did not elicit higher scores. Therefore, delivery does seem to matter over content, but it is a little ambiguous, which points to why more research is needed.

Figure 4

Average of best practices used

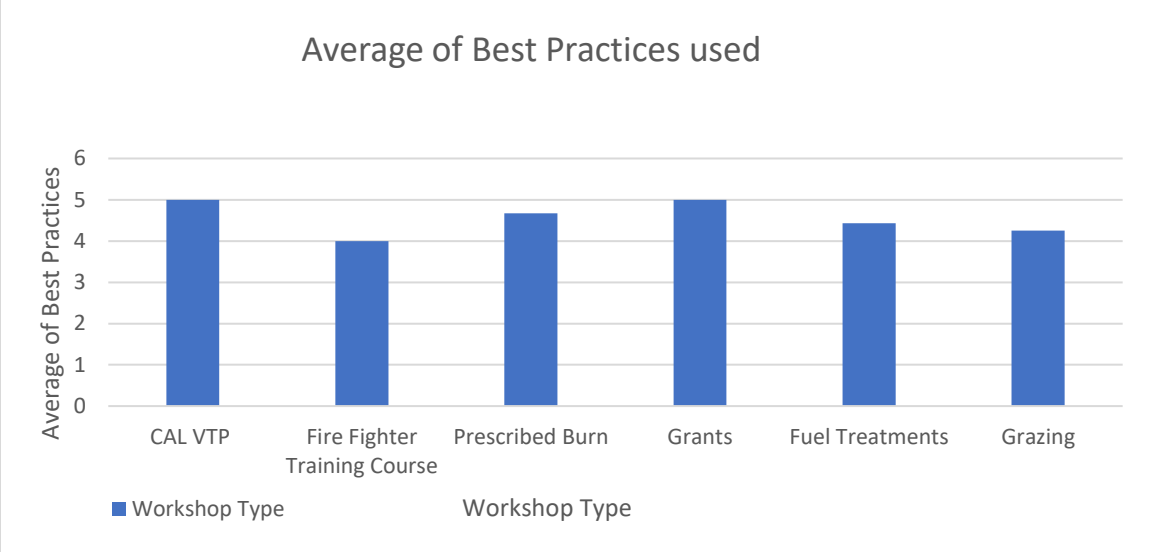


Table 2

Relationship between best practices and change in knowledge

Workshop Type	# of Best Practices	Change in Knowledge
Prescribed Burn		
Workshop #4	5BP	2.32
Workshop #5	5BP	3.43
Workshop #6	4BP	2.17
Fuel Treatments		
Workshop #8	5 BP	3.08
Workshop #13	2 BP	1.71
Workshop #15	5 BP	2.42
Workshop #17	4 BP	1.83
Workshop #19	5 BP	1.82
Workshop #20	5BP	1.6
Workshop #21	5 BP	2.5
Grazing		
Workshop #11	3 BP	2.26
Workshop #12	5 BP	2.29
Workshop #16	4 BP	0.86
Workshop #18	5 BP	2.05

rare cases where five best practices did not lead to a higher change in knowledge.

workshops where less than five best practices lead to a lower change in knowledge

CHAPTER 5

DISCUSSION

The purpose of this study was to do a post analysis of the effectiveness of fire workforce training. The different methods employed by various training programs are not frequently analyzed to understand effectiveness. This case study aimed to understand what educational practices that are being used by Swanton Pacific Ranch are most effective in equipping fire and forest professionals with the necessary skills and knowledge to be successful in their field. This will give Swanton Pacific Ranch and Cal Fire the opportunity to evaluate the current educational methods and determine the best practices for the future success of the program.

As hypothesized the correlation between experience and change in knowledge confirms hypothesis one which stated that there would be statistical significance or correlation between experience and change in knowledge. This hypothesis was based off the premise that if a participant had more knowledge and experience prior to the workshop their change in knowledge would be less, causing the participant to learn less than someone who had minimal knowledge or experience in forest and fire management. The negative rho of -0.27 that resulted from the Nonparametric Spearman Correlation test indicates that as experience increases change in knowledge tends to decrease. Kobizar et al. (2009) considers experience as one of the integral elements of the fire professional development triangle. Experience, training, and education provide the basis for achieving effective fire management. McGranahan and colleagues

(2022) and Murphy and Cole (2010) agree with Kobizar et al. (2009) about the need for experience when conducting prescribed burns and partaking in fire management. Therefore, as a fire professional has more experience in the field this element of the fire triangle becomes solid which would then cause their change in knowledge to decrease (Kobizar et al., 2009; McGranahan et al., 2022, Murphy & Cole, 2010).

Gender was an unexpected variable that had statistical significance with change in knowledge. The Tukey's HSD indicated that men state that they learn less than women. This agrees with the findings of Bench et al. (2015), Kamas and Preston (2012), and Owen (2022) who found that men overestimate their performance and exhibit overconfidence in STEM related fields such as math more than women do. This is a possible explanation for this relationship. Men overestimating their initial before knowledge would cause their change in knowledge to be less. Thus, indicating that they are learning less when their after knowledge is subtracted from before knowledge. This would then explain why men state that they learn less within the Swanton workshops.

The workshop type was also an unexpected variable that had statistical significance indicating that the type of Swanton workshop a participant attends could influence their change in knowledge. Workshop type aligns with the knowledge that a fire or forest professional must have. Each workshop covers topics that consist of management objectives (Husari et al.,2006), prescribed burn skills (Pacheco et al., 2015; Peterman & Peters., 1998), and management communication skills within the wildland-urban interface (Paveglio et al.,2009).

The multiple ANOVA indicated that the results from the ANOVA test were not influenced by an unbalanced number of experienced professionals participating in a particular workshop. Furthermore, the Tukey's HSD indicated that there was statistical significance between fuel treatments and Cal VTP, grazing and Cal VTP, grants and prescribed burns, fuel treatments and grants, and grazing and grants. Grants are included in three out of the five groups that displayed statistical significance. The significance between these five groups complements the findings of Table 2: *Workshop Type Change in Knowledge* that indicated that grants have the highest change in knowledge. This indicates that grants is a driving factor behind the statistical significance of workshop type and change in knowledge.

This study also identifies which educational practices were seen as the best by Swanton workshop participants. Workshop participants noted that instructors who engaged with workshop participants, the workshop topic, and kept a positive attitude were effective throughout the workshop. This aligns with the findings of Lewis and Abdul-Hamid (2006) who argued that teacher presence must be maintained throughout the duration of a presentation regardless of format. Additionally, teacher presence can be accomplished through remaining energetic and actively engaging with the material that is being presented (Lewis & Abdul-Hamid, 2006).

Workshop participants said that providing external resources such as website links, using organized presentations, digital resources, and thoroughly explaining concepts and definitions benefited their overall experience and

engagement. These identified educational practices correlate to the findings of Kostova and Atasoy (2008) and Sun and Chen (2016). The workshop participant identified practices fall under the category of learning objects or course materials that complement online course structure. Kostova and Atasoy (2008) and Sun and Chen (2016) also state that learning objects or course materials contribute to organization during online instruction which can increase engagement with students and instructors.

Swanton workshop participants also stated that having multiple instructors to facilitate the online Zoom format and the hands-on in person workshops contributed to organization that was seen as beneficial and engaging. Having multiple instructors to facilitate question and answer and discussion sections was also seen as beneficial. This is an example of instructors investing time in planning and organizing that leads to the success of online courses (Major, 2010; Lewis & Abdul-Hamid, 2006). Organization through facilitating online discussions, questions, and maintaining structure throughout the workshop contributes to successful online courses (Major, 2010; Lewis & Abdul-Hamid, 2006).

Swanton workshop participants also stated that personal experiences, stories, examples, and testimonies benefited their experience and engagement with the workshop material. This agrees with the findings of Lewis and Abdul-Hamid (2006) which state that sharing experiences to supplement the lecture material contributes to a better teaching presence and contributes to engagement with the material and students in the class.

Participants also stated that the Swanton Pacific Ranch Fuels Management workshops were free and accessible due to the online Zoom format. This is an unexpected result that correlates to the findings of McGranahan et al., (2022) and Wells (2011). Online workshops serve as an accessible and affordable method to train midcareer professionals. Additionally, free online fire and forest workshops aid in discouraging financial inaccessibility, adjustment to work schedules, and being able to attend the courses in person (Wells, 2010; McGranahan, 2022).

Additionally, statistical analysis also indicated that the usage of the identified best practices influences change in knowledge. The Pearson's Correlation test revealed a positive correlation thus indicating that as more than one best practice is used the change in knowledge of a Swanton participant increases. The Paired t-test between each of the five best practices and change in knowledge also indicated that the use of any of the five best practices influences the change in knowledge of a Swanton participant.

The relationship between workshop type and sum of best practices was statistically significant. These are confounding variables that raise the question of if the content or delivery is influencing change in knowledge. By comparing the different workshops under each individual topic for the number of best practices used and change in knowledge it indicated that the use of best practices as delivery methods for the content matters. Workshops who utilized less than five best practices had a lower change in knowledge than workshops who utilized all five for the topic of *prescribed burns*. Within the *fuel treatments* and *grazing*

topics there were workshops that utilized five best practices and had a lower change in knowledge (Workshop 18,19, and 20) than those that used less than five. Since this happened three times these were rare cases. A possible explanation is external factors such as problems with Zoom connectivity that negatively impacted the workshop participants. Since the multiple ANOVA indicated that workshops were not dominated by overly experienced individuals this explanation can explain the instances of a lower change in knowledge with the five best practices. The comparisons determined that delivery matters regarding the effectiveness of the workshops and that future analysis should be conducted between the other workshop types to decrease ambiguity.

The aforementioned educational practices answer both research question one and two and confirm hypothesis two. These educational practices align with literature on online education and instruction. Thus, displaying that the qualitative results reveal the best practices for the Swanton Fuels Management workshop. Identifying these best practices assists in establishing a cohesive framework for the future of the Swanton workshops to improve their effectiveness. It also demonstrates what the necessary components are for a successful forest and fuels online and in person workshop. Regularly implementing these practices can contribute to an increase in change in knowledge leading to more informed forest and fire professionals which will benefit California forests and fire curriculum.

CHAPTER 6

CONCLUSION

This study aimed to understand the effectiveness of the Swanton Pacific Ranch Fuels Management Training program as well as which practices are most effective in educating and training fire and forest professionals. It also aimed to understand which factors of a Swanton workshop participants background influenced their change in knowledge. Gender, years of experience, and workshop type influence a workshop participant's change in knowledge. The practices identified by workshop participants align with the literature and comprise the best practices for a cohesive and effective forest and fire training program and curriculum. It can also be concluded that the current Swanton Pacific Ranch Fuels Management Training Program is effective. Through the usage of best practices and a consistent increase in after knowledge the program is benefiting those in the California forest and fire industry.

It is suggested that the identified best practices be implemented on a larger scale. Due to the variation in instructors and teaching methods it is suggested that a training webinar should be conducted that establishes a consistent format for teaching based on the best practices. Workshop participants specifically named instructors who implemented these best practices. Therefore, having these instructors collaborate on a set method of instruction would benefit future participants and the effectiveness of the program.

Future research should be conducted to assess if a cohesive format with the implementation of the best practices contributes to an increase in change in

knowledge. This would aid in determining if the overall effectiveness of the training program is increasing. Studies that focus on online education and training standards for forest and fire professionals would be helpful to guide the implementation of new practices that emerge. Additionally, tracking the attitudes of the participants is another important area that could be monitored to ensure the program is continually being found as helpful, informative, and beneficial. Creating a further understanding of the participants' background can also help in understanding who is utilizing the program in California and how to better outreach to other agencies and areas of California.

This study is effective in understanding what components are best at assisting the forest and fire professionals that maintain California forests. The survey design could be adapted to assess if forest and fire professionals are receiving training on climate change and its impact on California forests. This could determine if additional training on climate change needs to be implemented to inform fire and forest management decisions. The Swanton Pacific Ranch Forest Management Training program is an excellent starting point for understanding the needs of those who maintain and protect California forests. It is also a starting point for creating a cohesive training curriculum that could be extended to other training programs at a college, post college, and agency level and could lead to becoming the standard for California forest maintenance.

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APPENDIX A

SWANTON WORKSHOP SURVEY

Evaluation: [workshop title]

This form asks for your agreement to participate in a research project on the methods of communication and education used to train forest and fire personnel at Swanton Pacific Ranch. Your participation involves providing honest feedback regarding the training program you attended. Please select the answers that most closely align with your personal background as well as your general feedback on the program. It is expected that your participation will take approximately 5 to 10 minutes. All survey data are anonymized. You may personally benefit from this study if you plan to attend another workshop held by Swanton Pacific Ranch and Cal Fire. Others may benefit from your participation by an increased effectiveness of the material communicated during Swanton Pacific Ranch programs and workshops. If you are interested in participating, please review the following information.

The purpose of the study is to track the effectiveness of the applied research and training program that is done by the NRES department at Cal Poly and CAL FIRE. The research and training program at Swanton Pacific Ranch in California is designed to bridge the gap between the limited personnel that inhibits fuel management tools on a larger scale.

If you agree to participate, you will be sent a survey to the email associated with the program/workshop you attended. The survey includes multiple choice questions as well as free response questions. Your participation will take approximately 5 to 10 minutes.

Please be aware that you are not required to participate in this research, refusal to participate will not involve any penalty or loss of benefits to which you are otherwise entitled, and you may discontinue your participation at any time. If you decide to withdraw your participation, you must contact either Dr. Nicholas Williams or Christine Johnson of Cal Poly San Luis Obispo. Your survey response will then be removed. There are minimal risks anticipated with your participation in this study. A risk associated with internet-based research is the inadvertent disclosure of private identifiable information. This would be considered social harm. Additionally, through internet-based research there is also the potential risk of loss of confidentiality. The survey does not collect names of subjects and your survey responses will be collected anonymously.

This research is being conducted by Christine Johnson a Master of Science in Environmental Sciences & Management student in the NRES Department at Cal Poly, San Luis Obispo. The faculty advisor for this project is Dr. Nicholas Williams of the NRES department at Cal Poly. If you have questions regarding this study or would like to be informed of the results when the study is completed, please contact the researcher(s) at Cjohn169@calpoly.edu or nwilli37@calpoly.edu .

If you have concerns regarding the manner in which the study is conducted, you may contact Dr. Michael Black, Chair of the Cal Poly Institutional Review Board, at (805) 756-2894, mblack@calpoly.edu, or Ms. Trish Brock, Director of Research Compliance, at (805) 756-1450, pbrock@calpoly.edu.

If you are 18 or older and agree to voluntarily participate in this research project as described, please indicate your agreement by completing the attached survey. Please retain a copy of this form for your reference, and thank you for your participation in this research.

1. Are you 18 years or older?
    a. Yes
    b. No

    *If “No” is selected survey automatically ends
2. Please select the number of years of prescribed fire experience you have.
    a. 0-2
    b. 2-5
    c. 5-10
    d. 10+
3. Please select your gender
    a. Female
    b. Male
    c. Not listed
4. Please select the type of institution/organization with which you are affiliated.
    a. State government
    b. Federal government
    c. Municipal government
    d. Regional government
    e. Tribal
    f. Private business
    g. NGO
    h. University/college
    i. Fire response
    j. Community
5. On a scale of 1 (low)-10 (high), please rate your knowledge and skill of [workshop title] before attending the training.

    a. 1 2 3 4 5 6 7 8 9 10

6. On a scale of 1 (low)-10 (high), please rate your knowledge and skill of [workshop title] after attending the training.
    a. 1 2 3 4 5 6 7 8 9 10
7. Please check the box that best describes you
    a. Administrator
    b. Agency advisor
    c. Business owner
    d. University/college student
    e. Educator
    f. Fire response personnel
    g. Land manager
    h. Private consultant
    i. Scientists/researcher
    j. Community
8. Please select the geographic region(s) where you feel most comfortable representing your organization.
    a. Klamath/North Coast
    b. Modoc
    c. Sacramento Valley
    d. Bay/Delta
    e. Sierra
    f. San Joaquin Valley
    g. Central Coast
    h. South Coast
    i. Mojave Colorado Desert
    j. Statewide
9. Please provide any additional feedback regarding the aspects of the workshop you found most beneficial.
10. Please provide additional feedback about ways this training could be improved. Are there any topics you had hoped to learn about that were missing?
11. What topics would you like to see addressed in future trainings?

APPENDIX B

PROJECT CODEBOOK

Quantitative Coding	
Years of Experience	
1	0-2
2	2-5
3	5-10
4	10+
Workshop Type	
1	Cal VTP
2	Fire Fighter Training Course
3	Prescribed Burns
4	Grants
5	Fuel Treatments
6	Grazing
Gender	
0	Male
1	Female
2	Other/not listed
Workshop Title	
1	Evaluation_ Basic Wildland Fire Fighter 2 Training Course
2	Evaluation_ CalVTP & PWP Webinar_ Covell Ranch Forest Health Fuels Reduction
3	Evaluation_ CalVTP Question & Answer Webinar
4	Evaluation_ Fire Qualification Plan for Prescribed Burning
5	Evaluation_ Prescribed Burning in the Soquel Demonstration State Forest
6	Evaluation_ Soquel Demonstration State Forest_ Advocacy Training for Prescribed Burn Program
7	Evaluation_ Wildfire Prevention Grant Webinar (2) (1)
8	S-290 Intermediate Fire Behavior Training Course
9	Evaluation_ CAL FIRE's CalVTPs in the Southern Sierra Foothills (1-10) (1)
10	Evaluation_ Practitioner Panel_ Tips and tricks for early entry into the CalVTP

11	Evaluation_ Navigating the Proposal Process for Wildfire Fuels Treatments using RX Grazing
12	Evaluation_ Targeted Grazing for Fuel Reduction_ Case Studies from East Bay Regional Parks
13	Evaluation_ Fire Friday_ Discussion about burning issues
14	Evaluation_ CalVTP in Practice_ Healdsburg Open Space & Community Fuels Reduction
15	Evaluation_ Shaded Fuel Break_ Lessons Learned Post Wildfire in the San Vicente Redwoods
16	Evaluation_ Targeted Grazing for Fuel Reduction_ Case Studies Rancho Jamul_Hollenbeck
17	Evaluation_ Fuels Treatments in the WUI_ Occidental Arts and Ecology Center
18	Evaluation_ Prescribed herbivory for fuels reduction_ grazing planning and permitting in CA
19	Evaluation_ Fuels Treatments in the WUI_ Sonoma Land Trust's Laufenburg _Ranch Preserve
20	Evaluation_ Post-Fire Fuels Treatments in a Coastal Demo Forest_ Swanton Pacific Ranch
21	Fuels Treatments in the WUI_ Lessons Learned Post Wildfire at Swanton Pacific Ranch
Organization Coding	
1	University/College
2	Applying for FF Jobs
3	Resource Conservation District (RCD)
4	Private Business
5	Community
6	State Government
7	Regional Government
8	NGO
9	Municipal Government
10	Consultant
11	Federal Government
12	Tribal
13	Fire Response

14	Neighbor
15	Owner
Location Coding	
1	Klamath/North Coast
2	Modoc Plateau
3	Northern Sierra
4	Central Sierra
5	Southern Sierra
6	San Joaquin Valley
7	Central Coast
8	South Coast
9	Mojave Desert
10	Colorado Desert
11	Statewide
12	North Coast
13	Sacramento Valley
14	Sierra
15	Bay/Delta
16	Statewide
Number/ Sum of best practices used	
1	1 BP used
2	2 BP used
3	3 BP used
4	4 BP used
5	5 BP used

Free Response Coding		
1	Resources that were used in the presentation	External resources, hands on field work, presentations, visual aids, definitions, question and answer, examples, experiences, explanation of concepts and break out rooms

2	Instructors and organization	Multiple instructors, instructors, and organization
3	Participants found the workshop helpful engaging informative etc.	Helpful, informative, comprehensive, accessibility, effective
4	Needed clarification, better explanation, resources, more time, difficulty being engaged, more example, Q&A not long enough, topic not thoroughly covered	Needed clarification, further explanation, needed more information, more time, or topic not thoroughly covered
5	Topics that were covered in seminar	CEQA, permitting, CAL VTP qualifications, and grants were thoroughly covered
6	Problems with zoom, unorganized presentation, bad etiquette from instructor, speed of instructor to fast	Problems with zoom and inorganization
7	Additional comments	
8	Existing topics that need better promotion	
9	Topics to considered having to do with people, experiences etc.	
10	Topics to consider having to do with nature, natural, etc.	