

Alternative Vegetation Management Strategy: Using Goats in Vegetation Management

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that the appropriate credit is given where I have used the language, ideas, and expressions, or writing of another

Signed: 

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Abstract

The problem was that Costa Mesa Fire & Rescue had not analyzed the use of goats to clear vegetation in several Costa Mesa parks. The purpose of this research was to determine if the use of goats would be beneficial in vegetation management in the City of Costa Mesa. Descriptive methodology was used to guide the following research questions: (a) What is the effectiveness of goats with other organizations, within the state of California, in reducing vegetation? (b) What impact/benefit would using goats in vegetation management have on nearby residents and homeless population? (c) What political, financial, and environmental factors need to be considered as it relates to implementing vegetation reduction utilizing goats? The procedures used included personal observations, and personal discussions with agency experts to determine if using goats as a vegetation management tool in several parks is a viable option in the City of Costa Mesa. The results indicated that goats have been used effectively to graze vegetation throughout the State of California. The recommendations included: (a) forming a working group to identify priority zones within the parks to be considered as a phased in approach, (b) developing a scope of work to encompass restoration of the targeted areas for grazing and publish as a request for proposal to seek vendors, and (c) evaluate the success of the program, beginning in Canyon Park.

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Alternative Vegetation Management Strategy: Using Goats in Vegetation Management

According to an article in *BioScience*, approximately \$23.4 billion is spent per year on non-indigenous, introduced weeds (Pimentel, Lach, Zuniga, & Morrison, 2000). Fire departments across the state of California continue to respond to the call of wildland or brush fires (for purposes of this research paper, wildland and brush fire terminology will be used to mean the same thing). In 2018, California was ranked number two in total number of wildland fires and number one in total acreage burned from wildland fires (Insurance Information Institute [iii], 2019), there is pressure on agencies to identify creative solutions to reduce the catastrophic effects of wildfires. There will always be brush fires; however, opportunities exist for the City of Costa Mesa to assist in reducing and/or minimizing the effects of brush fires by reducing or eliminating the invasive plant species found in and throughout the parks.

The problem was that Costa Mesa Fire & Rescue had not analyzed the use of goats to clear vegetation in several Costa Mesa parks. Current restoration plans of Fairview Park and Talbert Parks indicated use of mechanized removal of invasive, noxious plants and grasses. The plan does not include goats as a strategy in moving toward restoration. The City of Costa Mesa has also incorporated the use of volunteers and hosts several events where residents come out to participate in non-native plant removal and replace with native plant species (Money, 2018; City of Costa Mesa, 2019a). The purpose of this applied research project (ARP) was to determine if the use of goats would be beneficial in vegetation management (reduction) in the City of Costa Mesa. Descriptive methodology was used to guide the following four research questions: (a) What is the effectiveness of goats with other organizations, within the state of California, in reducing vegetation? (b) What impact/benefit would using goats in vegetation management have on the nearby residents and homeless population? and (c) What political, financial, and

environmental factors need to be considered as it relates to implementing vegetation reduction utilizing goats?

Background and Significance

Costa Mesa Fire & Rescue (CMFR) is a career fire and rescue department located in Orange County (CA). Broken into three divisions: (a) Fire Administration, (b) Fire/Rescue/Emergency Medical Services, and (c) Fire Prevention/Community Risk Reduction, CMFR is staffed with 90 members including: (a) fire chief, (b) division chief, (c) administrative captain, (d) executive assistant, (e) management analyst, (f) fire marshal, (g) community risk reduction specialists, (h) 18 fire captains, 18 fire apparatus engineers, (i) 30 firefighter/paramedics (FF/PM), and (j) 12 firefighters (FF). Suppression personnel respond out of six fire stations and administrative personnel are located at city hall. Four out of six fire stations are staffed as an advanced life support (ALS) four-person engine company while one station is staffed as a basic life support (BLS) four-person truck company with an ALS Rescue Ambulance staffed with two FF/PM's. The sixth station is staffed as a BLS four-person truck company (City of Costa Mesa, 2019b).

The City of Costa Mesa is located a few miles inland from the Pacific Ocean and is surrounded by the cities of Huntington Beach to the north, Santa Ana to the east, Newport Beach to the south, and the city of Fountain Valley is touched in the northeast corner. Incorporated in June 1953, Costa Mesa is home to over 113,000 residents and is 16.7 square miles (United States Census Bureau, 2019). Costa Mesa is run as a general law city and operates under a council-manager form of government. The City Council consists of a directly elected Mayor, Mayor pro-tempore, and four council members. Costa Mesa's annual operating budget is \$173.8 million, which includes 495 full-time equivalent (FTE) positions. The fiscal year 2019-20 budget for

CMFR is set at \$28.2 million. In 1999, Costa Mesa adopted the motto of “City of the Arts” and is home to several performing arts venues such as Segerstrom Center for the Arts, South Coast Repertory, and Costa Mesa Playhouse to name a few (City of Costa Mesa, 2019e).

There are several parks in the City of Costa Mesa; however, for purposes of this research project, the focus was on Fairview Park; and Canyon Park; both operated by the City of Costa Mesa (City of Costa Mesa, 2019d; City of Costa Mesa, 2019e). Focus will also be placed on Talbert Regional Park, operated by Orange County Parks (<http://www.ocparks.com/parks/talbert>). These parks are populated daily with park-goers who enjoy outdoor activities such as walking and biking through several trails, while others enjoy having a picnic in the park. Several single-family homes along with high density housing (apartments and/or condominiums) surround each of the parks. Residents of the nearby Newport Terrace community are frustrated and cite a recent large brush fire caused by an abandoned bon fire in a homeless encampment (Brazil, 2016). The nearby residents enjoy the amenities of the park but have expressed anger over what appears to be an increase in brush fires.

At 208 acres, Fairview Park is Costa Mesa’s largest open space. Fairview Park offers recreational activities such as hiking and biking and is home to several community events. The events include: Concerts in the park, goat hill junction railroad where park goers are provided with free miniature train rides and offers a designated area for radio-controlled model aircraft enthusiasts. Of noteworthy concern is that within Fairview Park, there are “two Nationally Registered Cultural Resource Historic Sites and five distinct habitat ecosystems which are home to many rare and endangered plant and animal species” (City of Costa Mesa, 2019d). Due to the sensitive nature of Fairview Parks ecosystem, challenges exist relative to weed abatement. The

current strategy uses mechanized mowers to cut down dry, overgrown vegetation while avoiding protected areas and has not addressed a strategy to manage vegetation in hard to reach areas.

Canyon Park is a 36-acre park that abuts several housing tracts. Seabluff Canyon, a nearby neighborhood is at significant threat to brush fires. Much of Canyon Park is open space, populated with non-native invasive plants (City of Costa Mesa, 2019c). Within Canyon Park is a narrow corridor connecting to Talbert Regional Park (South) that is bordered by Newport Terrace to the south and Seabluff Canyon to the north. A brush fire in this area, fueled by an onshore wind poses significant life safety issues.

Talbert regional park is divided into two areas, with Victoria Street being the divider of north and south. North of Victoria Street, Talbert regional park is 91.5 acres while south of Victoria Street Talbert regional park is 88.5 acres (Orange County Parks, 2019). According to the Biological Report for the *Talbert Regional Park Final Habitat Restoration Plan* (as cited in Moffatt and Nichol, 2015) Talbert Regional Park contains several non-native invasive plants. For example, Pampas grass is found to be pervasive in the area, and according to CMFR's Division Chief of Operations Jason Pyle (Personal Communication, September 12, 2019) (Appendix A), it is difficult to extinguish once a fire is deep seated in the base of the plant Pyle stated, "the pampas grass ruins our chainsaws."

This research is in direct alignment with the National Fire Academy's (NFA) Executive Fire Officer Programs (EFOP), *Executive Analysis of Community Risk Reduction* (EACRR) course goal of "reducing risks in the local community" (National Fire Academy, 2018, p. ix). Additionally, as stated in the updated United States Fire Administration's (USFA) Strategic Plan Fiscal Years 2019 – 2023, this research is linked to Strategic Goal one of "Build a culture of preparedness in the fire and emergency medical services", and accomplishes objective 1.1 of

“Enhance fire and EMS’ ability to identify, prevent, prepare for and mitigate community risk”
(United States Fire Administration [USFA], 2019, p. 9)

Literature Review

A review of the literature was performed to determine if using goats for vegetation management is a viable option in the City of Costa Mesa. Research began at the National Fire Academy’s Learning Resource Center (LRC), located in Emmitsburg, MD. Books, peer reviewed journals, and professional reports were utilized in conducting research. City of Costa Mesa administrative policies/procedures, laws/ordinances, and pertinent documents were included to provide a comprehensive analysis for this study. Several internet searches, utilizing EBSCO, scholar.google.com, and online libraries were performed to review relevant subject matter. Information relevant to the three research questions was readily available and pertinent. The literature reviewed also included information from other comparable agencies, including vendors and professional organizations whose mission to provide scientific data as it relates to utilizing goats in vegetation management.

There are several strategies that can be used to manage vegetation. Using mowers or weed whackers (mechanized), bulldozers to rip out large diameter vegetation, using herbicides, and utilizing hand crews equipped with hand tools, are strategies that are costly and potentially harmful to the environment. All the listed strategies are effective and useful, but one strategy in particular has gained in popularity over the past decade. Mike Canaday, owner of Living Systems Land Management, rents goats to graze open land. Canaday says they are “screaming busy” and credits the goats’ ability to eat up to “10 pounds of vegetation per day, and their ability to navigate difficult terrain” (Helmer, 2018, para. 3).

Agencies from across the state of California have embraced the idea of utilizing goats to munch on brush (vegetation) that contributes to rapid spread of wildfires (Rivera, 2019). Further, Rivera (2019) writes that “counties and cities like Laguna Beach, Ventura, Lemon Grove, Nevada City, San Rafael, West Sacramento, Lake County, Santa Rosa, and the Los Angeles County Forestry Division have all used goats to munch on the quickly drying grasses across California wildland.” Although not mentioned in the article authored by Rivera, the City of Anaheim is utilizing goats to clear vegetation to enhance public safety (L. Young, personal communication, September 20, 2019) (Appendix B). The agencies mentioned are faced with the same challenging invasive plants that are threatening the livelihood of native plants and providing fuel for wildfires.

Four-legged animals have the ability to survive and thrive in environments where humans, or people operating machinery are faced with challenges. Goats have the ability to climb trees, hike steep terrain, and eat noxious plants and grasses plaguing large open land areas throughout California. By consuming vegetation (fuel), goats are breaking the continuity of horizontal and vertical fuels, thus mitigating the devastating effects of wildfires (Lovreglio, Meddour-Sahar, & Leone, 2014). Many local communities are challenged with the pervasiveness of invasive plants, which are intrusive and obstructive to native plants.

Located in Northern California, the City of Oakland has been utilizing goats effectively for several years. Oakland Fire Department’s Supervisor of the Vegetation Management Unit Vincent Crudele is utilizing goats for vegetation management in concert with East Bay Regional Parks Fire District, East Bay Municipal Utility District, Lawrence Berkeley National Laboratory, CALTRANS and Pacific Gas & Electric. Their collective efforts in deploying 3500 goats has resulted in reducing their flash fuel height to three inches, thus greatly reducing the fuel bed and

dramatically reducing the occurrence and severity of a wildfire (V. Crudele, personal email, October 18, 2019) (Appendix C).

Further down the state in Southern California, located in Orange County and near Costa Mesa, the cities of Anaheim and Laguna Beach have been utilizing goats to clear vegetation in an effort to reduce the impacts of wildfires prevalent in the area. Anaheim Fire & Rescue's (AFR) Assistant Fire Marshal Lindsey Young (personal communication, September 20, 2019) (Appendix B), during a tour of their wildland urban interface, claimed that the overall success of the goats in reducing/removing vegetation was impressive, and despite not having any data to support her claims, stated that based on her experience and knowledge of the area that they have observed a dramatic reduction in vegetation. Further evidence was noted in 2018 when two catastrophic wildfires (Canyon one and Canyon two fires) burned the hills of Anaheim. During these fires, the fuel breaks created by the goats were effective in slowing and/or stopping the fires progression thus minimizing and/or eliminating potential damage to nearby residential communities (L. Young, personal communication, September 20, 2019).

The positive results espoused by the cities of Oakland (Northern California) and Anaheim (Southern California) are not surprising as noted in a study where the authors reported, "Grazing by goats not only broke the sequence of live fuels, horizontally, and vertically up to 1.5m, but also reduced the amount of 1- and 10-hour dead fuels (from 16.0 to 10.7 for the 1-hour and from 10.3 to 4.3 for the 10-hour) 33.2% and 58.3%, respectively..."(Tsiouvaras, Havlik, & Bartolome, 1989, p. 1128). Of equal importance, it was noted that the goats were effective in reducing the litter depth and crushing the fine fuels into the soil, which reduced chance of ignition (Tsiouvaras et al., 1989).

Assistant Chief J. Lopez with Los Angeles County Fire Department (LACoFD) assigned to Prevention Services Bureau oversees their “Fire Hazard Reduction Projects” where they utilize goats at a Biological Treatment Area in the Claremont Hills Wilderness Park and green areas found on the Etz Meloy Fuelbreak (County of Los Angeles Fire Department, n.d.). A news brief published by LACoFD, Forestry Division highlights that the goats were placed in an 80-acre field with the intent to reduce vegetation in an area where two previous destructive wildfires burned. In addition, the County hired a biologist to study the impact of using goats for fuel reduction. The results showed that “goats ate away highly flammable vegetation with little environmental impact” (County of Los Angeles Fire Department, Forestry Division, n.d., para. 6). Utilizing goats for vegetation management in place of mechanized techniques is thus reducing the carbon emissions and the negative impact on the environment.

A comprehensive case report published as a result of the 2017 Thomas Fire clearly articulates that the vegetative reduction strategies implemented in Montecito (CA) in Santa Barbara County showed favorable results in reducing the intensity of the fire by reducing the amount of vegetative fuels to burn (Kolden & Henson, 2019). Further, by reducing vegetative ground cover, the threat of fire spreading rapidly is reduced, thus reducing the threat to nearby homes and roads (Kolden & Henson, 2019). This case report provided positive support to the asserted comments by industry experts as well as underpinning the study by Tsiouvaras et. al (1989).

A goat’s diet varies in relation to the size of the field they have to graze and plants available. In a report published by the United States Department of Agriculture, U.S. Forest Service, Green & Newell (1982) highlighted the importance of “grazing pressure” as, goats choose to eat preferred shrubs when available. However, if grazing pressure were applied by

tightening the area in which goats graze, they will eat the less desirable shrubs and trees (Green & Newell, 1982). Talbert Regional Park (North & South) is littered with several non-native plant species that have been found to be a staple in the goats' diet (A. Cope, personal communication, November 5, 2019) (Appendix D). This was confirmed by Vegetation Mapping done, which found several non-native plant species including, but not limited to: (a) fennel, (b) shortpod mustard, (c) coyote brush scrub, (d) mule fat scrub, (e) quailbush scrub, (f) tree tobacco plants, and (g) pampas grass (as cited in Moffatt & Nichol, 2015). Pampas grass, found in Talbert Regional Park, Fairview Park, and Canyon Park, is a highly invasive plant, and according to the California Department of Fish and Wildlife is threatening several native plants and are not good foods for birds or wildlife (California department of fish and wildlife, n.d.). When asked if goats will eat pampas grass, Sage Environmental Groups Principal and Founder Alissa Cope (personal communication, November 5, 2019) (Appendix F) affirms they will when she stated, "yes, they eat all grasses" Sage Environmental Group offers vegetation management services including goats, herbicides, mechanized removal, and includes restoration as part of their vegetation management strategy.

A collaborative study performed by Irvine Ranch Conservancy and Sage Environmental Group found goats to be effective in reducing vegetative ground cover (Freese & Cope, 2019). Present day grasses are out of balance with native and non-native grasses and the goal is to shift to more native grasslands, which is in concert with both the Fairview Park Restoration (Kehr et al., 2008) and Talbert Park Restoration plans (Moffatt & Nichol, 2015). Figure 1 (Freese & Cope, 2019, IRC long-term monitoring transects 8:51) shows a dramatic decrease in non-native grasses over a four-year (2015 – 2019) period of using goats to graze on vegetation.

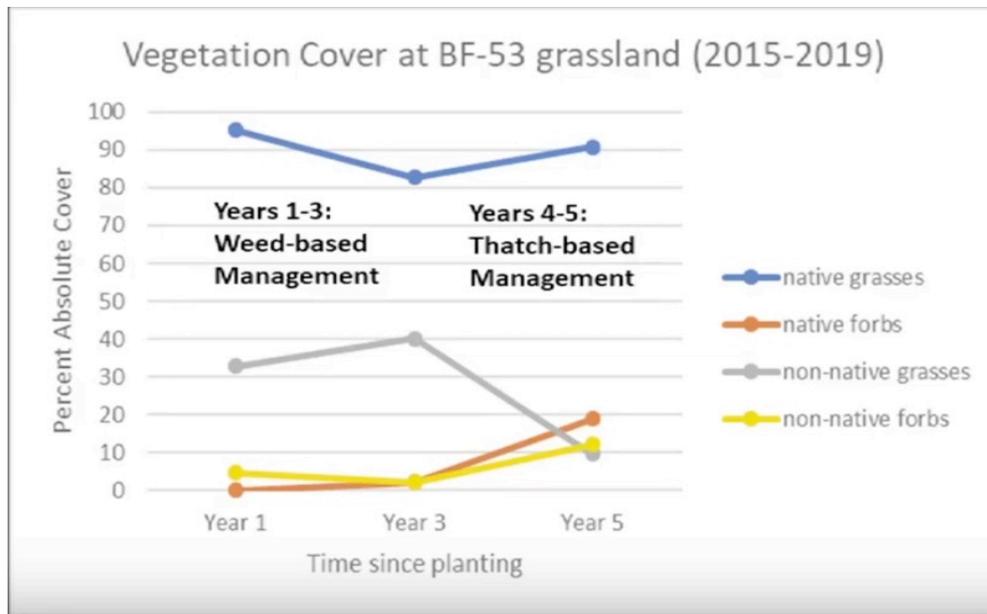


Figure 1. Vegetation Cover in BF-53 grassland (2015 – 2019)

Conclusive results from the study by IRC and Sage Environmental Group (2019) coupled with several personal communications (L. Young; personal communication, September 20, 2019; V. Crudele, personal communication, October 18, 2019; A. Cope, personal communication, November 5, 2019) (Appendix B, C, and F) with agency experts whom employ the use of goats in vegetation management is clear that goat grazing is effective if managed properly. Cope (personal communication, November 5, 2019) (Appendix F) laments that most goat grazing vendors do not focus on habitat restoration (introducing and protecting native grasses), which falls short of long-term benefits of grazing and restoration. When contemplating the use of goats for vegetation management, consideration needs to be given to not only the removal of invasive plants, but the “restoration” of the open field.

Kathy Voth, founder and owner of Livestock for Landscapes, LLC espouses, “Goats can quietly eat shrubs in hard-to-reach places very close to human residences. They keep the air clean and residents feeling safe” (Fire Science Brief, 2009, p. 2). Voth’s passion is to work with managers and planners in realizing the promise of utilizing goats in vegetation management. As

it relates to community impact, she opines “The kids (the human kids) love it!” (Fire Science Brief, 2009, p. 5). In 2009, Google hired goats to clear vegetation around their Mountain View (CA) headquarters. The Director of Real Estate and Workplace Services stated in the company’s blog, “It costs us about the same as mowing, and goats are a lot cuter to watch than lawn mowers” (as cited in Burgess, 2009). Not only do adults and kids love goats, PETA (People for Ethical Treatment of Animals) endorses the idea of goats being goats: “being cute and eating grass”, providing they are well taken care of and given proper nutrients (Siegler, 2009). While touring in the hills of Anaheim, AFR’s Assistant Fire Marshal Lindsey Young (personal communication, September 20, 2019,) (Appendix B) pointed out the “goat herder” is the person who oversees the goats and feeds them supplemental feed to ensure proper nutrition.

Assistant Fire Marshal Lindsey Young (personal communication, September 20, 2019) (Appendix B) emphatically claims that the community loves the goats. To back up her claim, she references a community event in which AFR hosted several hundred community members at a goat informational event where citizens were provided an opportunity to interact with the goats. In a separate personal communication, and in concert with L. Young, A. Cope (personal communication, November 5, 2019) (Appendix F), boldly claims that the presence of goats is therapeutic to nearby residents. Community concerns relative to the presence of goats is generally directed toward the guard dogs barking throughout the night (A. Cope, personal communication, November 5, 2019) (Appendix F). Guard dogs are important to the preservation of the goats as they are brought in to protect them from wild predators such as coyotes (A. Cope, personal communication, November 5, 2019) (Appendix F).

Goats are credited with saving a historical building during the “Easy Fire”. The “Easy Fire” was located in Simi Valley and started on October 30, 2019, a time when statewide

resources were at critical draw down levels due to several fires burning throughout California. Due to the draw down levels, firefighting resources were limited, if not unavailable. Several media outlets praised goats for saving the Reagan Presidential Library, a critical resource. CNN.com headline reads “Fire crews, air drops, and a herd of goats help save Reagan Presidential Library from wildfire” (Hanna, Chan, & Sanchez, 2019). The CNN article reports that the success of saving the Reagan Presidential Library has something to do with the fact that as many as 500 goats were put in place several months before the fire (Hanna et al., 2019).

Widespread concern over whether the invasive plants will regrow after mowing, raking, or weeding exists. The literature suggests that consideration be given to whether or not goats, and what they bring with them in their hooves, will prevent or aid in regrowth of invasive plants. Literature (Nader, Henkin, Smith, Ingram, & Narvaez, 2007) and industry experts (Freese & Cope, 2019) claim that goats with their four stomachs may be the most efficient, ecologically sound method of reducing vegetation. To prevent cross-contamination, the goats are segregated for three days prior to trucking them into a new area (A. Cope, personal communication, November 5, 2019) (Appendix F). As shown in Figure 2 (Freese & Cope, 2019, seed viability in droppings 12:58) the excrement of goats found that a goat’s digestive system is so efficient that no seedlings are present in their poop; whereas, mechanized mowing or weed whacking needs to be followed with herbicides to minimize the regrowth of non-native plants and grasses (Freese & Cope, 2019, seed viability in droppings 12:58).

Test #	1 Soil + Seed	2 Soil + Seed + Goat Droppings	3 Soil + Goat Droppings (no seeds)
Sample	<i>Elymus triticoides</i> seeds planted in sterile soil	<i>Elymus triticoides</i> seeds planted in sterile soil with goat droppings	Sterile soil, no seeds planted, goat droppings only
Result	<i>Elymus triticoides</i> sprouted	<i>Elymus triticoides</i> sprouted; No weeds sprouted	Nothing sprouted
Photo			

Seed Viability in Goat Droppings?

- **Question:** What is the viability of seeds that have passed through a goat's digestive system?
- **Approach:** Conducted germination test using new sterile soil, new native grass seed, and goat droppings
- **Method:** Distributed these materials into three flats and watered them weekly
- **Conclusion:** Nothing sprouted from goat droppings

Figure 2. Freese & Cope Study of Goat Droppings (Freese & Cope, 2019, seed viability in droppings 12:58)

Crime has plagued Talbert Regional park causing fear and frustration from nearby residents. Several homeless encampments located in Talbert Regional Park are obscured from the vision of park-goers and park rangers patrolling the area due to giant reeds and overgrown pampas grass (Brazil, 2016). On September 18, 2019 law enforcement agencies, including Costa Mesa Police Department, canvassed Talbert Regional Park. As a result, eight parolees were arrested for suspected municipal code violations for off-trail camping (Scafani, 2019). Removing or reducing the “giant reeds and long stalks of pampas grass” would improve visibility from the trails, thus reducing the anxiety by some park users. The City of Costa Mesa recently opened a Homeless Bridge Shelter where the homeless found living in the parks could be offered shelter and additional amenities (City of Costa Mesa, 2019f).

Cities incur the greatest cost the first year of grazing as vegetation has not been managed and trails must be planned and cut in to provide for low voltage electrical fencing (V. Crudele, personal email, October 18, 2019) (Appendix E). It is important to note, when dealing with

contractors of any kind, there is a social stigma that if a job is too small, costs will be higher than if you have the right-sized job. Similarly, V. Crudele (personal communication, October 18, 2019) (Appendix E) warns that costs could be exorbitant if the job does not include enough acreage, therefore, city officials should carefully plan the areas targeted for grazing. With Canyon Park being the smallest park of the three at 36 acres, there is plenty of acreage to graze and make it cost effective.

In a “Goat Grazing Agreement” signed by the City of Oakland (June 5, 2018), the City Administrator is authorized to enter into an agreement with a goat grazing company for a three (3) year six (6) month term at \$1,624,333,00, with options to extend the contract agreement (p. 3). Through the agreement, it is impossible to know what they are paying per acre. However, also within the agreement, is this statement,

Goat grazing is the most cost-effective way to clear hazardous fuel loads in the hill area, as determined by an internal statistical analysis based on historical figures from past contracts, using both hand crews/machinery versus goat grazing; now therefore be it (City of Oakland, CA, 2018, p. 3)

Cope (personal communication, November 5, 2019) (Annex F) provides per acreage cost at \$750/acre plus \$1400 in additional costs for set-up and delivery. Surcharges exist when access is difficult (e.g., steep narrow roads).

As compared to several other vegetation management strategies (mechanized, hand crew, fire, or herbicides), “goats are the most cost-effective, nontoxic, nonpolluting solution available” (Hart, 2001, p. E176). Hart (2001) addresses concerns relative to other methods of vegetation control in the following: (a) benefits of mechanized control is dramatic, but is short-lived and costly; (b) chemical control is effective, but there is an increasing cost due to registration costs

and chemical treatments may cause collateral damage to native plants (vegetation); and (c) fire is effective, but is dangerous physically and politically if it escapes control lines (p. E171).

Costa Mesa parks offer several amenities such as hiking trails, BMX track, Riparian areas, and ponds (small bodies of water). Using herbicides is risky and alternatives such as goat grazing could be a viable alternative.

In summary, the literature supported goat grazing being a viable option for the City of Costa Mesa. Personal communications and media releases indicated that utilizing goats in the Costa Mesa parks would be a welcomed sight and could provide opportunities for public engagement. Other than ensuring that the goats are protected and fed supplemental nutrition, there was no political downside to employing goats. Relative to financial and environmental considerations, it is best summarized by repeating what was found in the City of Oakland contract for services

goat grazing is the most cost effective way to clear hazardous fuel loads in the hill area, as determined by an internal statistical analysis based on historical figures from past contracts, using both hand crews/machinery versus goat grazing; now therefore be it (City of Oakland, CA, 2018, p. 3)

Procedures

The procedures in this ARP were guided by the descriptive research method. Several communication strategies (email, phone calls, face-to-face interview, and on-site tour with questions and answers) were conducted to determine the effectiveness of using goats in vegetation management and answer the three research questions. It was determined that personal communication would be the best method for obtaining data relevant to the research.

Several phone calls were made to agencies throughout California which were known for using goats in vegetation management. These phone calls were made to individual's in key-leading positions (Fire Marshal's, Asst. Fire Marshal, Community Risk Reduction Personnel, or Project Management personnel overseeing goats) from Anaheim Fire & Rescue, Los Angeles County Fire Department, Oakland Fire Department, and Ventura County Fire Department. Personal communication with each member was similar in that they were asked, or provided by email, the three research questions and requests were made to provide any relevant data, facts or figures that would assist in determining the effectiveness of using goats in vegetation management.

The first interview was with Costa Mesa Fire and Rescue's Division Chief of Operations Jason Pyle (personal communication, September 20, 2019) (Appendix A). J. Pyle has been with CMFR for close to 20 years and oversees the operating budget and several committees including, but not limited to the Tools and Equipment committee. The interview with J. Pyle was limited in scope and nature of the questions as it was determined that he had institutional knowledge and a bias toward the research. The second interview was with several members from Anaheim Fire & Rescue (AFR): Assistant Fire Marshal Lindsey Young (personal communication, September 20, 2019) (Appendix B), Community Risk Reduction Officer Justin Day (personal communication, September 20, 2019) (Appendix B), and Community Engagement Manager Natali Rudometkin (personal communication, September 20, 2019) (Appendix B). The team from AFR was chosen for their direct involvement and experience in managing the goat program for the City of Anaheim. The author met with the team from AFR at an open field, canyon area where goats were grazing to discuss the research questions and to observe the goats.

The third interview was conducted via phone call with Ventura County Fire Department Captain Kenneth Van Wig (personal communication, September 5, 2019) (Appendix C) who has been managing the goats throughout Ventura County for several years. The fourth interview was conducted with Los Angeles County Fire Department (LACoFD) Assistant Chief J. Lopez (September 12, 2019) (Appendix D). This was a phone conversation that resulted from an email to inquire who was in charge of managing the goats throughout Los Angeles County. After discussing goats with J. Lopez, he referred this author to contact Sage Environmental Group's Principal Environmental Planner and Habitat Restoration Expert, Alissa Cope. Before contacting Alissa Cope, the author conducted a fifth interview with Oakland Fire Department's Supervisor of Vegetation Management Vincent Crudele (personal communication, October 18, 2019) (Appendix E). The author learned of V. Crudele when he delivered a presentation at the California Fire Chief's Conference in October, 2019. V. Crudele responded to the research questions primarily by email.

The sixth interview was a face-to-face interview with Sage Environmental Group Principal Alissa Cope (personal communication, November 5, 2019) (Appendix F). Sage Environmental Group is contracted to provide goats for grazing to several communities within the LACoFD's jurisdiction. In addition to the face-to-face interview, A. Cope provided a PowerPoint presentation that was recently delivered at a California Invasive Plant Council conference. The presentation was presented by A. Cope and her colleague. The information was reviewed for relevant scientifically evaluated information, which assisted in providing information on environmental effects of goats grazing.

Each of the interviewees, with the exception of J. Pyle, were provided with the research questions to assist the author in determining if employing the use of goats in Costa Mesa would

(a) be beneficial, (b) how goats would impact nearby residents and homeless, and (c) what political, financial, and environmental factors should be considered. The author then reviewed the answers from each interviewee to determine common themes amongst them.

Several limitations were noted in this study. Although goat grazing appears to be a formidable option for agencies aiming to improve community resiliency, the timeliness of literature is mature. Timely literature (within the last five years) containing data to quantify the effects of goats was limited at the time of research for this study. Researchers, like Alissa Cope, are working with local universities to provide quantifiable and qualitative data to support agencies in their endeavors to hire goats for vegetation management. A review of internal data from Costa Mesa Fire & Rescue's Record Management System (Zoll, 2019) found that the data was lacking consistency in reporting guidelines and specifications leading to possible inaccuracies relative to the number of brush fires as well as the cause of the fire.

Of the agencies using goats for vegetation management, with the exception of qualifying their personal observations, none of them could provide hard usable data relative to vegetation management or environmental considerations to be included in this research. As such, when asked how they justified the initiation of using goats and/or renewing contracts with vendors to use tax-payer money for goat grazing, in concert with one another, they responded that they know it works (personal communication, L. Young, September 20, 2019) (Appendix B), (personal communication, K. Van Wig, September 5, 2019) (Appendix C), (personal communication, V. Crudele, October 18, 2019) (Appendix E). Further, bias was evident and difficult to support with scientific data. Although the information ascertained was considered a limitation and anecdotal, the information was important in assisting in determining the

effectiveness of using goats as a vegetation management strategy. Despite the limitations noted, the timely data was deemed appropriate and timely.

Results

The results for this research were gathered by performing personal communications, which included several phone conversations, emails, and face-to-face interviews. One face-to-face interview was conducted with several members (L. Young, J. Day, N. Rudometkin, September 20, 2019) (Appendix B) from Anaheim Fire & Rescue during a tour of the open land in Anaheim where goats were actively grazing. Another face-to-face interview was conducted at Costa Mesa Fire Station one with Alissa Cope (personal communication, November 5, 2019) (Appendix F) from Sage Environmental Group.

The first research question asked: What is the effectiveness of goats with other organizations, within the state of California, in reducing vegetation?

After reviewing the personal communications with Anaheim Fire & Rescue's Assistant Fire Marshal Lindsey Young (Appendix B); Ventura County Fire Department's Kenneth Van Wig (Appendix C); Los Angeles County Fire Department's Assistant Chief J. Lopez (Appendix D); and Oakland Fire Department Supervisor of Vegetation Management Vincent Crudele (Appendix D), it was determined that a common theme amongst the agencies who employ the use of goats do so as a simple strategy to reduce vegetation, which would translate into less destructive wildfires. The primary components of utilizing goats in vegetation management included the benefits of using goats to be their ability to: (a) traverse steep terrain (K. Van Wig, personal communication, September 5, 2019) (Appendix C), (b) their digestive system (goats have four stomachs) (V. Crudele, personal communication, October 18, 2019) (Appendix E), (c) their ability to eat noxious plants including poison oak which have harmful effects on humans

(A. Cope, personal communication, November 5, 2019) (Appendix F), and (d) that they are cute and the public loves them (L. Young, personal communication, September 20, 2019) (Appendix B).

Compiling the information extrapolated from personal communications, it was noted that the effectiveness of utilizing goats for vegetation management was based on years of personal observations from industry experts. For example, in Appendix C, Van Wig (personal communication, September 5, 2019) who manages the goat program for Ventura County Fire Department, was asked about the effectiveness of goats. He stated that a recent fire in Ventura County burned up to a fire break created by goats and stopped with limited suppression efforts from fire crews. He then directed this researcher to search google as several media outlets were crediting goats for saving the Reagan Presidential Library during a recent (2019) wind-driven fire. Anaheim Fire & Rescue's Assistant Fire Marshal Lindsey Young (personal communication, September 20, 2019) (Appendix B), when asked how she justifies spending tax-payer money on employing the use of goats stated, "we know it works because we see it," indicating that personal observations played a strong role in garnering support from city council members and the community.

Additional results from personal communications were noted and are noteworthy in answering research question one. Oakland Fire Department's Vincent Crudele (personal communication, October 18, 2019) (Appendix E), Supervisor Vegetation Management Unit surmises that the goats buy time for suppression crews to arrive and begin extinguishment. Results showed that goats are effective at reducing the flash fuel height thus reducing the receptive fuel bed where ignition occurs (V. Crudele, personal communication, October 18, 2019) (Appendix E). Grazing prior to the start of fire season is important and has been observed

to be effective in reducing the severity of fire once it reaches an area where goats have grazed (K. Van Wig, personal communication, September 5, 2019) (Appendix C)

The second research question asked: What impact/benefit would using goats in vegetation management have on the nearby residents and homeless population?

Common themes were found in personal communications and aided in answering research question two. The interview/tour with Assistant Fire Marshal Lindsey Young (personal communication, September 20, 2019) (Appendix B) with AFR, discovered that the community loves the goats. This sentiment was evident when AFR hosted a community event to meet the goats and observe the good work they are doing in and throughout the open fields of Anaheim. Results from the interviews with Ventura County Fire Department Kenneth Van Wig (personal communication, September 5, 2019) (Appendix C), Los Angeles County Fire Department J. Lopez (personal communication, October 3, 2019) (Appendix D), Oakland Fire Department's Vincent Crudele (personal communication, October 18, 2019) (Appendix E), and Alissa Cope (personal communication, November 5, 2019) (Appendix F) reinforce the notion that goats are a welcomed sight to nearby residents. Results from the interview with Alissa Cope (personal communication, November 5, 2019) (Appendix F) indicated that the only concern from nearby residents is the dogs barking throughout the night.

Results from personal communications lacked any substantial data relative to the impact and/or benefit to the homeless population. Interviews with L. Young (personal communication, September 20, 2019) (Appendix B), K Van Wig (personal communication, September 5, 2019) (Appendix C), and V. Crudele (personal communication, October 18, 2019) (Appendix E) determined that they do not have the homeless population living or camping in the areas they use goats. Results from the interview with Alissa Cope (personal communication, November 5,

2019) (Appendix F) determined that she is supportive of including the impact/benefit of how goats will affect the homeless population but could not provide any data to answer research question two.

The third research question asked: What political, financial, and environmental factors need to be considered as it relates to implementing vegetation reduction utilizing goats?

The political implications of employing the use of goat's hinges on the collaborative efforts of internal stakeholders including, but not limited to, the CMFR's Community Risk Reduction division, the Parks and Recreation division, and possibly working with the Orange County Parks department, should Talbert Regional Park be considered as a primary target for grazing. Additionally, a well-established relationship with the local community will be crucial in the overall success of the program (A. Cope, personal communication, November 5, 2019) (Appendix F). The interview with Alissa Cope (personal communication, November 5, 2019) (Appendix F) discovered that the City of Irvine's Mayor Christina L. Shea established credibility as a proponent of using goats in vegetation management when she hosted a community event to educate citizens on several methods of vegetation management, which included their effective use of goats in wildland management. Personal communications with agency experts who have been in the goat business for several years (Oakland FD, V. Crudele; Anaheim Fire & Rescue, L. Young; Ventura County FD, K. Van Wig; and LACoFD, J. Lopez) have indicated that the support of council members and their community is evident when they are not met with resistance when it comes time to renew contracts with goat vendors.

Sage Environmental Groups Principal Alissa Cope (personal communication, November 5, 2019) (Appendix F) estimates costs at \$750 an acre with approximately \$1400 in mobilization fees and must be considered as a recurring annual cost. Ventura County Fire Department

Kenneth Van Wig (personal communication, September 5, 2019) (Appendix C) estimates cost on their two projects (26 acres on one project and 13 acres on another) to range from \$900.00 - \$950.00 per acre. Oakland Fire Department Vegetation Management Unit Supervisor Vincent Crudele (personal communication, October 18, 2019) (Appendix E) estimates goat grazing to be at \$530 per acre and when compared to a hand crew costing over \$2500 to perform relatively the same amount of work, it is clear that goats are cheaper (personal communication, October 18, 2019). Additionally, V. Crudele (personal communication email, October 18, 2019) (Appendix E) advises to allocate more funds (non-specific amount) during the first year of implementation due to additional labor costs in order to install electrical fencing, which is used to keep goats in and predators out.

When considering environmental impacts, the results of personal communications conclude that the type of goat and which vendor to choose from is important. For example, Alissa Cope (personal communication, November 5, 2019) (Appendix F) discovered that several goat vendors use goats in vegetation management as a strategy to fatten them up before they go to slaughter, whereas, other vendors choose goats on the fundamental principle that they are being used as a first step in a multi-step process that concludes with habitat restoration. Considerations should also focus on the long-term (annual maintenance) environmental effects of goats grazing. As such, Alissa Cope (personal communication, November 5, 2019) (Appendix F) explained how a poop study determined seed viability as it relates to regrowth and proliferation of invasive plants after the seedlings pass through a goat's digestive system. It was determined, that if the goats were quarantined for 72-hours prior to delivery, nothing sprouted from their droppings. The interview with K. Van Wig (personal communication, September 5,

2019) (Appendix C) determined that 50 goats on an acre leave the same amount of bacteria as two squirrels.

Discussion

The literature review along with personal communication (L. Young, September 20, 2019) (Appendix B), (K. Van Wig, September 5, 2019) (Appendix C), (J. Lopez, September 12, 2019) (Appendix D), and (V. Crudele, October 18, 2019) (Appendix E) has demonstrated that utilizing goats has been an effective vegetation management strategy. It turns out that employing goats to assist in managing vegetation has shown to be a successful strategy that has been around for decades as noted in an article published by the Sierra Club. In the article, the author writes of Mike Canaday, who started a goat renting business in 2003 and is so busy he has a waiting list of clients (Helmer, 2018). The data gathered determined that goats have been used in many areas of California for well over ten years (K. Van Wig, personal communication, September 5, 2019). Literature (Lovreglio et al., 2014) documents that goats can help mitigate the severity of brush fires when goats are used to consume fuels thus reducing horizontal and vertical continuity of fuels.

Objectives of vegetation management range from a simple strategy of managing vegetation for aesthetic reason to reducing the size and continuity of non-native invasive plants in order to create fuel breaks and reduce the severity of wildfires to managing vegetation as an initial step in habitat restoration. The literature clearly documents that goats are effective in reducing the plant biomass (Tsiouvaras et al., 1989). As evidenced by the Fairview Park Restoration Plan (City of Costa Mesa, 2019) and Talbert Regional Park Plan (Moffatt & Nichol, 2015), further supported by A. Cope (personal communication, November 5, 2019) using goats as a vegetation management strategy would not only fulfill the goal of habitat restoration

outlined in the park restoration plans, but would also create a better environment for recreation and reduce the severity of brush fires located in Costa Mesa parks. The research clearly showed a connection of the literature and data obtained through personal communication to be a benefit of community risk reduction. Principally, the impact of wildfire was reduced when goats were used as a vegetation management strategy (County of Los Angeles Fire Department, Forestry Division, n.d.) (Tsiouvaras et al., 1989).

The invasive plant species located in and throughout Fairview Park is well documented (City of Costa Mesa, 2019) as is in Talbert Regional Park (Moffatt & Nichol, 2015). However, no literature was found that documented an inventory of plant species located in Canyon Park. After reviewing Google maps, it can be seen that the same species exist in and throughout Canyon Park. As such, and based on personal communications (L. Young, September 20, 2019) (Appendix B), (K. Van Wig, September 5, 2019) (Appendix C), and (J. Lopez, September 12, 2019), goat grazing is an effective strategy in vegetation management and should be considered in Costa Mesa. A. Cope (personal communication, November 5, 2019) (Appendix F) stated that goats love to eat pampas grass and that they love all grasses. While an on-site evaluation needs to occur, the results from data (A. Cope, personal communication, November 5, 2019) (Appendix F) indicate that using goats in the City of Costa Mesa would have favorable results.

Orange County is well known for offering some of the best hiking and biking trails in the nation. Within Orange County, Costa Mesa offers several hiking and biking trails and is recognized as being home to the popular BMX track called “Sheep Hills”. City leaders are faced with political pressure to maintain the parks and provide opportunities for recreation. To that end, the literature reviewed for this ARP espouses that the public find the goats to be “fun” and the “kids (the human kids) loved it!” (Fire Science Brief, 2009). Further drawing a nexus to the

literature, personal communications (K. Van Wig, September 5, 2019) (Appendix C), (V. Crudele, October 18, 2019) (Appendix E), and (A. Cope, November 5, 2019) (Appendix F) reinforced that communities “love” the goats and ask when they are will be back in the fields. The positive impacts of using goats on the nearby residents doesn’t stop there. Goats are effective at eliminating fuel (vegetation) thereby reducing an element of the fire or combustion triangle, which means that you must have fuel, oxygen, and heat in order to support combustion (personal communication, Crudele, October 18, 2019) (Appendix E). By using goats as a vegetation management strategy, city officials and politicians alike are working preemptively on reducing a potential threat to nearby residents. Ultimately, this can be considered a “Community Risk Reduction” strategy.

The literature review shows that an inference can be made that goats could be used effectively in aiding local officials in their efforts to mitigate a homeless issue in the parks. Media sources report frustrations amongst nearby residents toward the homeless encampment fires (Brazil, 2016). Residents blame tall reeds and overgrown plants as an attraction for the homeless to live in well-established camps. Residents have been forced out of the park due to the presence of homeless, specifically parolees (Scafani, 2019). The presence of goats in Costa Mesa parks may not be effective at relocating the homeless population; however, by employing goats to reduce vegetation biomass, law enforcement officers (park rangers) may have an unobscured view into well-established camps that were previously obscured by overgrown vegetation. When homeless are encountered, city officials work tirelessly to relocate them to the city’s homeless shelter where they are provided assistance and guidance in hopes of getting them off the streets, or out of the parks in this case. No data was found relative to providing insight or answers to homelessness in parks or open fields. Personal communications (L. Young, September 20, 2019)

(Appendix B), (K. Van Wig, September 5, 2019) (Appendix C), (V. Crudele, October 18, 2019) (Appendix E) showed that other local jurisdictions did not have homeless encampments. As such, personal communications were limited in offering information relative to the homeless population as their respective agencies do not have issues in the areas chosen for grazing.

The literature sources are claiming that utilizing goats in place of mechanized methods are less expensive (Green & Newell, 1982), and that the cost of managing invasive species nationwide is over \$137 billion (Pimentel et al., 2000). City officials would need to take a deeper dive into past practices as it relates to vegetation management to determine more precisely how much money is spent in managing vegetation in the parks. Bold claims through several personal communications (V. Crudele, October 18, 2019) (Appendix C), (L. Young, September 20, 2019) (Appendix B), (K. Van Wig, September 5, 2019) (Appendix E), indicate that goats are less expensive in managing vegetation than the more costly mechanized methods and are environmentally safe and sound. However, a major finding was that people knew little and could not provide data to support their claims. When asked how they justified using goats, their answers focused on “feel good” emotions that having goats elicited. The literature (Green & Newell, 1982) (Rivera, 2019) revealed that goats are effective and efficient but are not meant to be a singular approach. To be clear, goats, as effective as they are, should be a part of a multi-faceted approach, which includes the use of humans, mechanized methods, and perhaps herbicides if safe to do so.

After careful review of the literature, it was discovered that utilizing goats as a vegetation management strategy in the Costa Mesa Parks would be beneficial. Based on the results, the organizational implications are beneficial in three ways. First, it is an effective and efficient means in addressing the goal of reducing and preventing the proliferation of invasive plant

species, a goal that is in concert with the restoration plans discussed in the literature review. Second, it would have a positive impact on city residents, visitors and would help city officials manage the homeless population found in the parks. Finally, the controlled use of goats would eliminate any political pressure relative to the protection of riparian areas and provide an environmentally friendly method of vegetation management in a cost-effective manner.

Recommendations

The purpose of this research was to determine if the use of goats would be beneficial in vegetation management in the City of Costa Mesa. Based on the information discovered in the literature review and data collection the following recommendations are presented. The first recommendation was to identify city officials (internal stakeholders) from several departments (Parks and Recreation, Finance, and Community Risk Reduction), residents and vendors (external stakeholders) who will form a working group and provide feedback to key leaders (City Council, department directors, and community members).

The second recommendation was for the working group to evaluate each of the parks to designate areas of concern. With the *Fairview Park Master Plan* and the *Talbert Regional Park Restoration Plan* as a guide, identify plant species and sensitive areas (riparian areas), to determine zones as Primary, Secondary, and Tertiary. The zone designated as “Primary” would be first with secondary and tertiary following respectively. As a sub-set recommendation and based on proximity to the housing tract and the fact that there is not a formal master plan or restoration plan for Canyon Park, it is recommended that the working group use Canyon Park as starting point.

The third recommendation was for city officials, in collaboration with the working group, develop a Scope of Work (SOW) and publish a Request for Proposal (RFP) process to evaluate

vendors who provide goats for vegetation management. Within the SOW and the RFP, it is recommended to clearly articulate the goals as being twofold: (a) vegetation reduction, and (b) habitat restoration. Clearly articulating “habitat restoration” as a component will eliminate vendors whose current strategy does not include habitat restoration.

The fourth recommendation was at the conclusion of the RFP process when a vendor has been named, a robust communication plan be developed. The communication plan would include, but not be limited to the following: (a) sending mailers to nearby residents, (b) hand deliver flyers to homeless with a focus of relocating them to the homeless shelter. and (c) hosting an informational session where residents are invited to see the goats at work, social media messaging informing the public.

The fifth recommendation was to continue to research the effectiveness of goats. At the writing of this ARP, quantifiable data that documents the effectiveness of goats was limited. The author is aware that California Polytechnic Pomona University has received \$300,000 in grant monies and will soon be able to provide peer reviewed literature as it relates to the effectiveness of goats. In addition, University California Irvine and University California Riverside will be studying the use of goats. Key individuals and groups should continue to monitor the latest developments in these studies which can provide quantifiable data which may assist in making adjustments to the vegetation management strategy of utilizing goats. In addition, it is recommended that city officials use the latest information produced by the universities and Sage Environmental Group to evaluate the effectiveness of goats in Costa Mesa parks.

The author suggests that future readers focus on results from current and/or projected studies from the universities previously mentioned. With California Polytechnic Pomona University receiving \$300,000 in grant money along with University California Irvine and

University California Riverside currently studying the behavior and effectiveness of goats, future research needs to focus on the results of the studies. In addition, and at the forefront of research, future readers should focus on the results from studies by Sage Environmental Group. Lastly, it is recommended that future readers focus on the “risk reduction” benefits of utilizing goats for vegetation management.

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Appendix A

Interview (Costa Mesa Fire & Rescue)

Conducted September 20, 2019

The following is an account of a personal communication in the City of Costa Mesa with Division Chief of Operations Jason Pyle, conducted on September 20, 2019.

Q: As the operations chief, what is our operational challenges when fighting brush fires in our local parks?

A: I see several challenges with overgrown vegetation, which is wreaking havoc on our apparatus. We have had to look for alternative methods by which to access deep seated brush fires. We now have a patrol truck (F150 with a compressed air foam system), which helps. We also strengthened our relationship with city and county park rangers and our partner agencies who provide automatic aid in the event of a brush fire.

Q: In relation to the overgrown vegetation, do you view any specific plants as troublesome?

A: The pampas grass ruins our chainsaws. It is difficult to extinguish once a fire is deep seated in the base of the plant. I really dislike the pampas grass.

Appendix B

Interview (Anaheim Fire & Rescue)

Conducted September 20, 2019

The following is an account of a personal communication and tour of the fields in the City of Anaheim to view goats grazing with Assistant Fire Marshal Lindsey Young, Community Risk Reduction Officer Justin Day, and Community Engagement Manager Natali Rudometkin conducted on September 20, 2019.

Q: Why are using goats?

A: We use goats as a way to reduce vegetation in open land areas that are owned by the City of Anaheim. Per state regulations, it is the homeowner's responsibility to maintain 100' of defensible space by keeping the brush cut. It is the city's responsibility to maintain the brush (vegetation) beyond the 100'.

Q: Have the goats been effective in accomplishing the goals set forth by the City of Anaheim?

A: Yes, during 2018, we had two significant fires in the hills of Anaheim that threatened nearby communities. Our after action analysis showed that the fires severity was reduced when we observed that the fire burned up to the area where goats were grazing and prevented damage to nearby homes.

Q: Do you have any data that supports your assertion?

A: Other than the fact that we can see the results and when we tour specific areas where goats have grazed, we observed that the fire severity was reduced and/or eliminated.

Q: Have you had to present to city council in order to receive additional or recurring funding for employing the use of goats?

A: Yes, and when we did, it passed easily.

Q: Were you required to present any data or research to support what has been done in the past?

A: No, we presented to council following the Canyon 1 and 2 fires and were not asked for data. The city and council have just been supportive of using the goats.

Q: Do you have any issues with homeless in the areas you are using goats?

A: No

Q: What has been the community's reaction to the goats?

A: They absolutely love them. We invited the community to a Meet the Goats day where they were able to interact with the goats and pet them. The kids loved petting the baby goats and we took the opportunity to educate the public as to the reasons we were using the goats.

Q: Do you leave the goats out all night by themselves?

A: No, they are controlled by the electric fence you see here and way down the hill is the goat herder. He feeds them supplemental food to ensure they are getting proper nutrition. There are several dogs you see that are here for the protection of the goats against coyotes.

Q: What political, financial, and environmental aspects have you considered?

A: Our City Council is very supportive and approves funding when the contract comes up for renewal. Goats are environmentally friendly where they do not emit harmful substances into the atmosphere. Financially, it would be overwhelmingly expensive to control the vegetation by mechanical means alone.

Appendix C

Interview

The following is an account of a personal communication with Ventura County Fire Department Captain Kenneth Van Wig conducted on September 5, 2019.

Q: I recently read an article that quoted you discussing the use of goats in and throughout Ventura County. How effective are the goats?

A: The goats have been very effective! We have been using goats for 10 years with great success. As a fire department, we see the goats working to create fire breaks. When we graze in an area, all of the fuel is removed before fire season and it doesn't grow back until the following season, and it's much safer to have goats graze difficult terrain.

Q: Do you have any data that supports your assertion that goats are effective?

A: We have first-hand knowledge that it works as we see the benefits. We know it works because we have observed where fires have burned up to the fuel break and stopped.

Q: What impact/benefits do the goats have on nearby residents and/or homeless?

A: The community supports the use of goats. The goats are cute and when are they coming back.

Q: What are your political and financial considerations?

A: The politicians support the use of goats and I took this program over. Prior to me taking over, we had been using goats for 10 years, so the program was in place and we have never faced any resistance to spending the money because we all see that it works. We manage the goats on two projects, they typically cost \$900 - \$950 per acre.

Q: Do you see any issues with using goats?

A: We have had minimal issues where goats have jumped the fence and caused damage to nearby trees and shrubs.

Q: What are your environmental considerations?

A: They are environmentally friendly and efficient. I've read that 50 goats on an acre leave the same amount of bacteria as two squirrels.

Q: In closing, is there anything that you would urge me to look deeper into relative to my research.

A: No, just that we have been using goats for 10 years and see the benefits. It has been effective at reducing the severity of fires and creating effective fuel breaks!

Appendix D

Interview

The following is an account of a personal communication with Los Angeles County Fire Department Assistant Chief J. Lopez, Prevention Services Division conducted on September 12, 2019.

Introduction: Good morning and thank you for calling me. My email outlines who I am and what I am working on.

Lopez: Yes, thank you and it is a pleasure to speak with you.

Me: The pleasure is all mine Chief and to confirm you are an Assistant Chief with LACoFD and are the person who oversees the goats?

Lopez: Yes, please call me J as that is what everybody here calls me.

Me: Ok, I have a few questions, so I suppose it's best to just get into it, is that ok with you?

Lopez: Yes, I will help however I can

Q: What is your experience with managing goats and have you found them to be effective?

A: I have been overseeing the goats for several years. It is important to note that we (LACoFD) are not the final decision makers for using goats. Of the areas we provide protection, it is the city's that make that decision and then we oversee the project as part of our fire hazard reduction plan. Currently, we oversee goats in Biological Treatment Area in the Claremont Hills Wilderness Park and green areas found on the Etz Meloy Fuelbreak. The goats have been effective at reducing the amount of vegetation and we have seen the benefits of the fire breaks

created by goats. This was evident during recent brush fires where the fires intensity was drastically reduced upon reaching areas where goats had been grazing.

Q: What impact have the goats had on nearby residents?

A: We oversee the goats in two areas and the community loves them.

Q: Do you deal with any homeless people in the areas you have goats?

A: No

Q: What political factors do you consider?

A: We haven't dealt with any political backlash or issues. The goats are welcomed.

Q: What are your financial considerations?

A: We know that goats are cheaper than hiring hand crews and bringing in machinery to clear vegetation.

Q: What are your environmental considerations?

A: Goats are very efficient and are not harmful to the atmosphere. It is important that you choose the right vendor. We had vendors in the past who used certain goats and techniques that we found did not encompass all aspects of vegetation management. I would recommend you talk to Alissa Cope from Sage Environmental Group. I will forward you her contact information along with some literature I have that may help you.

Q: Is there anything else you can think of that would assist me in my research?

A: I will send you the information and if you have any questions, you can call me anytime. We have found goats to be an effective way of creating fire breaks and it is less expensive than using hand crews.

Email with J. Lopez

You are welcomed. Let me know how it goes.

J. Lopez, Assistant Chief
County of Los Angeles Fire Department
Prevention Services Bureau
Forestry Division
(323) 855-0093

From: COATES, CHRIS [<mailto:CHRIS.COATES@costamesaca.gov>]
Sent: Friday, October 04, 2019 10:49 AM
To: Lopez, J.
Subject: Re: Biological Fire Hazard Reduction - Goats

Chief Lopez,

Thank you for sending the information, I look forward to delving into it.

Thanks!



CHRIS COATES
Battalion Chief
chris.coates@costamesaca.gov | (949) 735-1534

From: "Lopez, J." <J.Lopez@fire.lacounty.gov>
Date: Thursday, October 3, 2019 at 9:56 AM
To: "COATES, CHRIS" <CHRIS.COATES@costamesaca.gov>
Subject: Biological Fire Hazard Reduction - Goats

Good Morning Chris,

Hope this email finds you well.

As per our conversation, information on some Fire Hazard Reduction Projects using Goats that we conducted is attached. I also included a Fire Science Brief.

One of our vendors that has a great handle on the use of goats for Fire Hazard Reduction is Sage Environmental Group. Here is the Principal's, Alissa Cope, contact information.

Alissa Cope, Principal
Sage Environmental Group

24040 Camino del Avion, Suite A77
Monarch Beach, CA 92629
Tel: 949.243.2282
Fax: 949.496.9345
acope@SageEnvironmentalGroup.com
Contractor's License No. 947034 (C-27)

Hope this helps your project and please call if you have any questions.

Regards.



J. Lopez, Assistant Chief

County of Los Angeles Fire Department
Prevention Services Bureau
Forestry Division
5823 Rickenbacker Road Room 123
Commerce, CA 90040
(323) 855-0093 Cell
J.Lopez@fire.lacounty.gov

www.fire.lacounty.gov

Appendix E

Interview/Email

The following is an account of a personal communication/email with Oakland Fire Department Supervisor of Vegetation Management Vicent Crudele, conducted on October 18, 2019.

Q: You have been using goats for several years in the Oakland Hills area. How effective has that been?

A: It has been very effective as all fires have burned up to the road or to a goat grazed fire break. You are buying time for engine companies to arrive and begin suppression efforts.

Q: What impact/benefit would using goats have on nearby residents and homeless?

A: The impact, in my opinion, would be good as anytime you reduce the byproducts of fire (i.e., smoke, carbons) you are providing a benefit to the community. We do not have a homeless issue in the area we use goats.

Q: What political, financial and environmental factors need to be considered?

A: Cost is \$530 and acre on average, whereas, a hand crew costs over \$2500. Timing is critical based on weather pattern—if you don't time it correctly you will need to do more grazing. Once a riparian area has dried, you can come in and graze with minimal impacts. The challenge during the first year is that goat herders need to cut line to install an electrical fence.

On a side note, I just returned from a hunting trip and have over a hundred emails and things to catch up on. If you give me a couple days, I will provide detailed answers to the questions in your email.

Good Morning Chief Coates ,

1. *What is the effectiveness of goats with other organizations, within the state of California, in reducing vegetation?*

I can only respond to what I have first-hand knowledge of here in the in the Bay Area. Locally, goats are utilized by the Oakland Fire Department, East Bay Regional Parks Fire District, East Bay Municipal Utility District, Lawrence Berkeley National Laboratory, CALTRANS and Pacific Gas & Electric. Our collective grazing efforts have significantly reduced the annual ground fuel load throughout the Oakland and East Bay Hills, the majority of which is a State designated Very High Fire Severity Zone. Here within the City of Oakland, we have 88 City owned parcels which total 1284 acres of parklands. We deploy 3500 goats beginning in late May of each year to graze approximately 950 to 1100 of those acres, depending on vegetation present from annual re-growth. The goal is to reach a vegetation level not exceeding 900 pounds of dry vegetation at ground level per acre. This translates into a flash fuel height of approximately 3 inches. By doing so, we have greatly reduced the receptive fuel bed in which wind cast brands and embers could ignite. Should an ignition occur, the flame length produced by active fire is minimal, it's thermal output minimal and its ability to access any overhead tree canopy greatly minimized. Goats not only graze the seasonal weeds and grasses, but the intermediate level brush and browse the lower tree leaves and branches up to a height of 6 feet. This interrupts the ladder fueling. With no fuels to carry the fire vertically, no canopy ignition. It's extremely effective. We can deploy our goats onto hillsides where is would be extremely difficult for hand crews or mechanized equipment to operate. Goats by there evolution, navigate steep, rough terrain with ease. Their digestive systems allow them to consume virtually all vegetation without complications and they have minimal impact on the environment or soils stability. Using goats reduces the erosion damage caused by heavier livestock such as cattle and sheep. No herbicides are broadcast when goats are utilized and not ignition threat is present that could be caused by fueled abatement equipment. Our grazing program continues throughout the summer and into the fall as a means of continuous management and concludes in late September / early October depending on fuel volumes (vary for year to year) and weather conditions. It's economically and fiscally responsible as well. Grazing is less expensive per acre than utilizing hand crews or mechanized abatement.

2. *What impact/benefit would using goats in vegetation management have on the nearby residents and homeless population?*

The impact, in my opinion, would be positive for your City's residents. You are reducing the risk of wildfire by reducing the only element of the combustion reaction (Oxygen + Fuel + Ignition) that we can control in advance, FUEL. It's the only known factor of this equation that we as Firefighting professionals have advanced knowledge of (location, amount, type, condition, exposure etc.). That stated, we can address the issue in advance and reduce or eliminate it's potential as a hazard. Goat grazing is environmentally friendly because we are NOT creating chemical exposures or pollution as herbicides might, we can isolate sensitive riparian habitat or protected flora through fencing, goats don't spark fires like fueled equipment can and don't create the noise pollution so commonly complained about that chainsaws, weed whackers and hedge pruners cause. It's a proactive means of managing fuel and fire threat with only positive reactions. In my experience, our residents welcome our goats each year with enthusiasm and thanks. They provide my Fire Department with a means of announcing "Fire Season" by

positively encouraging residents to manage their own parcels for defensible space because they see that WE are doing it on City ground.

Homeless – We (Oakland) don't have any issues with this as our homeless have not been in our grazing areas. CALTRANS has had to post and abate some encampments in areas that they graze in advance of deploying the goats. You can't have the goat bands (that's a small group of goats) or herds threatened by dogs or injured by trash and debris. Goats may eat things like plastic so the areas to be grazed should be as "clean" as possible.

3. *What political, financial, and environmental factors need to be considered as it relates to implementing vegetation reduction utilizing goats?*

Develop a scope of work and release a Request for Qualifications and a Request for Proposals depending on how your City Administration operates. Financially, grazing is going to cost you the most in the first year due to labor. Cutting in lines to establish low voltage electric fencing is the greatest cost in my experience. You'll also have the highest volume of fuel, so more goats, more time, more fencing pens equals more cost. What's your total acreage? Too small and it isn't cost effective for most grazing contractors, too large and it may exceed your City's / Agency budget. That stated, it's strategy. Maybe you only perimeter graze a parcel due to its size in year one and expand as more funding is identified. I recommend you propose a multi-year contract. Grazing gets better results over the longer duration of time and can change the fuel matrix. We have a 4 year contract with the option to extend for an additional 2 years with City Council approval.

Your City should have an up to date Vegetation Management Plan and Integrated Pest Management Plan. Before grazing, survey the area with your City forester and biologist to make sure you identify any State or Federal listed threatened or endangered species present. If identified, CALL the Department of Fish and Wildlife and ask that they meet you on site to evaluate what protective measures need to be in place at time of grazing.

Vincent Crudele
Supervisor
Vegetation Management Unit
Fire Prevention Bureau
Oakland Fire Department
510-238-7391 Office
510-755-5816 Cell
vcrucele@Oaklandca.gov

From: COATES, CHRIS [<mailto:CHRIS.COATES@costamesaca.gov>]
Sent: Friday, October 4, 2019 11:17 AM
To: Crudele, Vincent <VCrucele@oaklandca.gov>
Subject: [EXTERNAL] REQUEST - All Things Goats

CAUTION: This email originated outside of the City of Oakland. Please do not click links or open attachments unless you recognize the sender and expect the message.

Good Morning Chief,

My name is Chris Coates and I am a Battalion Chief with the City of Costa Mesa Fire & Rescue. Bernie Molloy, Division Chief with Lakeside FPD sat in on your presentation at Cal Chiefs and passed your info on to me.

My reason for contacting you is that I am looking for information about utilizing goats as a vegetation reduction/management strategy. Although the information obtained will certainly be used to determine if utilizing goats in Costa Mesa, I am more focused on a research project.

I am a second year student at the National Fire Academy (NFA), Executive Fire Officer Program (EFO) which requires student to complete an Applied Research Project.

The title of my paper is:

Alternative Vegetation Management Strategy: Using Goats in Vegetation Management

My research questions are:

1. *What is the effectiveness of goats with other organizations, within the state of California, in reducing vegetation?*
2. *What impact/benefit would using goats in vegetation management have on the nearby residents and homeless population?*
3. *What political, financial, and environmental factors need to be considered as it relates to implementing vegetation reduction utilizing goats?*

I did not get your contact number and understand that you are on a hunting trip (hoping it was successful).

Thank you so much and I look forward to hearing from you. Feel free to call if that makes more sense.



CHRIS COATES

Battalion Chief

Costa Mesa Fire & Rescue

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Appendix F

Interview (Sage Environmental Group, Alissa Cope)

Conducted November 5, 2019

Q: What do goats like to eat?

A: We have found that goats like to eat black mustard seed and have actually found that they will choose non-native species over native species. The first thing goats will browse is the non-native species and the grasses and tumbleweeds, they will just go for it. And, so what we are looking to at doing is that a lot of money is spent in the habitat restoration world versus manual habitat eradication. Herbicides are being looked at closely and I understand that LA County is banning the use of herbicides, so we are looking at other options. So, what we wanted to do was bring in grazing animals to hit that habitat first. That is what got us started.

Q: The city (Costa Mesa) uses volunteers as a strategy to aid in the overall goal of restoration.

Do you see this as a valuable option?

A: Yes, volunteers are great and will aid in getting funding, but they are not good at the heavy lifting and there are concerns about poisonous plants and/or allergies that volunteers may have to plants. Poison oak for example, goats love to eat poison oak; they eat it down to ground. There a lot of noxious plants that are toxic to humans, but goats love them.

Q: We have a lot of pampas grass in our parks, do the goats like to eat it?

A: Yes, they will eat it, they love the grasses. The best approach with goats is you go in and do an initial treatment but you really need to do a repeated approach. Initially, you focus on the infested areas to reduce the vegetation and then you come back to graze again to prevent

regrowth. By doing this you can control what becomes dominant and that is where the restoration comes in as we seed after the plants are removed. Native seeds don't need to be buried, you can just rake them in versus bringing people in to bury the seeds.

Q: From your professional opinion, do you see this as a viable option for Costa Mesa?

A: We would have to look at the sites. I haven't really spent time evaluating it. I know they can approach pampas grass and can address that. Timing is important too, so you consume that seed head before it goes to seed, so you are starting to repress that seed bank. We would have to look at the specific sites.

There can be hazards with over-grazing and issues with the herders. That's why J. Lopez (LACoFD) is interested in redoing it, it because it has this habitat restoration component.

Traditional grazers use these sites to feed their animals because the animals are meat goats, so it's a production of live stock which is completely legitimate and valuable. But, it's a different objective. Their objective is to fatten up the animal to sent them to slaughter, so they graze in areas they shouldn't be such as riparian areas and they are debarking trees where they shouldn't. That is why we became involved and why he (J. Lopez) suggested you talk to me. Using goats is a really powerful tool and I think it would be really beneficial as a fire suppression tool.

Q: What is the cost of using goats?

A: We do \$750 an acre plus a mobilization fee of \$1400 is a pretty good benchmark. You still have to feed the goats, clear vegetation to set up the fences, and deliver the goats. If you have a wild site where you have to walk goats in or bring smaller trailers to drive closer through hills and steep terrain may add costs because of more labor time.

Q: With Talbert Regional Park being in Costa Mesa but overseen by Orange County Parks, are there any issues with that area?

A: Well, we have a contract in place with Orange County Parks. We are doing habitat restoration in some areas for them, so it is already in place.

Attention needs to be given to the fact that goats can transport weed seeds from job to job. We have a protocol in place to avoid that by quarantining of goats for 72 hours prior to delivering them to a site. This may sound weird, but we are doing a goat poop study. Goats have four stomachs and the research so far is indicating that 97% of the seed that passes through the goats gut becomes non-viable, that's a really big deal. If the seeds become non-viable, you are really changing the habitat. That's one example, we check the tires, we check the hooves, we feed them purchased feed for three days (minimum) before going to a job site. That exceeds any recommendations made by the plant council.

Q: Do you have any recommendations on where I can find more information, peer-reviewed articles/journals, scientific data or otherwise, as it relates to goats grazing?

A: Cal Poly Pomona, U.C. Irvine and U.C. Riverside are interested in doing more studies with us on this subject. We haven't put it together yet, but that was one of the things that was identified by the Cal IPC Council and they have money to do it. So, we are going to set up a program to collect droppings at each of the sites. They will perform the studies where we don't have time and it should be third party.

Q: Can you think of any environmental impacts/benefits?

A: Using grazing animals you can open it up (vegetation) by 50% or whatever is identified and then pull the animals off at the tipping point of meeting the fuel objective and we are also preserving the habitat and it's very cost effective rather than having hand crews go out there. Collateral damage is incurred when just cutting away the brush and leaving it there; whereas, the goats consume it, it physically doesn't exist anymore. It just ends up as little pellets on the ground. It's really amazing how effective it is.

Q: Most of the research I have found is ten plus years old. Is this true, or have you found research within the last five years?

A: Right! Traditional grazers have a bad wrap. Grazing was much more common ten or more years ago. There is not much data that is timely.

Q: My research included asking several agencies what they have in place to quantify the effectiveness of goats should city policy makers require it and none of them could produce anything outside of the statements that they know it works. Are you aware of this and have any recommendations for further research?

A: Right, but there hasn't been the quantitative work done. Cal Poly Pomona has \$300k and we are hoping they will assist and they are very interested and it would be a great master's thesis for a graduate student. UCI has money and has done a study on our project.

I wanted to give you the statistical data that we presented at Cal IPC, which will provide some data for you to use.

Q: What impact/benefit do you see relative to nearby residents and homeless?

A: Neighbors LOVE having the little goatsters there. So, we can have guests come on the site as long as it is supervised. The goats are friendly. Last time we did this, one of the goats had a baby and the public loved coming to see the baby goat. We have received complaints about the dogs barking at night. The dogs are there to protect the goats from nocturnal predators such as coyotes. You can't really do anything about controlling the population (coyote), the only thing you can do is to control the food source by ensuring that trash cans are closed and food is not discarded.

Interfacing with the homeless, we definitely need police support and we have found that most agencies have a relationship with the homeless located in these areas. The animals will limb up trees giving them the shape of a lollipop. By doing this, the hiding areas are a lot more exposed. There is a lot of win in using goats and little downside with dogs barking at night.

The Mayor from Irvine is leading the charge on habitat restoration and she recently hosted a community event where they offered a tour of the hills where goats are grazing. Some items of discussion were to educate the community on the various methods of vegetation management.

Q: Can I get the presentation from you that was presented at Cal IPC?

A: Yes

Q: How is the relationship with Sage Environmental Group and the Mayor from Irvine?

A: We love her. She is concerned as she has a lot of kids in her community. She is focused on eliminating the use of herbicides and the long-term effects they have on people.

Q: Several literature sources claim that mechanized weed whacking or trimming are used to supplement the use of goats, do you use this strategy?

A: Yes, we need to use it sparingly to access areas or after the goats have left. We consider it a tool in the toolbox. We do herbicides, tractors, and other methods. It is an important tool.

The other thing I think is important, is public outreach. We do with Orange County Fire Authority. We had several community members who approached us and shared that they loved it. It is a restorative means for the public, almost like a therapy animal.