

Sustainable Fire Clearance Using Goats

A Senior Project

presented to

the Faculty of the Department of Agriculture Education and Communication

California Polytechnic State University, San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Bachelor of Science

by

Elida Moore

March, 2014

© 2014 Moore

Abstract

This project was created in order to fulfill the need of creating a unit of teaching for sustainable fire brush clearance using goats. The beginning goes over all the literature that was used to help create the project as well as the thought process that was followed in order to write the unit. These decisions were crucial for figuring out what was going to be included in the unit as well as the activities and lecture prompts that are provided. The unit covers everything from fire history and fire regulations in the state of California, to the care and treatment of goats and how best to utilize them for clearing the woody brush. The teaching unit itself is included as well as recommendations for those that would like to do something similar to this report as well.

Table of Contents

Chapter One	1
Introduction.....	1
Statement of the Problem.....	2
Importance of the Project.....	2
Purpose of the Project.....	3
Objectives of the Project.....	3
Definitions of Important Terms.....	3
Summary.....	4
Chapter Two	5
Introduction.....	5
Cal Fire Regulations.....	5
Goat Nutrition.....	7
Goat Health Management.....	8
High School Curriculum Standards.....	9
Chapter Three	12
Introducton.....	12
Researching Standards and Material.....	12
Deciding on the Criteria.....	14
Creating the Lesson Plans.....	15
Activities.....	16
Summary.....	17
Chapter Four	18

Sustainable Fire Clearance Using Goats.....	19
Chapter Five	49
Recommendations.....	49
Conclusions.....	49
References	51
Appendix A	53

Chapter One

Introduction

Fire management has become a very important issue in California these past few years because of the lack of rainfall and impending drought. Measures taken to prevent the spread of fires is not, however a new concept. Fire management dates back all the way to 1891 with the U.S. Fish and Wildlife Services (Fish and Wildlife Services [FWS] 2012). How fire is managed has changed over the years due to research and a better understanding of what fire does. Fire breaks are a common way that the Fish and Wildlife Services have come to combat the wildfires that break out on federal lands. These areas create defensible space and also help prevent flames from jumping areas. These breaks are typically made through purposeful burning or using tractors and machines to clear the area. In California, the Vegetative Management Plan is being developed for guidelines on how the firebreaks are going to be created and the different ways that California can go about preventing fires from occurring.

According to Cal Fire citizens need to have at least 100 feet of defensible space around their houses (2012). This allows firefighters to have enough area to maneuver and protect the house and creates a farther distance for the flames to have to jump. There are many ways to create a defensible space around one's home, through landscaping techniques, mowing lawns and weed whacking the surrounding lots. It is also suggested that fire resistant plants and trees are planted around the house to help protect it from fire (Cal Fire 2012).

California is also very concerned about sustainability and protecting the earth. Providing a way to create a defensible space while not harming the environment is a major concern, and the answer to that are goats. Goats are known for eating woody plants and shrubs as well as many unwanted weeds. By using goats to clear fire areas, unwanted plants and brush are removed, all while promoting the growth of plants that are wanted in the area. By grazing the land, diversity of plants and microorganisms is promoted. This benefits the environment by providing added fertility to the soil.

Statement of the Problem

California Agriculture Education does not have a unit for a goat herd utilized for fire brush clearing. There is a need for a sustainable source of fire clearing in California that can also be used in small yards and in creek areas. Therefore a program is needed so that students can learn about the sustainable methods of clearing land and the benefits that using goats can provide the ecosystem that meet California Agriculture Education standards as well as providing a guideline for setting up a program at a school.

Importance of the Project

Today, there is a great emphasis in creating a sustainable or green way of achieving our goals. Fire clearing is typically done with chainsaws, weed whackers, and tractors. All of these methods utilize gasoline, create greenhouse gases and have the potential to start a fire while trying to prevent it from happening. Using goats is an excellent way to create a sustainable way of creating a fire clearing zone. They eat many weeds and woody brush, as well as promote eco-diversity in the area.

Purpose of the Project

The purpose of this project is to create a detailed unit that meets standards set by California Agriculture Education as well as the Common Core Standards

Objectives of the Project

The objectives of this project are to create a functioning curriculum by:

- Writing a Unit that meets standards set by California Agriculture Education.
- Incorporating goals of the Common Core by having both written assignments as well as math assignments in this Unit.
- Provide activities that support the information that the students are learning in class.

Definitions of Important terms

Definition of important terms

VMP: vegetative management program that is being proposed in California. Gives the guidelines to how the state will address fire prevention and defense; including sustainable ways to fend off fire.

Fire Break: Segment of land that has been cleared to keep fire from spreading.

Sustainability: action that is not harmful to the environment and supports long term ecological balance

Summary

A Unit for about a goat herds utilized for fire brush management will provide an understanding of the benefits of using a sustainable resource for clearing brush. Students will get the opportunity to see how management of natural resources does not have to be destructive and can even be created into a successful business. Schools will also be provided the guidelines for getting their own brush management program started at their own facility as a way of creating revenue for the chapter and providing a learning experience for the students. The unit will meet several standards set by the California Agriculture Education standards as well as some that are set by the Common Core.

Chapter Two

Introduction

Having a unit based on fire brush management using goats will be beneficial for all schools in California. It will allow students to learn of an alternative, sustainable way of clearing the brush that surrounds their homes and communities. If the school decides to implement a herd of its own, it will meet the criteria for SAE for those students who do not have the area or money, to have an animal project. It also goes along with the animal science and biology portions of many classes as well as providing the opportunity to learn the history of fire and the role it plays in today's policy making.

California Fire Regulations

Fire clearance of structures need to be from 30 to 100 feet. This is so that it gives fire fighters a better chance to prevent or put out a fire that has occurred in your area (Cal Fire, 2012). This law was put into place in 2005 (Cal Fire, 2012). This is becoming more and more important in the state of California do to the drought conditions.

We need to manage the vegetation to California's wild lands because they are naturally prone to fires (California Department of Forestry and Fire Protection {CDFFP}, 2013). Wildfires have burned up, on average, a total of 325,000 acres annually (CDFFP, 2013). There are many ways to proposed ways to help with the brush clearing and fire clearance in the state. Fuel breaks are wide strips of land that the vegetation has been removed. This helps to prevent the fires from jumping area (CDFFP, 2013). There are many types of fire breaks and ways to maintain them.

The Prescribed herbivory treatments are clearing the land through the use of ruminant and non-ruminant grazing animals. Used to maintain fuel breaks in many areas. Goats are best used for area needing the removal of forbs, grasses and woody plants. (CDFFP, 2013) Cattle are also used, but are not as apt to eat the woody plants. This process works the best when alternating between cattle and goat grazing.

Chemical clearance, controlled burns, tilling the soil, mechanical removal of trees and shrubs are also used to clear areas for fire protection. Chemical clearance typically comes by the way of spraying herbicides on the plants. This has become more of an environmental issues over the years and can make room for more invasive species to enter (CDFFP, 2013). Contamination of water and soil is also a concern when using herbicides to clear land. Controlled burns, or prescribed fires, are used in areas where other methods may not be feasible due to terrain, and is only done under specific conditions (CDFFP, 2013). These prescribed burns can create an open fuel break to help prevent the spread of fires in the future.

Mechanical Treatment includes the ripping up of vegetation through the use of machinery such as tractors, crawlers, or vehicles with attachments used to rip, cut or uproot vegetation (CDFFP, 2013). These are best used to get rid of thick sections of vegetation, particularly in forested areas where herbicide treatment is not feasible (CDFFP, 2013). This is a very expensive form of vegetative treatment, but is extremely effective. Tilling up a section of land as a barrier to help prevent fires also provides an area of safety for those fighting it if one does come to pass (CDFF, 2013).

Goat Nutrition

Goats are very good at managing vegetation that can invade yards and lot, so that plants and grasses wanted can grow in the area instead (Escobar, 1996). This is widely the reason why they have become more popular as a vegetative clearing tool. The split lip allows them to gingerly take the seeds and edible parts of thorned plants and small leaves off of others (Luginbuhl, Poore, Mueller, Green, 1998). Goats are extremely agile and will even bend plants over to get to the tender small leaves (Luginbuhl et al., 1998). They will eat any number of plants including browse, legumes, shrubs, and grasses. They will eat the nutrient dense grasses first and then switch to the more woody variety as soon as the grasses are gone (Luginbuhl et al., 1998). Goats are also not adverse to bitter taste, which is the reason they will eat the woody plants when cattle will not. Goats are good uniform grazers, so there will be no patches of land where the area is not eaten down. If alternating between cattle and goats, it is recommended to graze the goats before the cattle because of this (Luginbuhl et al., 1998). There are some plants that are poisonous to goats, but it is all relative to the type of plant and how much the goat eats at one point in time. Goats typically try to avoid eating poisonous plants, so if they do it is often due to a lack of feed available to them (Forero et al., 2011). According to Forero et al. (2011) the most poisonous plants to goats in California are avocados, nitrate fixers, oxalate, lupine and oleander.

Goats have a small rumen, so they are not able to digest the cell walls as efficiently as cattle. This means that the goat will have to eat more grasses or a diet rich in concentrates in order to get the same amount of nutrients (Luginbuhl et al., 1998). If the forage available is of poor quality, make sure to not stock the area too heavily. If it is stocked with the adequate number of goats there will be not issue. The issues arise when there are too many goats placed on an area that does not supply the adequate nutrients to the goat (Luginbuhl et al., 1998). Goats eat

thirty percent of their body weight a day. This means that the area that you graze them on will need to be able to support around 4.5 pounds per goat per day. This will help you to choose the correct number of goats to graze on one specific area (Rutherford, 2013). The amount of feed in the area determines how many head can be on the property for so many days before needing to be rotated to another pasture (Rutherford, 2013).

` Fencing is a major controlling factor in how to keep goats in the areas that they are wanted and not in other areas. There are two types of barriers that can be used to keep goats in their designated area, psychological fencing and physical fencing. The most effective psychological fencing is electrified wire (Rutherford, 2013) Electrified wire of 4-5 strands is often preferred because it does not have to be stretched tight or in a straight line (Luginbuhl et al., 1998). Goats tend to try to sneak underneath the wires rather than jump over, so make sure to string a wire close to the ground in order to prevent this (Luginbuhl et al., 1998). Woven wire is a physical barrier that works great but can be very costly to utilize. These can cause goats to become stuck if they have horns so it is typically a good idea to string a wire out from the wire fencing about 6 inches to prevent them from getting their heads stuck (Luginbuhl et al., 1998).

Goat Health Management

When managing the health of a goat herd it is a good idea to know when the breeding season for goats. Goats tend to breed in the fall so that will have spring kids (Luginbuhl et al., 1998). Breeding yearlings occurs around the age of 8 months of age or when they are the correct size and weight to breed (Luginbuhl et al., 1998). There as certain vaccinations to be given in order to maintain a proper pregnancy in order to avoid abortions.

Goats are typically vaccinated for Pneumonia, Leptospirosis, enterotoxemia/tetanus, foot rot, caseous lymphadentis, rabies, and chlamydia (Leite-Browning, 2007). Vaccines come in two forms, a modified live vaccine or a killed vaccine. Killed vaccines give a dead version of a virus to the goat so that they can boost their immune system by creating the antibodies needed to fight the disease. The Modified Live Vaccine, MLV, contains bacteria or virus that has been modified to give the goat a mild case of the sickness in order to create the antibodies necessary to fight the disease. Some vaccines may not be needed in some areas, so it is best to speak with a veterinarian to set up a vaccination protocol for the herd in order to cut annual costs (Leite-Browning, 2007)

High School Curriculum Standards

According to the California Career Technical Education Model Curriculum Standards Grades Seven through Twelve [CCTEMCS] (2005) “In the Agricultural Business pathway, students learn about agricultural business operation and management”. This includes things such as financing, accounting, economics, marketing, and sales. By learning these skills students learn the role of agriculture in the world market and the importance that credit plays in the industry (CCTEMCS, 2005). Record books are kept for each student so that they can keep track of financial transactions such as loans, payments, interest, financial statements, Income, and person receipts as well as a calendar of events and a journal of all things that were purchased during the year. Marketing is also taught so that students understand the principal of marketing to the consumer and how a free market economy works (CCTEMCS, 2005). According to CCTEMCS, students will learn how advertising and promotions affect sales and how to develop a marketing plan for a product or service.

According to California Ag Education [CAE] (2013) animal and behavior students must know external anatomy, conception and gestation, cell structure and function, plant and animal cells, as well as nomenclature in order to meet state mandated standards. Teachers can expand upon these topics by educating students about animal behavior, dam/offspring interaction, hormones, meat production, parturition, and showmanship (CAE, 2013). Animal science can also expand to meet standards in genetics and breeding, Nutrition and Feeds, Animal Health, Livestock Evaluation and Selection, Genetics and Breeding and Anatomy/Physiology (CAE, 2013).

Plant Science also offers opportunities to learn about the management and growth of plants. California Standards include topics under Basic Botany, Soils, Irrigation, Plant Nutrition, Pest Management, and Measurement in Plant Science (CAE, 2013). According to CAE (2013) Pest management includes weed control, plant disease identification, pest control, and weed collection.

Fire in a natural resource management as well as basic forest management skills allows students to better understand the environment around them and how humans interact and influence the landscape. According to CAE (2013) courses using these standards students will understand forest management systems, know appropriate wildland fire-suppression practices, as well as understanding the California Forest Practice Act.

Today, California is facing the issue of the Common Core standards. These are standards placed across the nation “in the foundational subjects of English language arts and mathematics [and are] designed to prepare high school graduates to succeed in college and careers” (King,

2011). It is important for these standards to be kept in mind when creating subject material for the classroom.

Chapter Three

Introduction

In this Chapter I will be discussing how I created my unit for fire brush management using goats. It will be a detailed report on each step I took to create the actual document including some of the research steps that I needed to take. The development of this unit will help provide students a better understanding of sustainable management of brush and fire prevention in California. California Agriculture education has a curriculum that sets standards that the unit needs to meet. These standards provide basic points that need to be addressed in order to meet what it is approved for that section.

Researching the Standards and Material

Before writing the unit, it was necessary to determine that it was even needed. Searching through the California Agriculture Standards found that there was no designed unit for fire brush management using a goat herd. However, it does fall under the Forestry and Natural Resource Pathway with standards including E9.0 which is the role of fire and natural resource management where students are to E9.3 know and appropriate wildland fire-suppression practices as well as E9.4 understand the components of a fire-control plan. There are no set standards for brush management or brush management using goats. It also follows elements under both the Animal Science and Agriscience pathways as well.

Looking to the California Common Core Standards as a guideline, it will be essential to work in critical thinking skills as well as written assignments, vocabulary usage, experiments and

ensuring that students can properly identify important text and paraphrasing in their own words. It is also important to make sure all the lessons and experiments are engaging the students and holding their attention. In order to learn how to properly engage the students and increase the creativity of the unit, the book *Teach like a Pirate* by Dave Burgess offered great insight.

A great deal of time was spent researching the care and nutrition of goats to ensure that I had a good understanding of how the animals behave and their nutritional needs out on the range, as well as the plant life that inhabits California. Without the proper understanding of these topics it would not be possible to create this unit. Generally speaking, 6-8 goats will eat about as much as one cow in a day (Poore) and rotation needs are based upon the amount of fecal matter rather than that of the amount of feed available (Gasparotto 2012). This is due to the fact that goats are highly susceptible to internal parasites. Goats are also great for brush control because they will eat the more bitter greens than cows and other ruminants will turn away from because feed does not spend as much time in the rumen. This is good for California because much of the land is covered in non-herbaceous plants. Goats will also stand on hind legs to obtain feed as well as knock sapling trees and bend them in order to browse the tops (Poore).

There are no set standards for how much brush needs to be cleared for the state of California. Cal Fire does recommend that there is at least 100 feet of defensible space around your home. Some towns and cities have specific regulations that require more clearance of brush, particularly in towns that are located in forests and rural areas. Southern California tends to have stricter regulations on fire control and brush clearance because the area is very prone to wildfires.

Deciding on the Criteria

It was necessary to limit content in the unit and decide when in the year it should be taught because there is just so much to learn it could easily over a month of instruction. The unit will be taught in either March or April, since that is the beginning of fire season and students will be learning about an effective way to make the area around their homes safer for the upcoming season. Deciding to limit the unit to 3 days of length was appropriate because it gave enough time to complete several experiments and keep students engaged in the lesson without having them feel as though the lesson was dragging on. Deciding to limit the length of the unit is also due to the fact that it meets the standards in several pathways so can be used as a supplement in the Forestry and Natural Resources and the Animal Science pathways. If too much time was spent on the subject the students would be apt to lose attention and not get as much from the lessons than if they were interested and engaged in what was occurring. With 3 days of lecture, and assuming classes are 90 minutes, it will result in 4 1/2 hours of lecture.

Knowing that there are limited hours of lecture to work with, topics shall include:

- Evolution of Fire Safety and Prevention Methods
- Wildland Urban Interface and Goats
- Goat Management and Care

They are the most pertinent to the understanding of goat herd management and necessity of clearing brush in California. Each topic will be spoken about for at least an hour and followed with a short activity, if applicable. There will also be activities assigned after each assignment

applying what they learned that day and possibly in the lectures before, thus requiring the students to analyze and reflect on what they learned that day in class.

Starting with fire history and safety allows for discussion of fire hazards in California and the various methods that are used to control the outbreak of fires. This will then lead to the discussion of Wildland Urban Interface and the use of goats to manage certain areas and why it is beneficial to the environment. The next lecture highlights the basic nutritional needs of the goat and why they are a good choice for clearing brush. The third lecture discusses the health and care of the goats specifically. This will include diseases, parasites, vaccines, and plants that are poisonous to goats. If there is time, it will start the discussion of fencing material used for goats that are rented out and why electrical fencing is typically used. The activities that are going to go along with lecture include one about estimating the amount of feed in an area, identifying fire hazards around the school and a persuasive essay.

Each lecture will be guided lecture because it will cause student to be more engaged in the lesson. Each teacher will be given a partial script that they will use as a guideline. It will then be up to them to add supplemental information on the white board, or create a PowerPoint, for students to write down and comprehend. This will cause students to pay closer attention during class and grasp the concepts better, rather than frantically writing down slide information.

Creating the Lesson Plans

The template I chose for the lesson plan the one provided on the Cal Poly Agriculture Education page. This way, other teachers will have access to it for their own use if they like. Each lesson plan serves as a guideline for the teachers to follow and has attached documents for student handouts. These handouts will provide an outline for students to follow and takes notes

on during the lectures. Each Document will be able to be edited to fit the specific area that the teacher is located in.

Activities

Each lesson will have suggested activities for the teachers to implement if they have enough time. These activities were chosen based on the relevance to the subject being taught, as well as providing opportunities for expansion for the agriculture department itself.

Lesson 1's activity involves having the students go out and apply what they learned in class. They are to identify different fire hazards and fuels on campus and propose solutions to each of those hazards. These responses should be well thought out and have proper sentence structure.

The second activity that is provided takes the students outdoors again. This time the students will be estimating the amount of feed in a pasture and figuring out how many goats it will feed. This is crucial when dealing with vegetation clearance because one needs to know how long the animals can stay on a piece of property before there is not food left for the goats to survive on. They will be applying basic mathematical skills to this field assignment.

The final activity utilizes all that the students learned in the unit. It is a persuasive paper that is 1-2 pages long. In this paper students will be trying to persuade a Community Council that using goats for fire brush management is a good, sustainable method for the town or city to use. The students should site specific examples that are taken from their notes.

Summary

This chapter explains how the research for this unit was done and what influenced the design of the lessons. It goes on to highlight what each lesson is going to be on and how the information will be given to the class via lecture script and several activities. It explains how each lesson, activity and assignment was created so that anyone can replicate it and how it can be adapted to their area. This chapter also shows what standards are being met by the unit as well as how the lessons will adapt to the California Common Core standards that will soon be implemented in the schools.

Chapter Four

This chapter contains the teaching unit. In this unit I included a suggested lecture prompt for each lesson plan, handouts for students to take notes on and a suggested activity if there is time. This unit takes Common Core into consideration by having both a math and a persuasive essay portion. All of the ideas proposed are a minimum for the unit and are encouraged to be built upon by the instructor and made to adapt to their specific area.

Sustainable Fire Clearance Using Goats

Teaching Unit



Sustainable Fire Clearance with Goats

Unit Overview:

Unit contains lesson regarding importance of fire clearance in California and the move towards sustainable methods. Highlights species of goats and goes into nutritional care and upkeep of animals as well as entrepreneurship possibilities.

Content:

- Evolution of Fire Clearance in California
- Use of Ruminant animals to clear brush
- Care and upkeep of goat herd

Instruction Hours:

4-6

Standards:

- D1 Proper Housing and handling
- D2 Animal Nutrition
- D6 Cause and effect of disease
- D9 Animal Welfare
- E9 Role of Fire

Lessons

- Evolution of fire safety
 - 90 minutes
- Wildland-Urban Interface and Goats
 - 90 minutes
- Goat care and nutrition
 - 90 minutes

Teacher's Name _____
Lesson Title: Evolution of Fire Safety and Prevention Methods

I. Identification

Course title: Fire Safety in California

Teaching unit: Sustainable Fire Clearance with Goats

CDE Standards Addressed: E9.0 Role of Fire

Lesson number in this unit: 1

Length (time): 90 min

Best month: March/April

II. Specific Instructional Objective(s) (All three components):

- At the end of the lesson students should know how fire prevention started in the U.S. and California and apply clearing practices in their neighborhood
- By the end of the lesson students should be able to identify 3 different types of clearing brush and under what situations they should be utilized.
- By the end of the lesson, students will have a basic history of fire in the United States and how it affected fire policy.

III. Equipment, materials, supplies, books, resources needed for this lesson (attach handouts):

IV. Academic Language:

Fuel break, vegetation, complete suppression, fire regime, wildfire, mop up

V. Teaching procedures:

a. Anticipatory set:

- i. Ask students if they know of, remember, or heard about any large fires that have taken place in the United States, current or historical.
- ii. Ask the students if anyone knows what the fire clearance standards are for buildings in California.
- iii. Tell students about the importance of clearing brush, particularly in a state that is prone to drought.
- iv. Remind students that they are encouraged to raise hands and ask questions relevant to the lecture that is taking place.

b. Stated objective(s):

- i. Discuss the history of Fire and fire prevention in the United States
- ii. Go over what Cal Fire recommends for clearance areas around buildings and the ways they approve of providing the clearance
- iii. Make sure students understand the various methods of clearing brush and that they can identify at least three different ways to remove brush from an area.

c. Purpose: Students get a basic understanding of fire safety and prevention and are introduced to the various methods that are used to make sure large fires and house fires do not occur

- d. Input (presentation): See attached lecture prompt
- e. Check for understanding (write it out fully): Discuss with a neighbor the purpose of fire prevention and the various methods that are utilized today. Emphasize which method you believe to be the most effective in each, Urban, wildfire and WUI situations. Select students to share out to the class.
- f. Guided practice (application ... bullets or paragraph): Model a response for the quest activity in class before letting the students out onto campus.
- g. Quest activities (optional, if time permits): Have students take attached activity sheet out onto the school grounds. They are to identify 5 fire hazards and propose a way that they would correct each issue. If there is not enough time for them to do this at school, you may send the assignment home.
- h. Review/ Closure
 - Ask students to reveal some of their findings from the activity
 - Have them elaborate on why they believed it to be a hazard and why they chose their proposed solution.
 - Have students tell you how fire is categorized today and what the current fire policy is
 - Have students identify the main types of vegetative clearance methods and why they are popular today.

Evolution of Fire Safety and Prevention Methods Lecture Prompt

I. Basic Fire History

a. Miramichi fire

- i. Occurred in October of 1825 near New Brunswick along the Miramichi River.
- ii. Burned more than 4000 square miles due to high winds and little to no rainfall that year
- iii. 4 million acres of forest destroyed and over 160 people were killed. The exact numbers are unknown due to poor records at the time.
 1. Very few buildings and livestock survived
 2. Over 15,000 people were left homeless

b. Peshtigo fire/Chicago fire

- i. Peshtigo Fire occurred on the same night as the great Chicago Fire on October 8 of 1871.
 1. Chicago Fire was in a urban setting and vastly covered by media due to this even though no one perished
 2. The Peshtigo fire was perhaps the largest fire in the History of the US but is vastly forgotten
 - a. Burned millions of acres, roughly 2400 square miles and claimed around 2400 lives.
 - i. So much smoke was created, and got into the jet stream that ash was from the fire was found as far as Britain.
 - b. Caused due to extreme drought and burning to clear lands during wind storm
 - i. Finally died down when it reached Green Bay and the rain came to put the fire out

ii. Fire Policy Change:

1. Complete suppression: all fires are bad and must be put out immediately

c. Yellowstone 1988

- i. Fire that started on July 15th and burned until September 11th
 1. over 1.2 million acres in the national park.
 2. Most animals were not killed in the fire
 3. Fire was finally put out by the snow fall
- ii. Once Fire was finally put out
 1. Seed densities in the areas burned were up to 50,00 to 1 million seedlings in a single acre
- iii. US Fire policy changes
 1. Recognized that fires were a natural part of the ecosystem and that they are beneficial. If a fire starts naturally, let it burn, so long as it doesn't endanger human civilization.

- d. Today's policy
 - i. Somewhere between let it burn and complete suppression
 - 1. First and foremost is the safety of the firefighters and the public.
 - a. If fire is too dangerous for the firefighters, we do not send them in
 - b. If the fire is burning too close to public, we take defensive action.
 - i. One way to ensure public stays safe is by cutting line and creating a barrier
 - 2. Recognize that past fire practices might have damaged the fire regime by causing overgrowth of the vegetation.
- II. Branches of Fire Prevention
 - a. Wildland
 - i. Wildland fires are fires that occur in the wild that are not set on purpose. These fires fall under the jurisdiction of the U.S. Forest service to eradicate as well as Cal Fire. There are different branches of each department that serve different roles
 - 1. U.S. Forest Service
 - a. Managing fire for over 100 years
 - b. In charge of major forest fires in the United States. Spend time clearing brush to make sure that fires are less intense during the off season.
 - 2. Cal Fire
 - a. Provides air suppression support as well as land crews.
 - b. Provide Emergency Medical Treatment when necessary. Will sometimes have a full medic as part of crew
 - c. Will not only deal with fire response, but medical responses as well
 - b. Urban
 - i. City Fire
 - 1. In charge of fires that take place inside their specific jurisdiction
 - a. There is often more than one station in a city. They will work together as well as with Cal Fire when the situation calls for it
 - 2. Assist on medical calls when under their jurisdiction.
 - ii. Cal Fire
 - 1. Assists with breathing support and fire suppression of homes that have caught on fire. Provide aid to City Fire in these situations
 - 2. Go on medical emergency calls, such as car accidents, as well as cliff and ocean rescues.
 - c. Wildland Urban Interface

- i. All three agencies work together as they strive to protect the urban environment as well as attempt to put the fire out.

III. Creating Defensible Space

a. Identifying hazards and fuels

- i. Fuel is anything that can add to, or be the cause of a fire.
 - 1. types of fuels include grass, timber or home
 - 2. three groups of fuels
 - a. ground fuels are roots or rotten logs in a wildland fire
 - b. surface fuels are things like grass, forest litter, house and brush
 - i. responsible for the spread of fire
 - c. aerial fuels are those that are burning above 6 feet
 - i. limbs, leaves, eaves, trunks and tops of trees
- ii. hazards are preventable things that cause an area, or home to be at risk for a fire
 - 1. combustible materials
 - a. flammable liquids
 - b. paints
 - c. furniture and finishes
 - 2. electrical equipment
 - 3. smoking
 - 4. work processes that utilize heat
 - 5. overhanging branches
 - 6. litter in eaves
 - 7.

b. 100 ft defensible space

- i. Law passed in 2005 that requires homes to have at least 100 feet of defensible space for firefighters to protect homes in case of a fire
 - 1. This means the removal of flammable vegetation

IV. Vegetation Clearance Methods

a. Cutting line

- i. Can be done by man or by machine
 - 1. Man cuts using hoes and axes
 - 2. Machines, like bulldozers knock down and push away vegetation
 - a. Creates a fuel break causing fires to not be able to spread any further. These are physical cuts into the landscape that remove brush and vegetation.

b. Heavy machinery

- i. Bulldozers and tree cutters as well as chainsaws used to create fuel breaks and remove dead vegetation from forest areas. This drastically reduces the amount of vegetation and brush in an area that is likely to catch fire. This will reduce the heat and intensity of a fire, if the area does catch.

- c. Controlled burn/ prescribed fire
 - i. Used by firefighters, when conditions are right, that removes vegetation in the area, and promotes new growth.
 - 1. Removes unhealthy vegetation and dangerously overgrown areas
 - 2. Reduce risk of large, damaging fire
 - 3. Often set by Cal Fire, but occasionally done by the U.S. Forest Service
- d. Use of ruminants
 - i. A new method of vegetation management has become popular, and that is the use of ruminant animals to clear away vegetation
 - 1. It is found that these animals do a great job of clearing brush from areas since they have the digestive system that allow them to eat things that other animals cannot
 - 2. They eat at a relatively uniform rate so the removal of brush is even throughout the enclosed area.
 - 3. The best practice for management is to alternate between large ruminants and small ruminants: such as grazing cattle and then grazing goats afterwards to remove more of the woody and undesirable plants that the cattle will not eat
 - ii. Goats are the most popular
 - 1. Goats have a tendency to eat more types woody plants than other ruminants
 - 2. They are small and easy to transport in comparison to cattle
 - 3. Can be used in areas that cattle are less acclimated for, such as steep slopes, urban settings, and riverbeds.

Student Notes: Evolution of Fire Safety and Prevention Methods

- I. Basic Fire History
 - a. Miramichi fire
 - b. Peshtigo fire/Chicago fire
 - c. Yellowstone 1988
 - d. Today's policy
- II. Branches of Fire Prevention
 - a. Wildland
 - b. Urban

c. Wildland Urban Interface

III. Creating Defensible Space

IV. Vegetation Clearance Methods

Name: _____

Identifying Fire Hazards

In this activity you will be heading out onto the school grounds to identify 5 different potential fire hazards. Once you have identified these potential hazards, provide a possible solution for each hazard.

1. Hazard: _____

Location: _____

Possible solutions: _____

2. Hazard: _____

Location: _____

Possible solutions: _____

3. Hazard: _____

Location: _____

Possible solutions: _____

4. Hazard: _____

Location: _____

Possible solutions: _____

5. Hazard: _____

Location: _____

Possible solutions: _____

Teacher's Name Elida Moore
Lesson Title: Wildland-Urban-Interface and Goats

VI. Identification

Course title:

Teaching unit: Sustainable Fire Clearance with Goats

CDE Standards Addressed: E4.0 Rangeland Management, E8.0 Plant Physiology, D2.0 Animal Nutrition D7.0 Rangeland Management, 8.0 Waste Management

Lesson number in this unit: 2

Length (time): 90 minutes

Best month: March/April

VII. Specific Instructional Objective(s) (All three components):

- Understand the various types of WUI and how to deal with fire prevention in these areas.
- Be able to convey the economic viability of using goats for clearing land for fire prevention
- Understand how goats can be used for fire prevention and clearing in an urban setting.

VIII. Equipment, materials, supplies, books, resources needed for this lesson (attach handouts):

IX. Academic Language:

WUI, Interface, Intermix, Occluded, Rural, Sustainability, Viability, clearance, browse, "top down",

X. Teaching procedures:

e. Anticipatory set:

- Review of the previous lecture
 - Ask students what the change of fire policy has been in the US and what fires contributed to these changes
 - Have students tell you what the categories of fires are
 - Have students explain hazards and fuels
 - Have students tell you what the various types of prevention methods there are
- Ask students why they think Wildland Urban Interface is a difficult category of fire to deal with
- Have students tell you why they think using ruminants to prevent fires in this area is a good idea
- Ask students if anyone can define sustainability
- Remind students to raise hands and ask questions that are pertinent to the lesson.

f. Stated objective(s):

- By the end of the lesson students will understand the different types of WUI and why prevent fires in these areas is crucial

- By the end of this lesson students will know what sustainability is and how it applies to the use of goats and fire prevention
 - By the end of the lesson students will have an understanding of why goats are the ruminant animal of choice for the removal of vegetation.
- g. Purpose: To have students understand the sustainability of using goats for fire brush management, particularly in an urban setting, as well as the economic benefit this can have on a community.
- h. Input (presentation): See attached lecture prompt
- i. Guided practice (application ... bullets or paragraph):
- Model a feed calculation on the board.
 - You have 6 acres with 7 pounds of feed per 4 ft squared. If you have 10 goats weighing an average of 220 pounds, how long can you feed these goats on this pasture?
- j. Quest Activities (handout included): Divide students up into groups of four. Have them go out into a field of a known size. In their groups of four, have them stand in a large square formation. Once in this formation, have students evaluate if there is enough feed in that area to feed a goat. If they say yes, each student takes a step in. They are to continue to do so until the area inside will not feed a goat. Go back to the last size that could and estimate the square footage of that area. From there students are to calculate how much feed is in the pasture, per pound and how many goats that pasture would feed.
- k. Assessment (of lesson's objectives)
- Have students come in and give results from their quest activity.
 - Have them explain how they got to their answer and if they think that area would benefit from having goats on it.
 -
- l. Closure/ Review (Synthesis, Prep for tomorrow.):
- Have the students explain what sustainability is and how it pertains to goats clearing vegetation
 - Have students give an example of an urban situation that could benefit from goats
 - Ask what amount of feed a goat consumes each day

Wildland-Urban Interface and Goats Lecture Prompt

- I. Challenge of WUI
 - a. Wildland Urban interface is difficult to deal with because it combines both wildland and urban firefighting techniques. One of the biggest issues that occurs is that firefighters are either have the knowledge to fight one type of fire or the other, not both. It is also difficult to fight because, not only does it spread like a wildfire, but there is the human cost as well.
- II. Types of WUI
 - a. Interface
 - i. When highly urban areas are next to a vast expanse of wildland. The wildland fuels don't travel into the urban area, but are segregated either by a road or a fence.
 - b. Intermix
 - i. Structures are scattered thought a wildland setting and the wildland continues on outside of the town.
 - 1. In some cases it doesn't have to be wildland, but can be planted trees and shrubs that cause the area to be intermix
 - c. Occluded
 - i. When an urban area surrounds an expanse of wildland or planned park. The best example of this is New York City and Central Park
 - d. Rural
 - i. Situation where small structures, such as farms, ranches, or small towns are exposed to the wildland fuels
 - 1. For these types of areas, there may be no structure fire prevention possible.
- III. Economic Viability of Goats in WUI
 - a. Sustainability: it is when something is not harmful to the environment and does not deplete natural resources. Instead it supports long-term ecological balance.
 - i. In the case of goats for fire prevention, sustainability occurs because the environment provides feed to the goats that are clearing unwanted or invasive plants. This allows the environment to maintain a proper balance in the ecosystem and survive longer.
 - ii. Environment
 - 1. Goats are good for WUI because by utilizing these animals we can clear brush and vegetation from steep and rough terrain.
 - a. Goats can get to the areas that are difficult and/or dangerous for dozers and hand crews to enter.
 - b. They do an efficient job of clearing the vegetation without hurting the ecosystem because they are "top down" grazers

- i. This means goats will start eating up high and work their way down to the soil, eating the woody, tall invasive plants before they start eating grass.
 - c. Small size does not harm creek bed areas or cause erosion issues like cattle.
 - iii. Feed for goats
 - 1. Goats prefer to browse to grasses. Browse are woody type plants.
 - a. By eating the browse, goats provide clearance of invasive woody plants. Removal of these plants will allow more growth of the grasses.
 - 2. Because goats are such efficient eaters and will eat browse, legumes and grasses, they do not need supplemental feed and can get all the nutrients from the feed provided the designated area.
 - iv. Human benefit
 - 1. Goat meat is very good for humans because it is extremely lean. The goats raised on the cleared land can be harvested for human consumption
 - 2. By clearing the land of unwanted and dangerous vegetation, the goats provide protection for the wildland and the nearby town when fire season comes around.
 - 3. We also get the added benefit of being able to enjoy the wildlands after they have been cleared, knowing that the area is safe and the ecosystem is balanced after the clearance of vegetation and unwanted species.

CHECK FOR UNDERSTANDING: Have students turn to neighbor and discuss what sustainability means and why goats are a good choice for clearing areas prone to fire. When they are done, ask 3 students what they came up with.

- b. Clearance Calculations
 - i. When running a goat clearing business or if you have land that you want/need to be cleared by goats it is good to know how many goats you will need to clear the area and how long it will take them.
 - ii. Goats need to take in 3-4% of their body weight each day, thus intake will depend of breed of goat and how old the goats are. If using Boer goats then adult weight will range from 210 to 380 pounds.
 - 1. This means the range of feed consumed per goat will range from 6.3 to 15.2 pounds per day.
 - 2. When looking at a piece of property, one needs to estimate the amount of feed, in pounds that that property provides. This is best done by going out and doing a survey of the land to see how much feed is available.

- a. Once the amount of feed on the property is known it is a simple calculation to find out how many goats can be fed on that property for so many day.

IV. Goats in Urban setting

a. Viability

- i. People today are looking for more sustainable ways of living, particularly in the more urban settings.
 - 1. People are looking for a more environmentally friendly way of clearing out lots and creek beds that are in their towns. This is when goats are useful
 - a. Because of the way goats consume feeds, and their small size, they are perfect for being brought into the urban setting
 - b. Large parks can also benefit from using goats because it will help clear out invasive and unwanted plant life
 - 2. Downside to goats in an urban setting
 - a. Because goats are such efficient grazers, they will often eat plants that people do not want consumed
 - i. It is best to have goats in an area that it does not matter what they eat.
 - ii. If in an area that they do need to watch what they eat, fence off the area that they need to stay out of
 - 1. If small area, perhaps have goat on a tie down instead
 - a. Someone's side yard
 - iii. Keeping the goats safe can also be an issue, this means added security and maintenance will be necessary to ensure that no harm comes to the goat or goat herd
 - 1. People could steal the goats, or feed them something that is potentially hazardous to their health
 - iv. People may not like the manure that is left behind after the goats leave.

b. Sustainability

- i. Using goats in an urban setting is just as sustainable as when using them in a wildland situation. They will continue to do a good job in making sure that the area is cleared.

c. Effectiveness

- i. Goats will do a great job eating down the invasive species in yards, lots and parks. Cities can hire out goats to eat out vacant lots as well as larger areas of undeveloped land. The goats will keep down the invasive species and give good fire clearance in these areas. It is a much more sustainable and healthy way for

the city and people clear areas because it does not burn fossil fuels or add any excess noise pollution

Student Notes: Wildland-Urban Interface and Goats

- I. Challenge of WUI

- II. Types of WUI
 - a. Interface

 - b. Intermix

 - c. Occluded

 - d. Rural

- III. Economic Viability of Goats in WUI
 - a. Sustainability

b. Clearance Effectiveness

IV. Goats in Urban settings

a. Viability

b. Sustainably and effectiveness

c. Economic Impact

Name(s) _____

Estimating Feed in a Pasture

In a group of four, stand in a large square formation. Once in this formation, have determine if there is enough feed in that area to feed one goat. If the answer yes, each member takes a step in. You are to continue to do so until the area inside will no longer be able to feed a goat. Go back to the last size that could and estimate the square footage of that area. From there calculate how much feed is in the pasture, per pound, and how many goats that pasture can feed if the goats have an average weight of 180 pounds and consume 3.5% of their body weight each day.

Size of pasture: _____

Size of group square _____

Estimated amount of feed (lbs) in square _____

Amount of feed (lbs) in pasture:

Number of Goats Pasture can feed:

Teacher's Name _____
Lesson Title: Goat Care and Nutrition

XI. Identification

Course title: Goat Management and Care

Teaching unit: Sustainable Fire Clearance with Goats

CDE Standards Addressed: D1.0 Proper Housing and Handling, D2.0 Animal Nutrition, D6.0 Cause and Effect of Disease,

Lesson number in this unit: 3

Length (time): 90 min

Best month: March/April

XII. Specific Instructional Objective(s) (All three components):

- Students understand the basic care and nutritional requirements for goats
- Students will have a general understanding of plants that are poisonous to goats and what to look for when inspecting fields
- Students will understand that there are many things to consider when moving goats out to clear pasture other than just nutrition and disease.

XIII. Equipment, materials, supplies, books, resources needed for this lesson (attach handouts):

XIV. Academic Language:

Clostridium perringtons type C&D, Tetanus, Pasteurella, chlamydia, campylobacter, scrapie, gestation, alkaloid plants, cyanogenics, aglycone, saponins

XV. Teaching procedures:

m. Anticipatory set:

- Review the Previous Day
 - Ask what WUI stands for and the types of WUI there are
 - Ask what type of situation the students live in
 - Ask students to give several reasons for why using goats to clear brush is sustainable
- Ask students what the daily feed requirement is for goats
- Ask students what are some possible diseases goats may get

n. Stated objective(s):

- By the end of the lecture students will be able to tell you what the base vaccines are and how to spot an ill animal in the herd
- By the end of the lecture students will be able to list 3 types of plants that are poisonous to plants
- By the end of the lesson students will understand the basic management of a goat herd.

o. Purpose: For students to get the basic understanding of care and management of goats that are used for the clearance of brush.

- p. Input (presentation): see attached lecture prompt
- q. Check for understanding (write it out fully): Have students turn to neighbor and discuss the types of plants that are poisonous to goats as well as the devastation that scrapie can have on a herd. Then have ask students what is the best way to identify an animal that is not feeling well
- i. Review / Summary: Have students go over what they learned in class regarding fencing, herd health, vaccines and poisonous plants. Ask them how they would identify a sick animal in a herd. Ask what is the best type of fencing to use when moving goats around for vegetative management and have them give reasons for why they chose that type.
- j. Closure (Synthesis, Prep for tomorrow):
 - Basic review of entire unit
 - Ask students the evolution of fire policy in the United state
 - Ask students what are the main types of vegetation removal for fires are
 - Ask students why using goats is a viable and sustainable method for clearing areas of vegetation
 - Ask students why using goats in an urban setting can be don
 - Ask students what the basic vaccines for goats are
 - Ask students how they would identify a sick animal
 - Ask students how they would charge for use of their goats.
- k. Independent practice (homework): Students are to write a 1-2 page persuasive essay that is explaining to the Community Council why goats should be implemented to clear vegetation for fire season this year. This essay should draw on all three lessons and follow a logical progression of why these goats would be a benefit to the community.

Goat Nutrition and Care lecture prompt

I. Goat Nutrition

a. How much feed per goat per day

- i. Goats consume roughly 3-4% of their body weight each day

ii. Nutritional Requirements of the goat include a highly concentrated diet

- 1. They are unable to break down the cell wall of plants as efficiently as other ruminants because the food does not stay in the digestive system as long.
 - a. Because of this, goats can eat plants, such as trees and shrubs because they do not mind the bitter taste and need the higher quality protein that is offered in these feeds.
- 2. When quality of feed is low and the number of goats you have is low, they will still perform well due to the grazing habits of goats
 - a. If you remember, goats eat "top down" and prefer browse to grazing.

- iii. Because of the small digestive tract and the difficulty breaking down cell walls, feed that cattle can eat, such as straw, has little to no nutritional value to goats.

b. How much water needed

- i. As with all animals, goats should have access to clean fresh water every day.
 - 1. When on a clearing job this can be an issue. One of the things that should be considered is how water will be delivered to these animals. Often just a large tub filled with water is adequate, but the level does need to be checked daily. If goats are in an area with a creek or pond, water may not need to be provided.

II. Goat Health

a. Vaccines

- i. All goats should follow a proper vaccination schedule

- 1. Kids should be vaccinated for C,D and T by 8 weeks of age with a booster 4 weeks later

a. clostridium perfringens type C & D

- i. Bacteria that is typically found in the digestive tract of livestock. If subjected to large amounts of rich feed, bacteria will multiply and create toxins that will prove fatal

b. Tetanus

- i. Fatal disease caused by a bacteria that enters the body from deep wounds, umbilical infections and skin wounds as well as the banding method of castration. Causes a rigidity of muscles and animals starves to death due to inability to move mouth.

2. Pasteurella vaccination should be given by 8-12 weeks with a booster given 4 weeks later
 - a. Pasteurella is pneumonia like disease that can result in death if not taken care of properly. Often occurs in times of stress for young animals.
 3. All adults should be vaccinated for these as well
 - a. Breeding stock should be vaccinated for additional diseases
 - i. Chlamydia
 1. Causes pregnant goat to abort fetus in early stage of gestation. Causes young goats to develop arthritis.
 - ii. Campylobacter is a bacteria that causes inflammation of the gastrointestinal system. This is a particularly bad disease because it can be passed on to humans
 4. All goats must also have received a scrapie vaccination and have a tag put in the ear indicating that it has been done
 - a. Scrapie is a fatal degenerative disease that affects the nervous system of goats. It had disastrous results in breeding many years ago, so it is now mandatory to vaccinate against.
 - ii. One should also speak to the veterinarian in the area to find out what diseases are common in the area to make sure that the goats are protected from those as well. Especially when travelling.
 1. If goats are contracted out to new area, call veterinarian before they are moved in case additional vaccinations must be given.
- b. Poisonous plants
- i. Contrary to popular belief, goats are not able to eat everything; there are some plants that are poisonous to them if they are consumed.
 1. Most of the plants that are poisonous to goats are also not good for humans consumption. These types of plants include
 - a. Alkaloid containing plants: These are the plants that one normally considers when they think poisonous plants or that have mind altering capabilities. They are nitrogen containing compounds. Examples include:
 - i. Hemp
 - ii. Horse nettle
 - iii. Jimson weed
 - iv. Nightshade
 - v. Thorn apple
 - vi. Wild parsnip
 - vii. Wolfs-bane
 - b. Cyanogenics: have a sugar and a cyanide-containing aglycone (nonsugar component of glycoside, it is not a carbohydrate),

which creates a toxin, resulting in respiratory failure. Examples include

- i. Ivy
- ii. Lily of the Valley
- iii. Marijuana
- iv. Milkweed
- v. Nightshade
- vi. Oleander
- vii. Rhododendron
- viii. Sorghum

c. Saponins: naturally occurring glycosides (molecule that a sugar is bound to) that produce a foam and will cause bloat in ruminants

- i. Coffee weed
- ii. Rattlebox
- iii. Soapwort
- iv. Bagpod
- v. Purple sesban

c. Herd health

- i. To ensure that the herd stays healthy, having a good vaccination program in place, as well as being able to identify poisonous plants will be a good base. It is also important to know what an alert healthy animal looks like so that any animals that are sick can be removed from the herd and given the proper treatment.
 - 1. Healthy goats have bright eyes, a good appetite, no discharge from nose and are energetic
 - 2. Sick goats tend to be listless, have cloudy eyes, run a fever, discharge from nose, may have a cough, little to no appetite. Sick goats will not move around much and may be stiff in their movements. These animals should be removed from the herd and treated for illness
- ii. When sending goats out into the wilderness, it might be necessary to have a guard animal to keep away predators. The most common type of guard animal is a dog, but llamas and donkeys have also been known to do a good job, and not supplemental feed is needed for these animals, where a dog will need extra feeding each day.

III. Other things to consider

a. Fencing materials

- i. Goats rarely jump fences, but they are known to crawl under fencing to get to better feed on the other side. This means that the fences do not need to be high, but they need wires that are close to the ground
- ii. Portable electric fence

1. There are electric fences that produce a low charge and are easy to move from place to place because the material is very light weight. This fencing is woven like a net, roughly 3-4 ft high and, when placed properly, close to the ground so that the goats do not crawl under. A small solar batter provides plenty of electricity to run the fence.
- iii. Fixed fences
 1. Not applicable to using a fixed fence when moving goats for vegetative management. This type of fence typically has box corners with wood posts and wire along the sides. This can be square wire fencing, or it can be standard lines of wire, regardless they need to be sturdy.
 - a. This fencing is best for when the goats are at the home pasture and not be leased out for others to use.
 - iv. Portable panels
 1. These are not as sturdy or versatile as the electric or fixed fences. Because the panels are of a fixed size and shape, they are not well suited for difficult terrain. They may be a viable option for fencing in a flat terrain, but when moving goats around into dense vegetation on a hillside, these are not the type of fencing that one should use.
- b. Charge rates
 - i. When leasing out goats for vegetative management, one needs to consider how they will be charging the client.
 1. Number of goats leased
 - a. One can charge the client based on how many head they rent. This would be best to use when the entire herd is not leased out.
 - b. One may want 10 goats, you may charge \$5 per goat a day. You would be making a profit of \$50 a day.
 2. Number of days
 - a. This is used typically on larger jobs and when the whole herd is leased out. It is a flat rate per day of use for the animals
 - b. Someone has 80 acres that need to be cleared, one may charge a flat rate per day for the use of the goats. This will include the costs that are incurred when moving fence and ensure water is available to the animals
 - c. Herd maintenance
 - i. When goats get to the end of their life, one must consider where they will be taken. One must also consider the type of goats they are using and if they may have other uses as well
 1. Dairy Goats:

- a. Do you have a breeding program for these animals and would one want to incur the cost and time of having to milk these animals.
 - b. Often this is not the case because milking is very time consuming, so meat goats are typically preferred
2. Meat Goats
- a. These are larger goats that have good carcass quality. This means that they can be sold for human consumption. One might consider selling some of the goats each year for slaughter for added profit.
 - i. This can be part of the breeding program. By having more ewes than bucks, some of the offspring may be sold for meat purposes.

Student Notes: Goat Health and Care

I. Goat Nutrition

II. Goat Health

a. Vaccines

b. Poisonous plants

c. Herd health

III. Other things to consider

a. Fencing materials

b. Charge rates

Chapter Five

Recommendations

I recommend that teachers make this unit their own and expand upon the ideas present here. Ideally, a school and community will value the idea of using goats for fire brush management, thus allowing the chapter to capitalize on this and create a small enterprise right there on campus. This, in turn, will provide even more hands on activities for the instructor to include in the future.

If I had to do this project over again, I would insert more photographs as well as have more activities for the students to be involved in. I feel that students learn best by going out and applying what they learned in class, so more hands on activities would greatly benefit this unit. I would also go out and try to establish a goat clearing project at a school and run it as an example for the unit, showing chapters what could be done in their area as well. This would be a great way for the chapter and school to generate money, and give the students hands on learning experiences.

Conclusions

This project is ideal for the state of California because it deals with the very real danger of fire. Communities need to take action to prevent fire from occurring and it is important that the youth in the community learn about methods to prevent fire as well. Since our state is also looking for more sustainable and green ways of accomplishing things, goats is the perfect

solution. The unit that was designed can be easily adapted to any area in the state, and can even be shared out of state.

The biggest drawback to this unit is that there is not much hands on activity. Also, those that live in a more urban environment may not be interested in using this unit because they might believe it doesn't pertain to them and will not add to their student's education

References

California Ag Education (2013). Revised California Ag Basic Core. Retrieved from <http://calaged.csuchico.edu/resourcefiles/curriculum/RevisedBasicCoreCurriculum/rcore.htm>

California Career Technical Education Model Curriculum Standards Grades Seven Through Twelve (May, 2005). California Career Technical Education Model Curriculum Standards Grades Seven through Twelve. Retrieved from <http://www.cde.ca.gov/ci/ct/sf/documents/ctestandards.pdf#page=11>

California Department of Forestry and Fire Protection. (2013). Vegetation Treatment Program Draft Environmental Impact Report. Retrieved from [http://bofdata.fire.ca.gov/board_committees/resource_protection_committee/current_projects/vegetation_treatment_program_environmental_impact_report_\(vtpeir\)/pdfs/VTPEIR%20Ch%201-3.pdf](http://bofdata.fire.ca.gov/board_committees/resource_protection_committee/current_projects/vegetation_treatment_program_environmental_impact_report_(vtpeir)/pdfs/VTPEIR%20Ch%201-3.pdf)

Cal Fire. (2012) Cal Fire Why 100 ft?. Retrieved from http://calfire.ca.gov/communications/communications_firesafety_100feet.php

Escobar, Nelson (1996). Sustainable Use of Goats as a Vegetation Management Tool. Retrieved from www.usda.gov/afsic/nsfc/323.htm

Forero, Nader, Craigmill, Ditomaso, Puschner, & Mass. (January 2011) Livestock-Poisoning Plants of California. Retrieved from <http://anrcatalog.ucdavis.edu/pdf/8398.pdf>

Gasparotto, Suzanne W. Stocking Rates: How Many Goats per Acre. Retrieved from <http://www.tennesseeemeatgoats.com/articles2/goatsperacre.html>

Leite-Browning, Maria. (March 2007) Vaccination Protocol for a Goat Herd. Retrieved from <http://www.aces.edu/pubs/docs/U/UNP-0090/UNP-0090.pdf>

Luginbuhl, Green, Mueller, & Poore. (October 1998). Needs for Meat Goats and Sheep. Retrieved from http://www.cals.ncsu.edu/an_sci/extension/animal/meatgoat/MGFrngnds.htm

Rutherford, Robert. (2013). Grazing Management (1). Retrieved from https://polylearn.calpoly.edu/AY_2012-2013/mod/folder/view.php?id=143000

Soto, Victor. Writing Instructional Objectives: Student Learning Outcomes. Retrieved from <http://www.efc.dcccd.edu/Core/SLO-MVC.pdf>

Teie, William C. Firefighter's handbook on Wildland Firefighting: Strategy, Tactics and Safety 3rd edition. Copyright 2005.

Appendix A:

Sustainable Fire Clearance Using Goats Complete Unit

Sustainable Fire Clearance Using Goats

Teaching Unit



Sustainable Fire Clearance with Goats

Unit Overview:

Unit contains lesson regarding importance of fire clearance in California and the move towards sustainable methods. Highlights species of goats and goes into nutritional care and upkeep of animals as well as entrepreneurship possibilities.

Content:

- Evolution of Fire Clearance in California
- Use of Ruminant animals to clear brush
- Care and upkeep of goat herd

Instruction Hours:

4-6

Standards:

- D1 Proper Housing and handling
- D2 Animal Nutrition
- D6 Cause and effect of disease
- D9 Animal Welfare
- E9 Role of Fire

Lessons

- Evolution of fire safety
 - 90 minutes
- Wildland-Urban Interface and Goats
 - 90 minutes
- Goat care and nutrition
 - 90 minutes

Teacher's Name _____
Lesson Title: Evolution of Fire Safety and Prevention Methods

I. Identification

Course title: Fire Safety in California

Teaching unit: Sustainable Fire Clearance with Goats

CDE Standards Addressed: E9.0 Role of Fire

Lesson number in this unit: 1

Length (time): 90 min

Best month: March/April

II. Specific Instructional Objective(s) (All three components):

- At the end of the lesson students should know how fire prevention started in the U.S. and California and apply clearing practices in their neighborhood
- By the end of the lesson students should be able to identify 3 different types of clearing brush and under what situations they should be utilized.
- By the end of the lesson, students will have a basic history of fire in the United States and how it affected fire policy.

III. Equipment, materials, supplies, books, resources needed for this lesson (attach handouts):

IV. Academic Language:

Fuel break, vegetation, complete suppression, fire regime, wildfire, mop up

V. Teaching procedures:

a. Anticipatory set:

- i. Ask students if they know of, remember, or heard about any large fires that have taken place in the United States, current or historical.
- ii. Ask the students if anyone knows what the fire clearance standards are for buildings in California.
- iii. Tell students about the importance of clearing brush, particularly in a state that is prone to drought.
- iv. Remind students that they are encouraged to raise hands and ask questions relevant to the lecture that is taking place.

b. Stated objective(s):

- i. Discuss the history of Fire and fire prevention in the United States
- ii. Go over what Cal Fire recommends for clearance areas around buildings and the ways they approve of providing the clearance
- iii. Make sure students understand the various methods of clearing brush and that they can identify at least three different ways to remove brush from an area.

c. Purpose: Students get a basic understanding of fire safety and prevention and are introduced to the various methods that are used to make sure large fires and house fires do not occur

- d. Input (presentation): See attached lecture prompt
- e. Check for understanding (write it out fully): Discuss with a neighbor the purpose of fire prevention and the various methods that are utilized today. Emphasize which method you believe to be the most effective in each, Urban, wildfire and WUI situations. Select students to share out to the class.
- f. Guided practice (application ... bullets or paragraph): Model a response for the quest activity in class before letting the students out onto campus.
- g. Quest activities (optional, if time permits): Have students take attached activity sheet out onto the school grounds. They are to identify 5 fire hazards and propose a way that they would correct each issue. If there is not enough time for them to do this at school, you may send the assignment home.
- h. Review/ Closure
 - Ask students to reveal some of their findings from the activity
 - Have them elaborate on why they believed it to be a hazard and why they chose their proposed solution.
 - Have students tell you how fire is categorized today and what the current fire policy is
 - Have students identify the main types of vegetative clearance methods and why they are popular today.

Evolution of Fire Safety and Prevention Methods Lecture Prompt

I. Basic Fire History

a. Miramichi fire

- i. Occurred in October of 1825 near New Brunswick along the Miramichi River.
- ii. Burned more than 4000 square miles due to high winds and little to no rainfall that year
- iii. 4 million acres of forest destroyed and over 160 people were killed. The exact numbers are unknown due to poor records at the time.
 1. Very few buildings and livestock survived
 2. Over 15,000 people were left homeless

b. Peshtigo fire/Chicago fire

- i. Peshtigo Fire occurred on the same night as the great Chicago Fire on October 8 of 1871.
 1. Chicago Fire was in a urban setting and vastly covered by media due to this even though no one perished
 2. The Peshtigo fire was perhaps the largest fire in the History of the US but is vastly forgotten
 - a. Burned millions of acres, roughly 2400 square miles and claimed around 2400 lives.
 - i. So much smoke was created, and got into the jet stream that ash was from the fire was found as far as Britain.
 - b. Caused due to extreme drought and burning to clear lands during wind storm
 - i. Finally died down when it reached Green Bay and the rain came to put the fire out

ii. Fire Policy Change:

1. Complete suppression: all fires are bad and must be put out immediately

c. Yellowstone 1988

- i. Fire that started on July 15th and burned until September 11th
 1. over 1.2 million acres in the national park.
 2. Most animals were not killed in the fire
 3. Fire was finally put out by the snow fall
- ii. Once Fire was finally put out
 1. Seed densities in the areas burned were up to 50,00 to 1 million seedlings in a single acre
- iii. US Fire policy changes
 1. Recognized that fires were a natural part of the ecosystem and that they are beneficial. If a fire starts naturally, let it burn, so long as it doesn't endanger human civilization.

d. Today's policy

i. Somewhere between let it burn and complete suppression

1. First and foremost is the safety of the firefighters and the public.

a. If fire is too dangerous for the firefighters, we do not send them in

b. If the fire is burning too close to public, we take defensive action.

i. One way to ensure public stays safe is by cutting line and creating a barrier

2. Recognize that past fire practices might have damaged the fire regime by causing overgrowth of the vegetation.

II. Branches of Fire Prevention

a. Wildland

i. Wildland fires are fires that occur in the wild that are not set on purpose.

These fires fall under the jurisdiction of the U.S. Forest service to eradicate as well as Cal Fire. There are different branches of each department that serve different roles

1. U.S. Forest Service

a. Managing fire for over 100 years

b. In charge of major forest fires in the United States. Spend time clearing brush to make sure that fires are less intense during the off season.

2. Cal Fire

a. Provides air suppression support as well as land crews.

b. Provide Emergency Medical Treatment when necessary. Will sometimes have a full medic as part of crew

c. Will not only deal with fire response, but medical responses as well

b. Urban

i. City Fire

1. In charge of fires that take place inside their specific jurisdiction

a. There is often more than one station in a city. They will work together as well as with Cal Fire when the situation calls for it

2. Assist on medical calls when under their jurisdiction.

ii. Cal Fire

1. Assists with breathing support and fire suppression of homes that have caught on fire. Provide aid to City Fire in these situations

2. Go on medical emergency calls, such as car accidents, as well as cliff and ocean rescues.

c. Wildland Urban Interface

- i. All three agencies work together as they strive to protect the urban environment as well as attempt to put the fire out.

III. Creating Defensible Space

a. Identifying hazards and fuels

- i. Fuel is anything that can add to, or be the cause of a fire.
 - 1. types of fuels include grass, timber or home
 - 2. three groups of fuels
 - a. ground fuels are roots or rotten logs in a wildland fire
 - b. surface fuels are things like grass, forest litter, house and brush
 - i. responsible for the spread of fire
 - c. aerial fuels are those that are burning above 6 feet
 - i. limbs, leaves, eaves, trunks and tops of trees
- ii. hazards are preventable things that cause an area, or home to be at risk for a fire
 - 1. combustible materials
 - a. flammable liquids
 - b. paints
 - c. furniture and finishes
 - 2. electrical equipment
 - 3. smoking
 - 4. work processes that utilize heat
 - 5. overhanging branches
 - 6. litter in eaves
 - 7.

b. 100 ft defensible space

- i. Law passed in 2005 that requires homes to have at least 100 feet of defensible space for firefighters to protect homes in case of a fire
 - 1. This means the removal of flammable vegetation

IV. Vegetation Clearance Methods

a. Cutting line

- i. Can be done by man or by machine
 - 1. Man cuts using hoes and axes
 - 2. Machines, like bulldozers knock down and push away vegetation
 - a. Creates a fuel break causing fires to not be able to spread any further. These are physical cuts into the landscape that remove brush and vegetation.

b. Heavy machinery

- i. Bulldozers and tree cutters as well as chainsaws used to create fuel breaks and remove dead vegetation from forest areas. This drastically reduces the amount of vegetation and brush in an area that is likely to catch fire. This will reduce the heat and intensity of a fire, if the area does catch.

- c. Controlled burn/ prescribed fire
 - i. Used by firefighters, when conditions are right, that removes vegetation in the area, and promotes new growth.
 - 1. Removes unhealthy vegetation and dangerously overgrown areas
 - 2. Reduce risk of large, damaging fire
 - 3. Often set by Cal Fire, but occasionally done by the U.S. Forest Service
- d. Use of ruminants
 - i. A new method of vegetation management has become popular, and that is the use of ruminant animals to clear away vegetation
 - 1. It is found that these animals do a great job of clearing brush from areas since they have the digestive system that allow them to eat things that other animals cannot
 - 2. They eat at a relatively uniform rate so the removal of brush is even throughout the enclosed area.
 - 3. The best practice for management is to alternate between large ruminants and small ruminants: such as grazing cattle and then grazing goats afterwards to remove more of the woody and undesirable plants that the cattle will not eat
 - ii. Goats are the most popular
 - 1. Goats have a tendency to eat more types woody plants than other ruminants
 - 2. They are small and easy to transport in comparison to cattle
 - 3. Can be used in areas that cattle are less acclimated for, such as steep slopes, urban settings, and riverbeds.

Student Notes: Evolution of Fire Safety and Prevention Methods

- I. Basic Fire History
 - a. Miramichi fire
 - b. Peshtigo fire/Chicago fire
 - c. Yellowstone 1988
 - d. Today's policy
- II. Branches of Fire Prevention
 - a. Wildland
 - b. Urban

c. Wildland Urban Interface

III. Creating Defensible Space

IV. Vegetation Clearance Methods

Name: _____

Identifying Fire Hazards

In this activity you will be heading out onto the school grounds to identify 5 different potential fire hazards. Once you have identified these potential hazards, provide a possible solution for each hazard.

1. Hazard: _____

Location: _____

Possible solutions: _____

2. Hazard: _____

Location: _____

Possible solutions: _____

3. Hazard: _____

Location: _____

Possible solutions: _____

4. Hazard: _____

Location: _____

Possible solutions: _____

5. Hazard: _____

Location: _____

Possible solutions: _____

Teacher's Name Elida Moore
Lesson Title: Wildland-Urban-Interface and Goats

VI. Identification

Course title:

Teaching unit: Sustainable Fire Clearance with Goats

CDE Standards Addressed: E4.0 Rangeland Management, E8.0 Plant Physiology, D2.0 Animal Nutrition D7.0 Rangeland Management, 8.0 Waste Management

Lesson number in this unit: 2

Length (time): 90 minutes

Best month: March/April

VII. Specific Instructional Objective(s) (All three components):

- Understand the various types of WUI and how to deal with fire prevention in these areas.
- Be able to convey the economic viability of using goats for clearing land for fire prevention
- Understand how goats can be used for fire prevention and clearing in an urban setting.

VIII. Equipment, materials, supplies, books, resources needed for this lesson (attach handouts):

IX. Academic Language:

WUI, Interface, Intermix, Occluded, Rural, Sustainability, Viability, clearance, browse, "top down",

X. Teaching procedures:

e. Anticipatory set:

- Review of the previous lecture
 - Ask students what the change of fire policy has been in the US and what fires contributed to these changes
 - Have students tell you what the categories of fires are
 - Have students explain hazards and fuels
 - Have students tell you what the various types of prevention methods there are
- Ask students why they think Wildland Urban Interface is a difficult category of fire to deal with
- Have students tell you why they think using ruminants to prevent fires in this area is a good idea
- Ask students if anyone can define sustainability
- Remind students to raise hands and ask questions that are pertinent to the lesson.

f. Stated objective(s):

- By the end of the lesson students will understand the different types of WUI and why prevent fires in these areas is crucial

- By the end of this lesson students will know what sustainability is and how it applies to the use of goats and fire prevention
 - By the end of the lesson students will have an understanding of why goats are the ruminant animal of choice for the removal of vegetation.
- g. Purpose: To have students understand the sustainability of using goats for fire brush management, particularly in an urban setting, as well as the economic benefit this can have on a community.
- h. Input (presentation): See attached lecture prompt
- i. Guided practice (application ... bullets or paragraph):
- Model a feed calculation on the board.
 - You have 6 acres with 7 pounds of feed per 4 ft squared. If you have 10 goats weighing an average of 220 pounds, how long can you feed these goats on this pasture?
- j. Quest Activities (handout included): Divide students up into groups of four. Have them go out into a field of a known size. In their groups of four, have them stand in a large square formation. Once in this formation, have students evaluate if there is enough feed in that area to feed a goat. If they say yes, each student takes a step in. They are to continue to do so until the area inside will not feed a goat. Go back to the last size that could and estimate the square footage of that area. From there students are to calculate how much feed is in the pasture, per pound and how many goats that pasture would feed.
- k. Assessment (of lesson's objectives)
- Have students come in and give results from their quest activity.
 - Have them explain how they got to their answer and if they think that area would benefit from having goats on it.
 -
- l. Closure/ Review (Synthesis, Prep for tomorrow.):
- Have the students explain what sustainability is and how it pertains to goats clearing vegetation
 - Have students give an example of an urban situation that could benefit from goats
 - Ask what amount of feed a goat consumes each day

Wildland-Urban Interface and Goats Lecture Prompt

- I. Challenge of WUI
 - a. Wildland Urban interface is difficult to deal with because it combines both wildland and urban firefighting techniques. One of the biggest issues that occurs is that firefighters are either have the knowledge to fight one type of fire or the other, not both. It is also difficult to fight because, not only does it spread like a wildfire, but there is the human cost as well.
- II. Types of WUI
 - a. Interface
 - i. When highly urban areas are next to a vast expanse of wildland. The wildland fuels don't travel into the urban area, but are segregated either by a road or a fence.
 - b. Intermix
 - i. Structures are scattered thought a wildland setting and the wildland continues on outside of the town.
 - 1. In some cases it doesn't have to be wildland, but can be planted trees and shrubs that cause the area to be intermix
 - c. Occluded
 - i. When an urban area surrounds an expanse of wildland or planned park. The best example of this is New York City and Central Park
 - d. Rural
 - i. Situation where small structures, such as farms, ranches, or small towns are exposed to the wildland fuels
 - 1. For these types of areas, there may be no structure fire prevention possible.
- III. Economic Viability of Goats in WUI
 - a. Sustainability: it is when something is not harmful to the environment and does not deplete natural resources. Instead it supports long-term ecological balance.
 - i. In the case of goats for fire prevention, sustainability occurs because the environment provides feed to the goats that are clearing unwanted or invasive plants. This allows the environment to maintain a proper balance in the ecosystem and survive longer.
 - ii. Environment
 - 1. Goats are good for WUI because by utilizing these animals we can clear brush and vegetation from steep and rough terrain.
 - a. Goats can get to the areas that are difficult and/or dangerous for dozers and hand crews to enter.
 - b. They do an efficient job of clearing the vegetation without hurting the ecosystem because they are "top down" grazers

- i. This means goats will start eating up high and work their way down to the soil, eating the woody, tall invasive plants before they start eating grass.
 - c. Small size does not harm creek bed areas or cause erosion issues like cattle.
- iii. Feed for goats
 - 1. Goats prefer to browse to grasses. Browse are woody type plants.
 - a. By eating the browse, goats provide clearance of invasive woody plants. Removal of these plants will allow more growth of the grasses.
 - 2. Because goats are such efficient eaters and will eat browse, legumes and grasses, they do not need supplemental feed and can get all the nutrients from the feed provided the designated area.
- iv. Human benefit
 - 1. Goat meat is very good for humans because it is extremely lean. The goats raised on the cleared land can be harvested for human consumption
 - 2. By clearing the land of unwanted and dangerous vegetation, the goats provide protection for the wildland and the nearby town when fire season comes around.
 - 3. We also get the added benefit of being able to enjoy the wildlands after they have been cleared, knowing that the area is safe and the ecosystem is balanced after the clearance of vegetation and unwanted species.

CHECK FOR UNDERSTANDING: Have students turn to neighbor and discuss what sustainability means and why goats are a good choice for clearing areas prone to fire. When they are done, ask 3 students what they came up with.

b. Clearance Calculations

- i. When running a goat clearing business or if you have land that you want/need to be cleared by goats it is good to know how many goats you will need to clear the area and how long it will take them.
- ii. Goats need to take in 3-4% of their body weight each day, thus intake will depend of breed of goat and how old the goats are. If using Boer goats then adult weight will range from 210 to 380 pounds.
 - 1. This means the range of feed consumed per goat will range from 6.3 to 15.2 pounds per day.
 - 2. When looking at a piece of property, one needs to estimate the amount of feed, in pounds that that property provides. This is best done by going out and doing a survey of the land to see how much feed is available.

- a. Once the amount of feed on the property is known it is a simple calculation to find out how many goats can be fed on that property for so many day.

IV. Goats in Urban setting

a. Viability

- i. People today are looking for more sustainable ways of living, particularly in the more urban settings.
 - 1. People are looking for a more environmentally friendly way of clearing out lots and creek beds that are in their towns. This is when goats are useful
 - a. Because of the way goats consume feeds, and their small size, they are perfect for being brought into the urban setting
 - b. Large parks can also benefit from using goats because it will help clear out invasive and unwanted plant life
 - 2. Downside to goats in an urban setting
 - a. Because goats are such efficient grazers, they will often eat plants that people do not want consumed
 - i. It is best to have goats in an area that it does not matter what they eat.
 - ii. If in an area that they do need to watch what they eat, fence off the area that they need to stay out of
 - 1. If small area, perhaps have goat on a tie down instead
 - a. Someone's side yard
 - iii. Keeping the goats safe can also be an issue, this means added security and maintenance will be necessary to ensure that no harm comes to the goat or goat herd
 - 1. People could steal the goats, or feed them something that is potentially hazardous to their health
 - iv. People may not like the manure that is left behind after the goats leave.

b. Sustainability

- i. Using goats in an urban setting is just as sustainable as when using them in a wildland situation. They will continue to do a good job in making sure that the area is cleared.

c. Effectiveness

- i. Goats will do a great job eating down the invasive species in yards, lots and parks. Cities can hire out goats to eat out vacant lots as well as larger areas of undeveloped land. The goats will keep down the invasive species and give good fire clearance in these areas. It is a much more sustainable and healthy way for

the city and people clear areas because it does not burn fossil fuels or add any excess noise pollution

Student Notes: Wildland-Urban Interface and Goats

I. Challenge of WUI

II. Types of WUI

- Interface
- Intermix
- Occluded
- Rural

III. Economic Viability of Goats in WUI

- a. Sustainability

IV. Goats in Urban settings

a. Viablity

b. Sustainably and effectiveness

c. Economic Impact

Name(s) _____

Estimating Feed in a Pasture

In a group of four, stand in a large square formation. Once in this formation, have determine if there is enough feed in that area to feed one goat. If the answer yes, each member takes a step in. You are to continue to do so until the area inside will no longer be able to feed a goat. Go back to the last size that could and estimate the square footage of that area. From there calculate how much feed is in the pasture, per pound, and how many goats that pasture can feed if the goats have an average weight of 180 pounds and consume 3.5% of their body weight each day.

Size of pasture: _____

Size of group square _____

Estimated amount of feed (lbs) in square _____

Amount of feed (lbs) in pasture:

Number of Goats Pasture can feed:

Teacher's Name _____

Lesson Title: Goat Care and Nutrition

XI. Identification

Course title: Goat Management and Care

Teaching unit: Sustainable Fire Clearance with Goats

CDE Standards Addressed: D1.0 Proper Housing and Handling, D2.0 Animal Nutrition, D6.0 Cause and Effect of Disease,

Lesson number in this unit: 3

Length (time): 90 min

Best month: March/April

XII. Specific Instructional Objective(s) (All three components):

- Students understand the basic care and nutritional requirements for goats
- Students will have a general understanding of plants that are poisonous to goats and what to look for when inspecting fields
- Students will understand that there are many things to consider when moving goats out to clear pasture other than just nutrition and disease.

XIII. Equipment, materials, supplies, books, resources needed for this lesson (attach handouts):

XIV. Academic Language:

Clostridium perringtons type C&D, Tetanus, Pasteurella, chlamydia, campylobacter, scrapie, gestation, alkaloid plants, cyanogenics, aglycone, saponins

XV. Teaching procedures:

m. Anticipatory set:

- Review the Previous Day
 - Ask what WUI stands for and the types of WUI there are
 - Ask what type of situation the students live in
 - Ask students to give several reasons for why using goats to clear brush is sustainable
- Ask students what the daily feed requirement is for goats
- Ask students what are some possible diseases goats may get

n. Stated objective(s):

- By the end of the lecture students will be able to tell you what the base vaccines are and how to spot an ill animal in the herd
- By the end of the lecture students will be able to list 3 types of plants that are poisonous to plants
- By the end of the lesson students will understand the basic management of a goat herd.

o. Purpose: For students to get the basic understanding of care and management of goats that are used for the clearance of brush.

- p. Input (presentation): see attached lecture prompt
- q. Check for understanding (write it out fully): Have students turn to neighbor and discuss the types of plants that are poisonous to goats as well as the devastation that scrapie can have on a herd. Then have ask students what is the best way to identify an animal that is not feeling well
- i. Review / Summary: Have students go over what they learned in class regarding fencing, herd health, vaccines and poisonous plants. Ask them how they would identify a sick animal in a herd. Ask what is the best type of fencing to use when moving goats around for vegetative management and have them give reasons for why they chose that type.
- j. Closure (Synthesis, Prep for tomorrow.):
- Basic review of entire unit
 - Ask students the evolution of fire policy in the United state
 - Ask students what are the main types of vegetation removal for fires are
 - Ask students why using goats is a viable and sustainable method for clearing areas of vegetation
 - Ask students why using goats in an urban setting can be don
 - Ask students what the basic vaccines for goats are
 - Ask students how they would identify a sick animal
 - Ask students how they would charge for use of their goats.
- k. Independent practice (homework): Students are to write a 1-2 page persuasive essay that is explaining to the Community Council why goats should be implemented to clear vegetation for fire season this year. This essay should draw on all three lessons and follow a logical progression of why these goats would be a benefit to the community.

Goat Nutrition and Care lecture prompt

I. Goat Nutrition

- a. How much feed per goat per day
 - i. Goats consume roughly 3-4% of their body weight each day
 - ii. Nutritional Requirements of the goat include a highly concentrated diet
 - 1. They are unable to break down the cell wall of plants as efficiently as other ruminants because the food does not stay in the digestive system as long.
 - a. Because of this, goats can eat plants, such as trees and shrubs because they do not mind the bitter taste and need the higher quality protein that is offered in these feeds.
 - 2. When quality of feed is low and the number of goats you have is low, they will still perform well due to the grazing habits of goats
 - a. If you remember, goats eat “top down” and prefer browse to grazing.
 - iii. Because of the small digestive tract and the difficulty breaking down cell walls, feed that cattle can eat, such as straw, has little to no nutritional value to goats.
- b. How much water needed
 - i. As with all animals, goats should have access to clean fresh water every day.
 - 1. When on a clearing job this can be an issue. One of the things that should be considered is how water will be delivered to these animals. Often just a large tub filled with water is adequate, but the level does need to be checked daily. If goats are in an area with a creek or pond, water may not need to be provided.

II. Goat Health

- a. Vaccines
 - i. All goats should follow a proper vaccination schedule
 - 1. Kids should be vaccinated for C,D and T by 8 weeks of age with a booster 4 weeks later
 - a. clostridium perfringens type C & D
 - i. Bacteria that is typically found in the digestive tract of livestock. If subjected to large amounts of rich feed, bacteria will multiply and create toxins that will prove fatal
 - b. Tetanus
 - i. Fatal disease caused by a bacteria that enters the body from deep wounds, umbilical infections and skin wounds as well as the banding method of castration. Causes a rigidity of muscles and animals starves to death due to inability to move mouth.

2. Pasteurella vaccination should be given by 8-12 weeks with a booster given 4 weeks later
 - a. Pasteurella is pneumonia like disease that can result in death if not taken care of properly. Often occurs in times of stress for young animals.
3. All adults should be vaccinated for these as well
 - a. Breeding stock should be vaccinated for additional diseases
 - i. Chlamydia
 1. Causes pregnant goat to abort fetus in early stage of gestation. Causes young goats to develop arthritis.
 - ii. Campylobacter is a bacteria that causes inflammation of the gastrointestinal system. This is a particularly bad disease because it can be passed on to humans
4. All goats must also have received a scrapie vaccination and have a tag put in the ear indicating that it has been done
 - a. Scrapie is a fatal degenerative disease that affects the nervous system of goats. It had disastrous results in breeding many years ago, so it is now mandatory to vaccinate against.
 - ii. One should also speak to the veterinarian in the area to find out what diseases are common in the area to make sure that the goats are protected from those as well. Especially when travelling.
 1. If goats are contracted out to new area, call veterinarian before they are moved in case additional vaccinations must be given.
- b. Poisonous plants
 - i. Contrary to popular belief, goats are not able to eat everything; there are some plants that are poisonous to them if they are consumed.
 1. Most of the plants that are poisonous to goats are also not good for humans consumption. These types of plants include
 - a. Alkaloid containing plants: These are the plants that one normally considers when they think poisonous plants or that have mind altering capabilities. They are nitrogen containing compounds. Examples include:
 - i. Hemp
 - ii. Horse nettle
 - iii. Jimson weed
 - iv. Nightshade
 - v. Thorn apple
 - vi. Wild parsnip
 - vii. Wolfs-bane
 - b. Cyanogenics: have a sugar and a cyanide-containing aglycone (nonsugar component of glycoside, it is not a carbohydrate),

which creates a toxin, resulting in respiratory failure. Examples include

- i. Ivy
- ii. Lily of the Valley
- iii. Marijuana
- iv. Milkweed
- v. Nightshade
- vi. Oleander
- vii. Rhododendron
- viii. Sorghum

c. Saponins: naturally occurring glycosides (molecule that a sugar is bound to) that produce a foam and will cause bloat in ruminants

- i. Coffee weed
- ii. Rattlebox
- iii. Soapwort
- iv. Bagpod
- v. Purple sesban

c. Herd health

- i. To ensure that the herd stays healthy, having a good vaccination program in place, as well as being able to identify poisonous plants will be a good base. It is also important to know what an alert healthy animal looks like so that any animals that are sick can be removed from the herd and given the proper treatment.
 - 1. Healthy goats have bright eyes, a good appetite, no discharge from nose and are energetic
 - 2. Sick goats tend to be listless, have cloudy eyes, run a fever, discharge from nose, may have a cough, little to no appetite. Sick goats will not move around much and may be stiff in their movements. These animals should be removed from the herd and treated for illness
- ii. When sending goats out into the wilderness, it might be necessary to have a guard animal to keep away predators. The most common type of guard animal is a dog, but llamas and donkeys have also been known to do a good job, and not supplemental feed is needed for these animals, where a dog will need extra feeding each day.

III. Other things to consider

a. Fencing materials

- i. Goats rarely jump fences, but they are known to crawl under fencing to get to better feed on the other side. This means that the fences do not need to be high, but they need wires that are close to the ground
- ii. Portable electric fence

1. There are electric fences that produce a low charge and are easy to move from place to place because the material is very light weight. This fencing is woven like a net, roughly 3-4 ft high and, when placed properly, close to the ground so that the goats do not crawl under. A small solar batter provides plenty of electricity to run the fence.
- iii. Fixed fences
 1. Not applicable to using a fixed fence when moving goats for vegetative management. This type of fence typically has box corners with wood posts and wire along the sides. This can be square wire fencing, or it can be standard lines of wire, regardless they need to be sturdy.
 - a. This fencing is best for when the goats are at the home pasture and not be leased out for others to use.
 - iv. Portable panels
 1. These are not as sturdy or versatile as the electric or fixed fences. Because the panels are of a fixed size and shape, they are not well suited for difficult terrain. They may be a viable option for fencing in a flat terrain, but when moving goats around into dense vegetation on a hillside, these are not the type of fencing that one should use.
 - b. Charge rates
 - i. When leasing out goats for vegetative management, one needs to consider how they will be charging the client.
 1. Number of goats leased
 - a. One can charge the client based on how many head they rent. This would be best to use when the entire herd is not leased out.
 - b. One may want 10 goats, you may charge \$5 per goat a day. You would be making a profit of \$50 a day.
 2. Number of days
 - a. This is used typically on larger jobs and when the whole herd is leased out. It is a flat rate per day of use for the animals
 - b. Someone has 80 acres that need to be cleared, one may charge a flat rate per day for the use of the goats. This will include the costs that are incurred when moving fence and ensure water is available to the animals
 - c. Herd maintenance
 - i. When goats get to the end of their life, one must consider where they will be taken. One must also consider the type of goats they are using and if they may have other uses as well
 1. Dairy Goats:

- a. Do you have a breeding program for these animals and would one want to incur the cost and time of having to milk these animals.
- b. Often this is not the case because milking is very time consuming, so meat goats are typically preferred

2. Meat Goats

- a. These are larger goats that have good carcass quality. This means that they can be sold for human consumption. One might consider selling some of the goats each year for slaughter for added profit.
 - i. This can be part of the breeding program. By having more ewes than bucks, some of the offspring may be sold for meat purposes.

Student Notes: Goat Health and Care

I. Goat Nutrition

II. Goat Health

a. Vaccines

b. Poisonous plants

- c. Herd health

- III. Other things to consider

- a. Fencing materials

- b. Charge rates