THE IMPERATIVE OF CONSERVING CALIFORNIA’S FOOTHILL OAK WOODLANDS

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California Foothill Oak Woodlands Research Proposal

The California foothill oak woodlands is a region of paramount importance. This area of California creates a ring around the Great Central Valley, and extends to small areas of the outer Coast Ranges and lower Sierra slopes. The foothill oak woodlands inhabit a colossal amount of species, and a few of these are endemic to California. There is a rich cultural history that is intertwined with the foothill oak woodlands. Native Americans within the region thrived off the resources the woodlands produced. The foothill oak woodlands also endured the Spanish Period, Mexican Era, and the American Period. This small, yet vital region of California is enduring major threats from a myriad of sources. These threats have caused the foothill oak woodlands habitat to shrink along with other detrimental impacts. Restoration and conservation practices are key in order to preserve this significant region.

Within this research project, information on California’s foothill oak woodlands and restoration and conservation methods will be reviewed through books, scholarly articles, documents, and attending conferences. Information will also be gathered by consulting with Conservation and Stewardship Project Manager of the American River Conservancy, Elena Delacy. My experience with the California foothill oak woodlands is vast. I grew up within El Dorado County, and I am currently a Conservation and Outreach intern for American River Conservancy. My main duty is to compose a management and restoration plan for a parcel of land that is within the foothill oak woodlands. I will use the knowledge I have gained upon my experiences with the area along with the research I have conducted in order to obtain the goal of this project. The intent of this paper is to educate others upon the importance of preserving the foothill oak woodlands, and the conservation practices to do so.
Annotated Bibliography

*Guidelines for Managing California’s Hardwood Rangelands*. Oakland, Ca: Regents of the University of California Division of Agriculture and Natural Resources, 1996. Print.

In this work, the main idea was to provide landowners of rangeland properties with management plans for their parcel of land while sustaining the ecology of the area at the same time. It goes into detail on the habitat of the community and the relationship it shares with the wildlife of the area. It discusses how to manage and sustain oak trees on livestock and grazing properties. It also explains various conservation and oak regeneration options. This work will be extremely helpful to my project because it elaborates on a variety of oak regeneration options such as: artificial, natural, and grazing regeneration. It will help me provide an abundance of information on a variety of ways to preserve the foothill oak woodlands.


Bakker 1984 goes into in depth detail about the ecological diversity within California’s natural communities. She states that California can be seen as an island due to it being essentially isolated by the topography, Mediterranean climate, and the vast amount of species that are endemic to the state. In this book, Bakker 1984 elaborates on the foothill oak woodland community. She goes into detail about the land features, species, and cultural history. This will be helpful to my project because it supports my thesis that the oak woodlands are important to preserve due to the biodiversity, and symbiotic relationship that the various species share with each other in this community.

The authors of this book report the variety of oak trees in California. This book delves into the history and ecology of oak communities. It also goes into great detail about the oak as a food resource and shelter for a colossal amount of species within the woodland. There is even greater detail upon the cultural history the community withstood by revealing the impacts of Native Americans, Spanish, Mexican, and American Periods. This work will help support my thesis on the importance of conserving oak woodland because it elaborates upon the various impacts humans and species have had on this community. It will also help greatly due to the authors writing detailed problems and threats these oaks are facing and conservation practices that can be used to prevent further damage.


Johnston describes each forest and woodland community in California. She reveals that these forests and woodlands are not just trees. These communities are a complex system of different species working together in a symbiotic relationship. She goes into detail about the foothill oak woodland community and the symbiotic relationship the various species share. Johnston also lists the detrimental impacts that humans and different species have had on the foothill oak woodlands. This book will be helpful to my project due to its expansion upon the damage that has been done to this community and the importance of conserving it.


Keator describes the various oak trees in intricate detail. He suggests that these trees are extremely complex and vital to the community in which they reside. Keator goes into extreme detail about the framework of an oak tree from its roots, trunk, limbs, branches, and type of leaf.
He also details the oaks’ life cycle and its ecosystem. This work will be helpful to my project because the oak tree is an extremely vital species that is a part of the foothill oak woodland community. It will help me elaborate on how it functions, and the benefits it produces for the species within the region.

Kueppers, Lara M, Mark A Snyder, Lisa C Sloan, Erika S Zavaleta, and Brian Fulfrost.


The authors describe the potential negative impacts climate change can have on two California endemic oaks: *Quercus douglasii* and *Quercus lobata*. They used the regional climate model to predict the impacts because it would be more effective in showing the changes for endemic species. Their results showed a decrease in Blue and Valley Oak by 59% and 54%. They also noted that these species would make a northward shift. In these findings, they concluded that the current protected areas will not be sufficient for the future oaks due to the potential of the northward movement. This article will be helpful to my project because it will help me provide information on potential climate change impacts on the foothill oak woodlands, and the direction that conservation efforts should go.


McCreary researches the success of oak regeneration in the last 25 years within the Sierra Foothills. Instead of trying natural regeneration, they used artificial oak regeneration. It was found that these oaks could establish. They needed to be protected from animals and other plants that could potentially harm the oaks. The author also went into detail on how to protect seedlings
so they have a chance to establish. This article will be helpful to my project because it provided a
great amount of information on how artificial regeneration of oak trees work. It will help in my
discussion of different oak regeneration tactics.

Meentemeyer, Ross, David Rizzo, Walter Mark, and Elizabeth Lotz. "Mapping the Risk of
Establishment and Spread of Sudden Oak Death in California." *Forest Ecology and

The authors of this article describe sudden oak death and its negative impacts on the region.
They mapped host species distribution, monthly weather conditions, and predictions of the risk
of spread on GIS. These predictive maps showed that a large amount of forest ecosystems are at
high risk of gaining the disease. These models help identify the appearance of sudden oak death
before it establishes, and helps prevent an outbreak. This article will be helpful to my project
because it describes one of the main threats to the foothill oak woodlands. It will help me
contribute information on sudden oak death, the potential of a spread, and how it can be
prevented.

Santos, Maria J., and James H. Thorne. "Comparing Culture and Ecology: Conservation
Planning of Oak Woodlands in Mediterranean Landscapes of Portugal and

Santos’ and Thorne’s paper analyzes oak woodlands that have been impacted by humans in
California and Portugal. The authors question if conservation policy can effectively preserve the
oak woodland communities with different sociopolitical cultural conditions. They describe the
cultural history and current cultural setting of the oak woodlands in California and Portugal. The
authors detail conservation tools each place uses and each of their protected oak woodlands.
They also explain the impact of climate change on the regions. They state it is possible to
conserve the oak woodlands and take human activities into account. This work will be helpful to my project because it will help me provide more detail on conservation efforts, and how certain human activities can persist without being harmful to the region.


Schoenherr provides a detailed portrait on the various landforms, habitats, and the biodiversity of California. He goes into great depth upon the foothill oak woodland region. He discusses the various tree species and how they are beneficial to the area. Schoenherr goes into further detail on the importance of the acorn. He explains the mass increase of acorn eating animals, tannins in acorns, and how Native Americans also exploited the food resource. Schoenherr also expands on bird species, animals, and flora of the region. This work will help me with my project because it will help me present the great biodiversity within the foothill oak woodlands, and give more detail on the importance of the acorn. All of this information will help to support my thesis that the region is of great importance and needs to be preserved for future generations.
California Foothill Oak Woodlands Detailed Outline

I. Introduction

-The California foothill oak woodlands is a region of paramount importance.

- The woodlands is an intricate ecosystem that inhabits a colossal amount of species.

- A majority of these species share a symbiotic relationship, and need one another in order to thrive.

- Some of these species are endemic to California.

- There is a rich cultural history that is intertwined with the foothill oak woodlands.

- Native Americans within the region thrived off the resources the woodlands produced.

- The region also endured the Spanish Period, Mexican Era, and the American Period.

- There are threats to this region that come from a myriad of sources.

- Human Impact

- Agriculture

- Development

- Climate Change

- Sudden Oak Death

- Regeneration

- Restoration and conservation practices are key in order to preserve this significant region.
-Information on California’s foothill oak woodlands and restoration and conservation methods have been reviewed through books, scholarly articles, documents, and attending conferences.

-Data will also be gathered by consulting with Conservation and Stewardship Project Manager of the American River Conservancy, Elena Delacy.

-The intent of this paper is to educate others upon the importance of preserving the foothill oak woodlands, and the conservation practices to do so.

II. California Foothill Oak Woodlands Ecosystem

-Region

-The California foothill oak woodlands creates a ring around the Great Central Valley.

-The region covers two-thirds of California, and covers about ten million acres of the state.

-The area occurs at an elevation between 400-5000 feet.

-It spans across the interior of the Coast Ranges, Transverse Ranges, Sierra Nevada, Cascades, and Klamath-Siskiyou mountains.

-The foothill oak woodlands range from Trinity County at the northernmost point and Los Angeles County being the southernmost point.

-It lies between a vast savannah and forest.

-The California foothill oak woodlands is distinguished by grasslands covering rolling hills dispersed with massive trees.

-It is dominated by oak trees with pine intermingled throughout the area.
- A variety of shrubs, herbs, and annual grasses scatter the understory of the woodlands.
- Due to the climate, the species within this region are drought-tolerant.

- Climate
  - California’s climate is Mediterranean with mild wet winters and extremely dry hot summers.
  - The foothill oak woodlands is the driest of California habitats.
  - Rainfall in this area is between 15-40 inches.
  - Even if there is considerable rainfall, the hot and dry summers decrease the benefits of it.
  - Rainfall and temperature have little to no effect on oak distribution.
  - A majority of the species within the oak woodlands adapted and are drought-tolerant.
  - These species have a specialized system, which enables them to thrive during the extremely hot summer days.
  - The soils that the species live upon are apart of this system, and help them to continuously survive.

- Soil
  - There is an extensive amount of various soil types found within California.
  - Soil types also vary throughout the foothill oak woodlands.
  - It can range from rich loams to thin and rocky soil.
  - A majority of the region is covered in lateritic soil.
  - Riparian communities within the foothills thrive off of alluvial soils.
This soil type enables deciduous leaves to photosynthesize and encourage expeditious growth.

Very few species can survive on serpentine soil.

Some of the tree and plant species within the foothill belt have a soil preference in which they live upon, which can determine distribution.

Trees

There are at least twenty species of pine and sixteen species of oak within California.

However, pine is more dispersed within mountainous communities.

There are a select few that live within the foothill belt.

Pine

The Foothill Pine (Pinus sabiniana) is the most common conifer within the region.

It used to be more commonly known as Digger Pine.

The term Digger is a derogatory term that is a reference towards the Miwok Native Americans.

The Miwok would eat the nuts that came from the Foothill Pine, and would dig in order to get most of their food.

The miners of the Gold Rush named the conifer “Digger Pine” because of the Miwoks’ harvest habits.

The Foothill Pine occurs in elevations ranging from 1000-3000 feet.

It usually lives on serpentine soil.

The conifer is known for its long needles that are around 7-13
inches in length.

-Its foliage has a gray colored appearance, which gave it’s other common name: Gray Pine.

-The foliage is extremely sparse, and the pine has massive cones.

-At the end of the cones are where the seeds reside.

-The Foothill Pine was not only a source of food for the Native Americans, but also is a source of food for many foothill animals.

-Oaks

-Oaks dominate the region.

-They are unique and variable.

-Four out of the six species of oak that lie within the foothill oak woodlands region, are endemic to California.

-Interior Live Oaks, Valley Oak, Engelmann, and Blue Oak

-Blue Oak, Valley Oak, and Engelmann Oak are all deciduous trees.

-If they are winter deciduous, they lose their leaves at the end of the growing season.

-If they are drought-deciduous, they lose their leaves in extreme dry seasons.

-Coast Live Oaks, Interior Live Oaks, and Canyon Oaks are evergreen.

-Their leaves remain intact year round.
-Blue Oak

- The most common oak seen throughout the foothill belt is the Blue Oak (*Quercus douglasii*).

- It is apart of the subgroup White Oaks.

- It grows to be around 60 feet tall.

- Leaves are wavy and are about one to three inches long.

- The leaves have a blue color, which was how the common name was given.

- Their acorns are the most edible.

- It is common in the interior valleys.

  - Blue Oak grows below 3,500 feet.

  - It is only found in California, and is the most widespread within the state.

- Valley Oak

  - Valley Oak (*Quercus lobata*) is the biggest oak in North America.

  - It is winter deciduous.

  - It is characterized by its massive canopy that sometimes touches the ground.

  - The leaves of the Valley Oak have deep lobes.

  - The Valley Oak produces a massive amount of acorns every other year.
- It occurs from the 2000-4000 feet.
- Valley Oak is endemic to California.

- Engelmann

- Engelmann (*Quercus engelmannii*) are medium in size
  - They grow to 40 feet.
  - It is drought-deciduous.
  - Their leaves are thick and can be flat or wavy.

- Engelmann Oaks used to be dispersed throughout California.
  - It is now restricted to Southern California in San Diego County.
  - It lives in elevations below 4,200 feet.
  - Engelmann Oaks are endemic to California, and are extremely rare.

- Coast Live Oaks

- Coast Live Oaks (*Quercus agrifolia*) grow low to the ground.
  - They have a hemispherical crown.
  - Their leaves are oval and can grow up to three inches long.
  - Coast Live Oaks are evergreen.
  - They are found along the coast.
  - Coast Live Oaks grow up to 5000 feet in elevation.
They are found from Mendocino County as the Northernmost point to Baja as the southernmost point.

Coast Live Oaks are native to California, but are not endemic to the state.

Interior Live Oak

-Interior Live Oak (*Quercus wislizeni*) has extremely rugged oak bark.
  -The leaves on top have smooth margins and the bottoms are prickly.
  -It is green all year round.
  -Interior Live Oak is an extremely broad tree.

The Interior Live Oak lives below 5000 feet in elevation.

-It doesn’t have a soil preference.
-Interior Live Oak is dispersed throughout the whole foothill belt.
-It is endemic to only California.

Canyon Oak

-Canyon Oak (*Quercus chrysolepis*) grows up to 50 feet tall.
-It is evergreen.
-Its acorns have fuzzy covers, which has given the Canyon Oaks’ other common name: Golden Cup
Oak.

-It is found in deep canyons or North facing slopes
-It is found in elevations up to 9,000 feet.
-It can grow in alluvial or rocky soils.
-It is found below all major mountain ranges within the state.
-It is endemic to California.

-Food Source
-Oaks are a food source for both Native Americans and various animals.
-Acorns are an extremely vital food source and are important for oak regeneration.

-Shelter
-Oaks provide shelter for vast amount of species.

-Plant Life
-Plant life in foothill oak woodlands include: whiteleaf manzanita, redbud, coffeeberry, and poison oak.
-There are a variety of annual grasses that are not native to California.

-Animal Life
-Around 313 animal species thrive in California foothill oak woodlands.
-Many of these animals have extreme low metabolisms so they don’t need as much food.
-This enables them to survive in drought resistant areas.
- **Symbiosis**

  - The various tree, plant, and animal species live in symbiosis.
  
  - They need one another in order to survive.
  
  - Animals help in the dispersing of acorns, which in turn helps the regeneration of oaks.
  
  - Oaks provide shelter and food for various animal species.

**III. Cultural History**

- **Native Americans**

  - Several Native American tribes lived within the California foothill oak woodland.
  
  - They used the oaks as a resource of food, basketry, and acorn granaries.
  
  - Several cultural traditions surrounded the use of acorns.

- **Spanish Period**

  - During the mission period, Spaniards brought over various invasive species, along with agricultural practices.

- **Mexican Period**

  - During the Mexican period, there was a great increase in ranching and agricultural practices that were detrimental to the oak woodlands.

- **American Period (Gold Rush)**

  - During the Gold Rush, population rapidly increased.
  
  - This caused great threat to the oak woodlands and had negative effects.
  
  - Several trees were cut down for wood, and were cleared for farmland.

**IV. Threats/Issues**
-Human Impact

- Agriculture
  - Cattle grazing is a severe negative impact upon foothill oak woodlands.
  - Cattle is one of the reasons as to why oaks are having a hard time regenerating.
  - The cattle step over and graze over acorns that have recently fallen and are attempting to germinate.
  - Several trees have been cleared for farming.

- Development
  - Development is the main threat to foothill oak woodlands.
  - The foothills are the most rapidly developing area within California.
  - Several trees are being removed and cleared for residential and commercial uses.
  - It is causing the oak habitat to shrink even further.

- Climate Change
  - Due to climate change, there has been a great decrease in Blue and Valley Oak.
  - It is also causing species to shift North.

- Sudden Oak Death
  - Sudden oak death is caused by a plant pathogen called Phytophthora ramorum.
  - It is rapidly spreading.

- Regeneration
  - Oaks are struggling to regenerate due to the threats listed above.
  - Acorns regenerate trees, having troubles due to the threats listed above.
V. Restoration and Conservation

-Preservation

-One of the best methods of conserving the foothill oak woodlands is parks and preserves.

-Regeneration

-Natural Regeneration

-Artificial Regeneration

-Habitat Restoration

-Habitat restoration can include planting trees and acorns, getting rid of invasive species, reintroducing native species, and decreasing livestock grazing.

-Wildland Management

-Decreasing animals is vital in order to help the regeneration and conservation of oak woodlands.

-Education

-Education is the best way to preserve the foothill oak woodlands.

VI. Conclusion
Chapter 1 Introduction

The California foothill oak woodlands is a region of paramount importance due to a plethora of reasons. This area of California creates a ring around the Great Central Valley, and extends to small areas of the outer Coast Ranges and lower Sierra slopes. The foothill oak woodlands inhabit an immense amount of species, and a large amount of these are endemic to California. There is a rich cultural history that is intertwined with the foothill oak woodlands and has endured years of human interaction. Native Americans were the first to utilize California’s foothill oak woodlands followed by the Spaniards, Mexicans, and the Americans. This small, yet vital region of California is experiencing major threats from a myriad of sources. These threats have caused the foothill oak woodlands habitat to shrink along with other detrimental impacts. Restoration and conservation practices are key in order to preserve this significant region.

The rolling hills overlaid in grasslands and massive trees that sprawl across the region are the distinguishing factors of the foothill oak woodlands. Two-thirds of California is covered by foothill oak woodlands, and occurs at 400 to 5,000 feet in elevation (Bakker 1984). The state of California has a Mediterranean climate with mild wet winters and extremely dry hot summers, but due to the elaborate topography there are diverse microclimates. The California foothill oak woodlands is an intricate ecosystem that contains various species and soils. There is an extensive amount of soils within the state that vary throughout the foothills. California foothill oak woodlands inhabit an ample amount of species, and a vast amount are endemic to the state. Oaks are the dominant tree species within the region, and play an important role in the process of symbiotic relationships between a wide array of wildlife and plant life. Numerous animal, insect, and plant life need these oaks in order to thrive, and in turn, the oaks need these diverse species to prosper.
Cultural history is deeply rooted within California’s foothill oak woodlands. The region endured Native Americans, the Spanish Period, Mexican Era, and the gold rush. Several Native American tribes utilized the resources the woodlands provided, and each tribe had their own use for oak trees, such as basketry, food, acorn granaries, spiritual ceremonies, and cultural traditions. Acorns were of vital importance to Native Californians, and various cultural and spiritual traditions surround the use of acorns.

During the Spanish Period, the Portola Expedition of 1769 and Father Junipero Serra’s establishment of missions within California brought immense change to the woodlands (Johnson, Muick, Pavlik, & Popper 1991). Many trees were cut down for these missions, agricultural practices, and grazing. The Spaniards implemented their agricultural practices, animal husbandry, and introduced numerous invasive species to the region. The actions of the Spaniards caused a copious amount of harmful impacts towards the foothill oak woodlands that still affect them today.

When California was changed from Spanish to Mexican control in the mid 1800’s, there was a massive increase in ranching. This was of great damage to the oak woodlands, as was the tanning industry that was at its peak in the late 1800’s. Bark from tanbark and oak trees were used in order to complete the tanning process, which caused a great decrease in species and almost caused extinction (Johnson, Muick, Pavlik, & Popper 1991).

The population in California’s foothill oak woodlands dramatically escalated during the 1849 gold rush. This time period also had a vast impact on the region, and several animal species populations greatly decreased due to hunting, food, and clothing purposes. There was substantial clear cutting for farmland, fuel, tools, and development, and oaks during this time period were also used as feed for farm animals, and as burial sites. The different cultural practices that
individuals from each time period instilled upon the woodlands have provided great changes and impacts to the region.

The California foothill oak woodlands is experiencing threats and issues from an array of sources. Human impact upon the woodlands has been extensive, and the detrimental effects of their actions are still harming the region that will continue onto the future. Agricultural practices cause a majority of the damages to the foothill oak woodlands. Grazing hinders the regeneration of oak trees, which is a massive problem within the woodlands. Several trees have been cleared for farm use and various other uses. Also, the introduction of invasive species has caused great harm to the area. As of late, residential and commercial development is the main threat to foothill oak woodlands, because the foothills are the most rapidly developing region within California. The oak habitat is shrinking at an extreme fast rate due to clear cutting for residential and commercial purposes. Climate change is also a threat that the woodlands face, and it has caused a decrease in certain species that inhabit the region. Another issue is sudden oak death, which is a rapidly spreading disease is caused by a plant pathogen called Phytophthora ramorum (Kay 2000). It is contributing to the decrease in certain oak species throughout the woodlands. The rate at which these colossal amount of threats and issues the foothill oak woodlands is enduring is extremely alarming. However, these problems can be deterred through various restoration and conservation practices.

California’s foothill oak woodlands is in dire need of aid, and different restoration and conservation practices can be implemented in order to help preserve the region. One of the best methods of conserving the foothill oak woodlands is through creating parks and preserves. These parks are also vital in their role of educating the public on the importance of the region. Education is also critical in order to preserve the foothill oak woodlands. Creating further
awareness will help promote conservation methods over a larger area of the region. The oak regeneration problem can be diminished through natural and artificial regeneration. The restoration of foothill oak woodland habitat can include planting trees and acorns, getting rid of invasive species, reintroduce native species, and decreasing livestock grazing. Wildland management and decreasing animals is extremely important in order to help the regeneration and conservation of oak woodlands. These various restoration and conservation techniques can drastically improve the area and severely decrease the threats of the foothill oak woodlands.

Although this area of California is small, it holds great importance. It contains a vast amount of species that share an extensive symbiotic relationship. The cultural history that is embedded within the foothill oak woodlands is vital not only to human history, but was the beginning of the fast rate of change the region endured. Several threats and issues have transpired from various human activities. California foothill oak woodlands need to be preserved in order for the region to continue to survive. Within this research project, information on California’s foothill oak woodlands and restoration and conservation methods will be reviewed through books, scholarly articles, documents, and conference attendance. Information was also gathered by consulting with Conservation and Stewardship Project Manager of the American River Conservancy, Elena Delacy. The intent of this paper is to educate others upon the importance of preserving the foothill oak woodlands, and the conservation practices to do so.
Chapter 2 California Foothill Oak Woodlands Habitat

The ring that the foothill oak woodlands lie within covers about ten million acres of California. This represents around ten percent of the state's land area. The region occurs at an elevation from 400 to 5,000 feet, and lies between a vast savanna and dense forests. It spans across the interior of the Coast Ranges, Transverse Ranges, Sierra Nevada, Cascades, and Klamath-Siskiyou mountains (Holland & Keil 1995). California’s foothill oak woodlands range from Trinity County at the Northernmost point and Los Angeles County being the Southernmost point.

Figure 1: Regional Climates of California

Source: Kauffman, Eric. “Climate and Topography.” A Remarkable Geography: California
The general and overall climate of California is Mediterranean. This climate involves mild wet winters and extremely dry hot summers. Due to California’s motley topography, there are several regional climates within the state. Latitude also plays a major role in determining these various climates. Based on this, the diversified climates have a major impact upon vegetation diversity and dispersal throughout California.

There are two regional climates in California’s foothill oak woodlands. The first is Mediterranean cool summer, which is found in higher elevations and the coast. This climate experiences warm dry summers, and the average temperature never exceeds 71.6 degrees Fahrenheit. The average temperature in the coldest months in this regional climate is between 32 to 64 degrees Fahrenheit. Precipitation within this regional climate has an average of 25 to 55 inches of rain or snow annually (Holland & Keil 1995). The second regional climate of the foothill oak woodlands is Mediterranean hot summer. This regional climate is found in the Central Valley and the interior foothills. There are extremely hot and dry summers and mild wet winters in this regional climate. The average temperature in the warm months exceeds 71.6 degrees Fahrenheit, and average at 27 to 64 degrees Fahrenheit in the cold months. The average annual precipitation is between 12 and 25 inches (Holland & Keil 1995). These two regional climates play a massive role in determining the variety and diffusion of species throughout the foothill oak woodlands.

Soil types can also play a role in how species are placed in the foothill oak woodlands. There is an extensive amount of soil types found within the state, and vary throughout the foothill oak woodlands. It can range from rich loams to thin and rocky soil. Riparian communities within the
foothills thrive off of alluvial soils. Due to California’s mediterranean climate, Xerolls are found throughout the entire state.

The major soils of California are Aridisols, Entisols, Inceptisols, Mollisols, and bedrock soils (Bakker 1984). A majority of California’s foothill oak woodlands is covered in lateritic soil, and is dominated by three major soil types. The first type of soil found in the region is Alfisols. This soil type has low organic matter and high fertility. The second type found in the foothill oak woodlands are Mollisols. This soil type is found where grassland is prevalent, and is the most fertile soil within California. Lastly, Inceptisols are “young soils with poorly developed horizons” (Holland & Keil 1995). There can be a direct connection and relationship between soil types and vegetation cover, but this has not been widely studied. Which in turn, the direct relationship is not well known at this time (Holland & Keil 1995). However, some of the plant and tree species within the foothill belt have a soil preference in which they live upon, which can determine the distribution.

The rolling hills overlaid in grasslands and massive trees that sprawl across the region are the distinguishing factors of the California foothill oak woodlands. The colossal trees that dominate this area are mainly oaks with pines intermingled throughout the region. There are at least twenty species of pine and sixteen species of oak within California. Pine is more dispersed within mountainous communities, and there are only a select few pines that live within the foothill belt. Within this paper, there is one major pine and six oak species that will be discussed in further detail.

The Foothill Pine (*Pinus sabiniana*) is the most common conifer within the region. It used to be more commonly known by the name “Digger Pine.” The term Digger is a derogatory term that is a reference towards the Miwok Native Americans that resided in the foothills of California.
The Miwok would eat the nuts that came from the Foothill Pine, and would dig in order to get most of their food and sustenance. When the Gold Rush hit, the miners deemed the conifer “Digger Pine” due to the Miwoks’ harvest habits (Johnston 1994).

This conifer occurs in elevations ranging from 1,000-3,000 feet (Johnson, Muick, Pavlik, & Popper 1991). Very few species can survive on serpentine soil, however Foothill Pine is known to live upon this soil type. This pine tree has several characteristics. It is known for its long needles that are around 7-13 inches in length, and its extremely sparse foliage. The color of the tree’s foliage is gray, which gave its other common name: Gray Pine (Johnston 1994). Foothill Pines have massive pinecones, and at the end of the cones is where the seeds reside. This pine was not only a source of food for the Native Americans, but also is a source of food for many foothill animals.

Oak trees dominate the foothills of California. Four out of the six species of oak that lie within the foothill oak woodlands region are endemic to California. These species are: Interior Live Oaks, Valley Oak, Engelmann, and Blue Oak. The last three listed above are all deciduous trees. If they are winter deciduous, they lose their leaves at the end of the growing season. If they are drought-deciduous, they lose their leaves in extreme dry seasons. Coast Live Oaks, Interior Live Oaks, and Canyon Oaks are evergreen, which means their leaves remain intact year round. They are all unique and variable throughout the region.
The most common oak seen throughout the foothill belt is the Blue Oak (*Quercus douglasii*). Blue Oak is apart of the subgroup White Oaks. It is a medium sized tree that grows to be around 60 feet tall (Bakker 1984). Their leaves are wavy and are about one to three inches in length. The color of the leaves is blue, which was how this oak tree was given its common name. Out of all the oak species, the Blue Oak has the most edible acorns. It also provided food for the Native Americans, and various animal species throughout the region.

The Blue Oak is seen once entering the foothill oak woodlands. It is extremely common within the interior valleys. Blue Oaks grow below 3,500 feet and rarely reach above 4,000 feet (Johnston 1994). This tree has an extreme wide range for environmental tolerance. This is due to its evolving into one of the most drought tolerant species within California. Blue Oak can

withstand extreme hardship because of years of adaptation (Bakker 1984). It can be found on rocky soils, mesic hillsides, and less developed soils. This oak is only found in California, and is the most widespread within the state.

![Map of Valley Oak Distribution](image)

**Figure 3: Valley Oak (Quercus lobata) Distribution**


Valley Oak (*Quercus lobata*) is the most colossal oak within North America. It occurs in a range from 2,000 to 4,000 feet (Johnston 1994). The Valley Oaks distinguishing characteristic is its massive canopy that can sometime touch the ground. This oak is winter deciduous, but after a month of spring its leaves already begin to grow. The leaves of the Valley Oak have deep lobes, which its scientific name refers too. This oak produces a massive amount of acorns every other year, which is for regeneration purposes. The Valley Oak is also apart of the subgroup White
Oaks, and is commonly called California White Oak. This oak tree is also only found within California.

**Figure 4: Engelmann Oak (*Quercus engelmanii*) Distribution**

Engelmann Oak (*Quercus engelmanii*) is endemic to California, and is extremely rare. They used to be widely dispersed throughout California, but several anthropogenic factors caused a great decrease. Engelmann Oaks are now restricted to Southern California in San Diego County, and live in elevations below 4,200 feet (Johnson, Muick, Pavlik, & Popper 1991). Their leaves are thick, flat, or wavy, and it is drought-deciduous.

Coast Live Oaks (*Quercus agrifolia*) are found along the coast and grow up to 5,000 feet in elevation (Bakker 1984). They can reside in sandy, alluvial, or xeric soils (Bakker 1984). Coast Live Oaks are found from Mendocino County as the Northernmost point to Baja as the Southernmost point (Johnson, Muick, Pavlik, & Popper 1991). This oak is apart of the Black Oak subgroup. Their distinguishing characteristic is their hemispherical crown. Coast Live Oaks are also unique in how they grow. These trees can grow very low to the ground and have a tangled appearance. This oak is an evergreen. Its leaves are oval, and they can grow up to three inches long. Coast Live Oaks are native to California, but are not endemic to the state.

Figure 6: Interior Live Oak (*Quercus wislizenii*) Distribution


Interior Live Oak (*Quercus wislizenii*) is spread throughout the whole foothill belt. This oak is also apart of the Black Oak subgroup. Interior Live Oak trees have several defining characteristics. These evergreen have a round dense canopy, and its leaves have smooth margins on tops and prickly bottoms. Interior Live Oaks are not very tall, but are extremely broad. It lives below 5,000 feet in elevation and doesn’t have a soil preference (Johnson, Muick, Pavlik, & Popper 1991). Coast Live Oaks are only found in California.
**Figure 7: Canyon Oak (*Quercus chrysolepis*) Distribution**

Canyon Oak (*Quercus chrysolepis*) is a part of the Intermediate Oak subgroup, and it is the only tree within this subgroup. This evergreen has varied shaped leaves. The younger leaves of this tree are sharp, and the older leaves are toothless (Bakker 1984). Canyon Oaks most distinguishing factor is its acorns. Their acorns have fuzzy golden cover, which has given this oak its other common name: Golden Cup Oak. Canyon Oaks are found in elevations up to 9,000 feet, and reside in deep canyons or North facing slopes (Johnson, Muick, Pavlik, & Popper 1991). Canyon Oaks prefer alluvial or rocky soils. This oak species is found below all major mountain ranges within the state, and is endemic to California.

Oak trees not only provided food for Native Americans, but for a variety of species as well. Mammals, birds, and insects all consume a variety of resources oak trees supply. Due to the

various oak species throughout the foothill oak woodlands, acorn harvest can last for as long as three to four months (Schoenherr 1992). Acorns are available annually within the foothills. This is another benefit of having diverse oak species within the region. Mule deer, black beers, wild pigs, and band-tailed pigeons are only a few species that readily consume acorns during harvest season. Acorn woodpeckers, scrub jays, woodrats, and gray squirrels are a few species that store the acorns for later use. The list of species that feed upon acorns is enormous, and those listed above are just an extremely microscopic example.

Oaks leaves, twigs, sap, roots, and pollen are also a food resource that diverse species exploit. Deer, livestock, dusky-footed woodrats, California oak moth caterpillars, tent caterpillars, and western tussock moths are some species that consume oak leaves and twigs (Keator 1998). Aphids, whiteflies, mites, and leafhoppers are an example of species that eat the sap from oak trees and their leaves (Johnson, Muick, Pavlik, & Popper 1991). Sap is also eaten by a variety of birds that collect it beneath the bark. Western harvest mice consume bark, pocket gophers and longhorn beetles eat roots, and multiple insects eat twigs and limbs (Johnson, Muick, Pavlik, & Popper 1991). Bees use the pollen from the oaks flowers. The whole oak tree is utilized as a food source for a myriad of species throughout the foothill oak woodlands.

Not only is the oak a food resource, but it is also a shelter for species. Just like it is with providing food, the entire oak tree’s framework is used as a refuge and dwelling. Birds and mammals use twigs as a building block for nests, and also use branches as a place to perch their nests. Hollow areas within the trunks of trees are also used as a place for nesting, protection, and storage of food. The shrubs and plants that lie beneath the oaks provide shelter from predators and a place to rear newborns. Rodents and insects use the system the roots of the oak trees
created to reside within. Insects are a great example of how an entire oak tree can be used as a shelter and a food source.

Insects use branches, twigs, and leaves of the oak trees to lay their eggs. An example of this is the cynipid wasps. They lay their eggs on branches, twigs, but they mainly use leaves. Once the egg is laid and hatched, it produces a gall. Galls are, “a tumorlike growth that is made after an egg laid in plant tissues hatches. Something in the hatching larva reprograms the plant tissues around it to grown into the gall” (Keator 1998). These galls upon the oak trees provide food and shelter for these wasps for a majority of their lives. This is just one out of an innumerable examples that show how oak trees are a vital food resource and shelter that enable these diverse species to thrive.

The oak trees within the foothill oak woodlands are an extreme integral part of the habitat for multiple reasons. First, they protect soils by preventing landslides and erosion from occurring (Bernhardt & Swiecki 2001). Secondly, these oaks are fundamental to the foothill woodlands because two-thirds of California’s water flows through this region (Miller-Cripps 2013). Oaks play a role in providing water quality and regulate water flow in watersheds (Bernhardt & Swiecki 2001). Lastly, they are a main staple for a profusion of diverse species throughout the region. The oak trees and a variety of species share a complex symbiotic relationship with one another. An example of a symbiotic relationship within the foothill oak woodlands is the Scrub Jays and oak trees.

Scrub Jays diets mainly rely on acorns from a variety of oak trees within the foothill oak woodlands. This bird will store the acorns and consume them later on. Usually, the Scrub Jays bury their collection into the ground, and in doing so, it aids in planting oak trees. This relationship that the Scrub Jays and oak trees share is beneficial for both parties. The oaks
provide the Scrub Jays with sustenance, and the Scrub Jays help the oaks in regenerating by dispersing acorns into the ground (Schoenherr 1992). Symbiotic relationships are key for the survival of several species within the foothill oak woodlands, and the scrub jays and oaks are just one example of this.

California’s foothill oak woodlands is an intricate ecosystem that inhabits a tremendous amount of species. There are around 1,100 native plant species (CalFlora 2013), 313 terrestrial vertebrate species (Miller-Cripps 2013), 370 fungal species, and around 5,000 arthropod species (Bernhardt & Swiecki 2001) that reside and utilize the foothill oak woodlands. These species share an intricate symbiotic relationship between themselves and the foothill oak woodlands. A symbiotic relationship means that two or more species depend on one another in order to survive (Bakker 1984). The interaction can either be beneficial for all parties, or can only be a benefit to one while it’s a detriment to the other. If the habitat shrinks any further or one of these endemic species are eradicated due to the multitude of threats California’s foothill oak woodlands faces, a domino effect of population diminishment or disappearance will commence.

The foothill oak woodlands is the most biologically diverse region within California. The oak woodlands lie within the California Floristic Province, which is a world biodiversity hotspot. There are a large amount of endemic plants within the California Floristic Province, which means these species can only be found in California (Slattery 2010). Biodiversity hotspots are areas that are cannot be replaced to the species that depend upon it in order to thrive. Vast majorities of the species within California’s foothill oak woodlands are endemic, and they need this specific habitat in order to survive. This is one of the most crucial reasons as to why it is extremely vital for the conservation and preservation of California’s foothill oak woodlands.
This region is irreplaceable to them, and need the foothill oak woodlands to be intact in order for their survival.
Chapter 3 Cultural History of California’s Foothill Oak Woodlands

Cultural history is exceedingly prolific throughout California’s foothill oak woodlands. This region endured Native Americans, the Spanish Period, Mexican Era, and the Gold Rush. The foothill oak woodlands was once home to an array of Native American tribes that exploited the area’s resources for their livelihood. Later on, the Europeans entered the region with the Portola Expedition of 1769, which was the commencement of massive changes that the woodlands were going to encounter. Then when Mexican rule took over California, there was a massive increase in ranching and the tanning industry that continued the change throughout the foothill oak woodlands. Once the Gold Rush hit in 1849, there was a drastic increase in population in California (Johnson, Muick, Pavlik, & Popper 1991). The waves of cultures that interwove itself through California’s foothill oak woodlands each had their own impacts upon the region.

The Native Americans of California had an intimate relationship with the foothill oak woodlands. They utilized a majority of the woodlands resources for their survival and to perform cultural practices. Native Americans were aware that the foothill oak woodlands inhabited an abundance of species, which could provide them with a vast amount of sustenance. The oak trees of the region were a main staple in Native Americans’ livelihoods, and each part of the oak tree was exploited for different purposes. Tribes, villages, and families based their territory on areas that inhabited oaks. Sometimes, families were allowed to “own” the trees that were closest to their homes. As previously stated, the oaks provided the Native Americans with three quarters of their daily diet (Johnson, Muick, Pavlik, & Popper 1991). They were also worshiped, used in spiritual rituals, used as medicines, and other material items.
Figure 8: California Native American Tribe Distribution

The acorns are arguably one of the most important components of an oak tree. Native Americans utilized acorns from oak trees as one of their main sources of food. Acorns were around three-fourths of Native Americans daily diet (Johnson, Muick, Pavlik, & Popper 1991). This food source provided them with three main nutrients that are needed in order to thrive. Acorns are composed of 20 to 30 percent fat, 6 to 8 percent protein, and around 68 percent carbohydrates (Keator 1998). The rest of the acorn contains water, minerals, and fiber. Native Americans would store their gatherings of acorns in granaries, so when harvest was low they always had something to lean back on. When it came time to consume the acorns, the process of preparing them was an extremely intensive project.

Acorns could not be eaten raw due to the poisonous tannins that they contain. In order to get rid of these tannins, Native Americans had to go through a thorough process called leaching. This required grinding the acorns into meal through mortar and pestles. After the meal was made, it was sifted and water was poured through it several times. This could take up to seven hours for only a few days of meal (Johnson, Muick, Pavlik, & Popper 1991). Even though this was an extremely intricate process, the acorn was an extremely vital food source that enabled the Native Americans to thrive.

Acorns were an immensely imperative component to the Native Americans daily lives. The acorns were most often used as a trade item between various tribes throughout the state. They not only gave them the nutrition they needed in order to survive, but were also used for medicine. The tannins from the acorns were removed and used to treat several afflictions. Besides providing medication, acorns were also used in cultural traditions. Several religious ceremonies were performed in fall to commemorate the harvest of acorns the season would bring. The Wintu tribe is an example of acorns used in cultural practices, when someone dies the body is sent into
the other realm with acorn meal and water for the spirit to consume (Johnson, Muick, Pavlik, & Popper 1991). Throughout several tribes that resided in the foothill oak woodlands, acorns were considered a sacred symbol.

Other elements of the oak trees were utilized for various purposes as well. They were also used as medicine, cultural practices, and spiritual traditions. Bark and insect galls from the oak trees contained high concentrations of tannins that were used to treat ailments. Along with providing medical treatments, tannins from the bark were used to produce dyes for baskets, animal skins, and fishnets. The tannins from the oak galls also provided the Native Americans with a rich-colored dye that was used for creating tattoos. Oak trees were also seen as a sacred symbol to the Native Americans, and were used in ceremonies to celebrate life and death. When a boy was born into the Wintu, the umbilical cord would be wrapped around an oak tree to symbolize that the boy would become aware and bold (Johnson, Muick, Pavlik, & Popper 1991).

The spiritual and material importance of oak trees was widely seen in tribes throughout California, especially for those that resided within the foothill oak woodlands.

When the Spaniards arrived in California, it was the beginning of an extreme drastic change to the foothill oak woodlands. The Portola Expedition of 1769 set out to find Monterey Bay, which was founded by Sebastian Vizcaino back in 1602. During the Expedition, Father Junipero Serra and other Franciscans established twenty-one missions between 1769-1823 (Johnson, Muick, Pavlik, & Popper 1991). A majority of these missions were established in the coastal foothill oak woodlands, and the goal was to convert the Native Americans to Christianity. Due to the missions being established among oak groves, it made easier for this goal to be attained.

During this Expedition, the Spaniards also realized the great potential for agriculture in California. The Spaniards implemented their intensive farming and animal husbandry to the
region. Several oak trees and other tree species within the foothill oak woodlands were clear cut for agricultural purposes. They introduced several non-native and invasive species to the region, which is extremely detrimental to the foothill oak woodlands. It causes the native plant life to compete with the new species, and the native plants usually cannot keep up with their competitors. Spaniards also introduced cattle, sheep, horses, goats, and pigs to the foothill oak woodlands. This was even of greater detriment to the region, which will be explained in greater detail later on. It is estimated that $\frac{1}{6}$ of the California was farmed and grazed during the Mission Period (Johnson, Muick, Pavlik, & Popper 1991). The Spaniards were responsible for the beginning of the radical change in landscape of the foothill oak woodlands.

The destructive changes of the foothill oak woodlands continued further once Mexican rule took over in the mid-1820s. During this time, ranching increased dramatically within California. Predators were killed to protect livestock and were used as a food source as well. This was a great impact upon the woodlands due to the rapid increase of seed eating animals and a lack of predators. Ranching also required massive clear cutting throughout the foothill oak woodlands. The tanning industry was also at its highpoint during this time, and it required the cutting of an endless amount of oaks as well. Oak and various other species populations were substantially decreased due to the impacts of the ranching and tanning industries brought to the region.

Once the Gold Rush hit, even greater change was brought to the foothill oak woodlands. The Gold Rush brought a momentous increase in population to California in 1849 (Johnson, Muick, Pavlik, & Popper 1991). Clear-cutting the foothill oak woodlands drastically grew for various reasons. Oaks and other tree species of the foothill oak woodlands were used for firewood, made into tools, fueled trains, and for building purposes. The woodlands were also cleared for farming
and orchards. With an increase in population, brought a great depletion to a majority of the species within California’s foothill oak woodlands.

California’s foothill oak woodlands endured the Native American, Spanish, Mexican, and Gold Rush Periods. The Native Americans were the last to have little impact upon the region. Once the Spaniards arrived, it was the beginning of the changes of California’s landscape and exploiting the foothill oak woodlands resources. This continued on to the Mexican Period, and there was an even greater depletion in foothill oak woodland habitat and species populations. With the massive increase in population brought by the Gold Rush, oaks were utilized for more purposes than ever before, and habitat and species populations depleted even further. Ripple effects of pernicious impacts were created once the Europeans entered California. Since then, the actions of these various cultures to the region have caused several threats and issues the foothill oak woodlands still face today.
Chapter 4 Threats and Issues

The threats that California’s foothill oak woodlands face are extremely damaging. The oak species within the region are having an issue with regeneration. The effects of human influence are the main cause of this. Humans have severely impacted the region through numerous ways. The introduction of Old World agriculture practices and non-native species greatly transformed the foothill oak woodlands. Rapid development of the region is one of the main threats that faces the region. Another threat the foothill oak woodlands face is climate change. It has caused a decrease in certain oak species and species movement trends. Lastly, the region faces sudden oak death. All of these threats are reasons as to why it is imperative to begin restoring and preserving the foothill oak woodlands.

A tremendous issue the oak species within the foothill oak woodlands are fighting is regeneration. Even if the oak trees have excess in acorn dispersal, there is still a problem of tree replacement. Acorns are seen as the “ovary” of the oak tree (Keator 1998). Once the acorns are scattered amongst the ground, they are responsible for germinating and maturing. Regardless of there being a great production of acorn dispersal, they are being consumed by seed eating rodents and animals before or during the germination process. This has become even more of an issue because of the rapid increase in seed eating rodents and animals. The predator extermination program implemented by humans was the cause of this increase (Schoenherr 1992). The increase in seed eating animals is also accountable to the introduction of annual grasses. Once the Spaniards introduced the annual grasses that soon replaced the perennial bunch grasses, there was a rapid increase in seedeaters. This is because annual grasses produce more seeds than perennial bunch grasses, which in turn provides more food for these animals (). The reduction of predators and greater availability of food for these seed eating animals and rodents have enabled
the increase in their populations. Therefore, aiding in the decrease of regenerating oaks. Another factor that is preventing the acorns from germinating and growing into mature oak trees is agriculture.

When the Spaniards introduced their intensive agriculture and animal husbandry practices, it drastically impacted the woodlands. It mainly affected the region in the long run with causing regeneration issues. As time went on, population increased, which led to an increase in agricultural practices that brought with it an increase in grazing animals. These grazing animals are the main reason as to why oak species are having trouble regenerating (Bakker 1984). They trample over or consume the acorns and sprouts before the acorns have a chance to turn into saplings. Due to there being a great abundance of seed eating animals and rodents along with grazing animals, there is a great imbalance and oaks are not regenerating. It is causing “acorns and seedlings to be eaten out of existence” (Schoenherr 1992). With the clear-cutting of trees and plant life taking place due to agriculture, this imbalance is becoming even more apparent, and making the regeneration issue an even greater risk to the region. The reasons listed above are responsible for the lack of different age cohorts within the foothill oak woodlands. Either mature trees or sprouts can be found, however, there is a lack of saplings (Miller-Cripps 2013).

The regeneration issue is a massive threat to the foothill oak woodlands because it greatly affects other species within the region. As stated previously, the oak species share an extremely intricate symbiotic relationship with a majority of the diverse species that reside in the foothill oak woodlands. If one of the oak species is eradicated due to regeneration issues, it would bring great harm to those species that depend upon it for survival. This could cause species displacement and decrease species populations. Blue Oaks are extremely sensitive to this issue because they grow very slowly. They have been eliminated from some areas of the foothills for
agriculture, and also struggle to survive because of the introduced annual grasses ( ). The rapidly seed producing annual grasses make it difficult for Blue Oaks and other oak species to compete. The fact that the Blue Oaks are endemic to California, means that the regeneration issue could cause it to disappear for good (Schoenherr 1992).

Development is the main threat that California’s foothill oak woodlands encounter today and in the future. The foothills are the most rapidly developing area within California, and several trees have been removed and are being removed and cleared for residential and commercial uses (Scripps-McClatchy 1996). This is causing the foothill oak woodlands habitat to shrink at a rapid rate than before. The three species that have been hit hard by development and regeneration threats are Blue Oak, Valley Oak, and Engelmann. Large amounts of Blue Oaks were cleared for development purposes, and have struggled to regenerate since. Ninety percent of Valley Oaks that lived in riparian habitats in the early 20th century were removed for development purposes (Johnson, Muick, Pavlik, & Popper 1991). This loss has contributed to the struggle of transitioning to saplings. Development also aided in the habitat loss of the Engelmann Oak, and they can only be found in an extremely small area in Northern San Diego County (Scripps-McClatchy 1996). The impacts of development on these three species in particular are extremely destructive due to their endemic nature. Development is still occurring and will continue to occur in the future. If conservation and preservation practices are not implemented on foothill oak woodlands, the increase in habitat loss could lead to the elimination of these indispensable species.

Climate change and the impacts that it could bring to the future of California’s foothill oak woodlands is also an impending threat. A study was done on how climate change will potentially impact the foothill oak woodlands by Brian Fulfrost, Lara Kueppers, Lisa Sloan, Mark Snyder,
and Erika Zavaleta that was detailed in “Modeled Regional Climate Change and California Endemic Oak Ranges.” They used a Regional Climate Model to document future climate change scenarios for restricted species habitats. The focus on Blue Oak and Valley Oak was used and mapped with the RCM. The results showed that the range of Blue Oak and Valley Oak shrank to 59% and 54% of what the range could have potentially been. It was also noted that there would be a Northward shift. Both of these results are depicted in the map above. Conservation areas within the foothill oak woodlands will protect less than 50% of the species that reside within it in the future. This is due to the Northward shift, and conservation practices should take into account the potential shift in habitat that climate change could cause in order to be effective. This study is a great example to show how climate change can affect the foothill oak woodlands in the future. The threat of decreasing species populations, decrease in habitat range, and shifts in habitat need to be taken into account in order to effectively protect California’s foothill oak woodlands.

Lastly, the oak species within the foothill oak woodlands are confronted with the issue of sudden oak death. Sudden oak death is caused by a plant pathogen called *Phytophthora ramorum*, and mainly attack Coast Live Oaks (Beam 2003). It is believed that this fungus is related to the one that caused the Irish potato famine. Sudden oak death causes cankers on the trees, which eventually dissipates the bark. This in turn enables bark beetles to enter the tree, and can kill the tree within one month. This is how the pathogen received the name sudden oak death (Kay 2000). This rapid spreading disease is extremely damaging to the foothill oak woodlands, and needs to be terminated. With the participation of others along with implementing conservation and preservation techniques, this disease could be slowed and eventually stopped.

California’s foothill oak woodlands face a myriad of threats from various sources. A great majority of these were from anthropogenic causes. When the Spaniards entered California, they
brought over their intensive agricultural and animal husbandry practices along with non-native species. The continuous and increasing use of these methods have led to a growing problem of regeneration for the oak species within the woodlands. This can eventually eradicate endemic species, which would cause chaos to the region. Development is the main threat that the foothill oak woodlands face, and causes the habitat to shrink even further. Another issue that the region faces is climate change. Studies have shown a decrease in species along with a decrease and shift in habitat range. Finally, sudden oak death is a rapidly spreading disease that attacks oak species in the foothill oak woodlands, and contributes to the decrease in species within the region. All of these threats are examples as to why it is extremely pressing to begin enforcing restoration and conservation techniques upon California’s foothill oak woodlands.
Chapter 5 Restoration and Conservation

In order to save California’s foothill oak woodlands from further damage, it is important to begin conservation efforts. To achieve sustainability and to conserve this vital region, promoting diversity is key. Keeping California’s foothill oak woodlands as the most biologically diverse region of the state can be protected through several techniques. Creating preserves and parks in the oldest method that is used. Another way to maintain the foothill oak woodlands is through regeneration practices along with habitat restoration. Wildland management is also crucial in preserving the region. Lastly, education is essential and is the best way to save California’s foothill oak woodlands. All of these techniques can be utilized in order to sustain this small, yet vital area of California.

Preservation of the foothill oak woodlands can be created through preserves and parks. This is the oldest and most commonly used approach in California. These parks and preserves can be created through publicly held land that is managed by various agencies. These preserves are extremely important and can run from a few to thousands of acres of land. If the parks and preserves are publicly held land, they have to allow recreational uses on the sites as well. However, there are strict guidelines that should be followed in order to promote eco-friendly values so the habitat will be prevented from further damage. Even though publicly held preserves and parks contain more land, privately held preserves are extremely valuable. Privately held preserves usually take action by executing exceptionally challenging restoration programs that involve naturally sensitive areas. This is sometimes preferable because its central focus is on protecting and preserving ecologically sensitive and damaged areas (Johnson, Muick, Pavlik, & Popper 1991). These parks and preserves, whether they’re held publicly or privately, are useful to the foothill oak woodlands because ecological values and protection of sensitive areas are
promoted and implemented. It also helps the public become aware of the issues the region faces, and can encourage public participation in these efforts.

The regeneration issue that the foothill oak woodlands face can be helped through natural or artificial regeneration practices. Natural regeneration is most effective when it comes to sustainably managing an area. Having knowledge on the types of oak trees and their physiological requirements is key in order for natural regeneration to successfully occur. This is extremely vital in order for the acorn to germinate and grow into a sapling. Another way to promote successful germination for natural regeneration is to perform a prescribed fire or scarification before acorn production. The last step is to monitor the seedlings and making sure there is enough light. The other form of promoting regeneration is through artificial regeneration (Standiford 1996).

Artificial regeneration is the process of physically planting acorns and monitoring them in a “pampered environment” (McCreary 2010). The first step in artificially regenerating oak trees is to collect acorns. There are several stipulations to take into account when it comes to collection. First, acorns must be gathered near the site they will be planted in. Secondly, they should be collected from the trees because that is when they are deemed healthiest. The acorns should be gathered in early fall, just before harvest season. Lastly, they need to be stored, and the caps need to be taken off of the acorns before being placed in the refrigerator. If some acorns were collected from the ground, they need to be soaked in water. Floating acorns are indicators of disease or insect infestation, and should be thrown away. After collecting and storing the acorns, the next step is planting. They can be planted in early November until March, but planting the earlier allows for longer growth time. The acorns should be planted one inch deep into the soil, and should be monitored closely until the process of regeneration has been successful.
Using natural or artificial regeneration in California’s foothill oak woodlands would be extremely beneficial since some of the endemic oak species in the region are suffering from lack of regeneration.

Another form of conserving the area is habitat restoration, which is a relatively new program. It is usually specific to the site that is under consideration, and includes a variety of processes. Habitat restoration really focuses on protecting and sustaining the region. It can be a part of regeneration efforts in that it includes the planting of trees and acorns. Habitat restoration can also include eradicating non-native and invasive species along with reintroducing native species. Lastly, it can help with decreasing livestock grazing (Johnson, Muick, Pavlik, & Popper 1991). Habitat restoration is beneficial to the woodlands because it promotes sustainability and native plant regeneration. It is also helpful in that it promotes participation by getting the public involved in volunteering to complete the processes listed above. This in turn, educates the public upon the issues that the foothill oak woodlands face, and how these efforts can restore the vital region.

Wildland management is also extremely important in preserving California’s foothill oak woodlands. As stated previously, grazing animals are extremely detrimental to the region. If the correct wildland management practices are put into action, livestock and the foothill oak woodlands could potentially live harmoniously with little or no negative impacts. There are three important aspects of wildland management in order for it to be executed successfully. The first is to decrease livestock animals so there is less of an impact on the region. Secondly, the timing and length of grazing needs to be taken into account. Grazing in one area for a long period of time can be extremely detrimental especially if it is during early fall and spring when acorn production and germination takes place. Lastly, rotating pastures helps in making sure that one
area is not overgrazed and permanently damaged (Standiford 1996). Due to the prevalent use of agriculture in the foothill oak woodlands, these management practices would be extremely advantageous to the region especially if every farmer and rancher implemented these ideas.

Lastly and more importantly, education is absolutely key in conserving California’s foothill oak woodlands. Knowledge is crucial when it comes to effectively executing sustainable practices, and education is the best way to preserve the foothill oak woodlands. In knowing that the species and habitat of the region are irreplaceable, it can jumpstart conservation efforts throughout the state. Getting individuals to participate in restoration efforts helps the agencies that manage the preserves, parks, and land to maintain the diversity of the foothill oak woodlands in a sustainable manner. In educating people on the importance of preserving the foothill oak woodlands, it could greatly increase the actions and endeavors to sustain this threatened and extremely vital region of California.

Each of these conservation efforts are extremely beneficial to California’s foothill oak woodlands, and could help save it from the persistent threats the region encounters. Maintaining the foothill oak woodlands diversity through parks and preserves is the oldest and most commonly used method. The regeneration issue has been fought through natural and artificial regeneration practices throughout the region. By planting and monitoring acorns through the germination process, it has increased the success rate of growing into saplings. Habitat restoration has also been extremely helpful to the foothill oak woodlands through the planting of acorns and trees, getting rid of invasive species while reintroducing native species, and decreasing livestock grazing. It is a relatively new program, so studies still need to be done in order to tell its overall effectiveness. However, it has had positive results thus far. Since agriculture and animal husbandry practices have been introduced to California, it has had severe
impacts on the region. Wildland management practices should be implemented in order to reduce
the negative harm grazing livestock has upon the region. Lastly, education is extremely vital in
saving California’s foothill oak woodlands. Knowledge is key in promoting diversity and
sustainability efforts. The foothill oak woodlands is in dire need of restoration, and if each of
these conservation efforts are put into practice it could drastically improve and enable the region
to survive for future generations.
Chapter 6 Conclusion

California’s foothill oak woodlands may be a small region, but it is extremely important for a myriad of reasons. Due to this, it is absolutely imperative for the foothill oak woodlands to be preserved, restored, and conserved. It is the most biologically diverse region within the state of California, and lies within the California Floristic Province. The foothill oak woodlands contain a colossal amount of endemic species that share an intricate symbiotic relationship with other diverse species and the habitat. If the region suffers any more damage, habitat loss, or decrease in species populations it could have detrimental effects. Due to the region being a hotspot, the habitat is irreplaceable to these species, and if it is lost some of these species could go extinct. This is one of the main reasons as to why conserving this region is critical.

The woodlands are not only important to wildlife and plant life, but were vital to human survival as well. California’s foothill oak woodlands are rich in cultural history, and endured the Native American, Spaniard, Mexican, and Gold Rush periods. Even though this region is vital in human history, it was the beginning of the rapid change in landscape the foothill oak woodlands endured. The impacts that the Spaniard, Mexican, Gold Rush, and modern populations had on the region were extremely detrimental, and are the cause of the multiple threats the woodlands continue to endure.

Some of these threats are fast acting and extremely harmful to the foothill oak woodlands, which is why conservation and restoration efforts need to take place now. This region is extremely paramount to California for its biological diversity and cultural history. If efforts are not taken to stop regeneration issues, sudden oak death, and prevent climate change, loss of habitat, species displacement, and extinction will occur. By implementing conservation efforts through preserves, natural and artificial regeneration, habitat restoration, wildland management,
and education, it is possible to save the woodlands from further damage. It is crucial for California’s foothill oak woodlands to be restored and conserved in order for it to thrive and endure in future generations, and the time to take action is now.
Bibliography


