# LIVING WITH FIRE

Mohan Wang Master of Landscape Architecture Rhode Island School of Design

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Mohan Wang
M. Landscape Architecture Thesis 2022
Rhode Island School of Design

Thesis Book was written and designed by Mohan Wang



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**LIVING WITH FIRE**

A thesis submitted in partial fulfillment of the requirements for the Master of Landscape Architecture Degree in the Department of Landscape Architecture of the Rhode Island School of Design, Providence, Rhode Island

By Mohan Wang
Date 05/28/2022

**Approved by Masters Examination Committee:**

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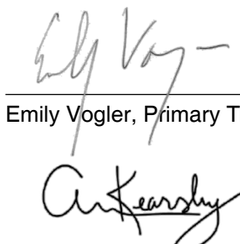


Emily Vogler, Primary Thesis Advisor



Ann Kearsley, Secondary Thesis Advisor

## Content

**Abstract**

For decades, landscape architects have been working with water, proposing vocabularies like sponge parks, rain gardens, emergent shorelines, and hydrologic urbanism. Surviving with water is common sense. However, there is not enough landscape design research and practice when it comes to another destructive natural force - fire. The new normal is that people are being exposed to more frequent and catastrophic wildfires and the burn-on-burn phenomenon is becoming common. With climate change and sprawling land-use patterns that increase the wildland-urban interface, a greater number of communities are having to adapt to living with fire. Landscape architects are in need to play a more significant role in establishing a beneficial and sustainable human-fire relationship.

Based on the study of the historic and modern prescribed burning, fire-mitigation, and post-fire recovery strategies, this thesis focuses on the wildland-urban interface and the Mediterranean ecosystem in the Santa Monica Mountain region. By transforming a ranch into a fire educational park and proposing multifunction installations as markers in fire-touched wildland, the thesis aims to convey new attitudes towards the fire landscape and initiate aesthetic and ecological dialogues on innovative ways of living with fire.

## Lexicon

### Wildland-Urban Interface (WUI)

The WUI is the zone of transition between unoccupied land and human development. It is the line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. [1]

### Landscape Resiliency

Landscape resilience refers to the ability of a landscape to sustain desired ecological functions, robust native, biodiversity, and critical landscape processes over time, under changing conditions, and despite multiple stressors and uncertainties. [2]

### Prescribed Burning

A controlled or prescribed burn, also known as hazard reduction burning,backfire, swelling, or a burn-off,is a fire set intentionally for purposes of forest management, farming, prairie restoration or greenhouse gas abatement. [5]

### Traditional Ecological Knowledge (TEK)

Traditional ecological knowledge (TEK) describes indigenous and other traditional knowledge of local resources. As a field of study in Northern American anthropology. [6]

### Good Fire

Refers to the fire that Indigenous tribes use to manage natural resources increase soil fertility, and promote the production of foods such as acorns and huckleberries. [3]

### Fire Mosaic

Applying planned fire at varying intensities, scales and times within a broader landscape to create patches (a mosaic) of burnt and unburnt areas that change over time. [4]

### Systematic Fire Suppression

Fire Suppression Systems are used to extinguish, control, or in some cases, entirely prevent fires from spreading or occurring. [7]

### Fuel Loads

The total quantity of combustible contents of a building, space, or fire area, including interior finish and trim, expressed in heat units or the equivalent weight in wood. [8]

1 “What Is the WUI?” U.S. Fire Administration, 9 July 2021, https://www.usfa.fema.gov/wui/what-is-the-wui.html.

2 “Operationalizing Landscape Recilience”, Erin Beller , April Robinson , Robin Grossinger, Letitia Grenier, Audrey Davenport, Erica Spotswood,resilientsv.sfei.org

3 Indigenous Tribes Restore Prescribed Burns in California. https://www.nature.org/en-us/magazine/magazine-articles/indigenous-controlled-burns-california/. Accessed 17 May 2022.

4 “Landscape Mosaic Burns” Department of Sustainability and Environment, https://cliffcare.files.wordpress.com/2012/08/landscape_mosaic_burning_factsheet_jun10.pdf

5 “Controlled Burn.” Wikipedia, 9 May 2022. Wikipedia, https://en.wikipedia.org/w/index.php?title=Controlled_burn&oldid=1087020455.

6 “Traditional Ecological Knowledge.” Wikipedia, 4 May 2022. Wikipedia, https://en.wikipedia.org/w/index.php?title=Traditional_ecological_knowledge&oldid=1086179243.

7 “Fire Suppression System.” Wikipedia, 3 Aug. 2021. Wikipedia, https://en.wikipedia.org/w/index.php?title=Fire_suppression_system&oldid=1036954439.

8 NFPA 921, 2017, 3.3. 93

### Urban Growth Boundary

An urban growth boundary, or UGB, is a regional boundary set in an attempt to control urban sprawl by, in its simplest form, mandating that the area inside the border be used for urban development and the area outside be preserved in its natural state or used for agriculture. [9]

### Urban Sprawl

The rapid expansion of cities and towns' geographic extent is often characterized by low-density residential housing, single-use zoning, and increased reliance on the private automobile for transportation. [10]

### Vegetation Type Conversion (VTC)

Type conversion is the ecological change from one type of plant community to another, either through disturbance or some other environmental change. For example, when chaparral type converts, it typically changes from native shrubland to non-native grassland. [13]

### Defensible Space

Defensible space is the buffer you create between a building on your property and the grass, trees, shrubs, or any wildland area surrounding it. [11]

### Habitat Fragmentation

Habitat fragmentation is when a large expanse of habitat is transformed into several smaller patches of smaller total area isolated from each other by a matrix of habitats unlike the original. [12]

### Foehn Wind

Foehn wind is a type of dry, warm, down-slope wind that occurs in the lee of a mountain range. It is a rain shadow wind that results from the subsequent adiabatic warming of air that has dropped most of its moisture on windward slopes. [14]

9 "Urban Growth Boundary." Wikipedia, 1 Mar. 2022. Wikipedia, https://en.wikipedia.org/w/index.php?title=Urban_growth_boundary&oldid=1074585811.

11 "Defensible Space." Ready for Wildfire, https://www.readyforwildfire.org/prepare-for-wildfire/get-ready/defensible-space/. Accessed 17 May 2022.

10 Urban Sprawl | Definition, Examples, Problems, Causes, & Alternatives | Britannica. https://www.britannica.com/topic/urban-sprawl. Accessed 17 May 2022.

12 Habitat Fragmentation - an Overview | ScienceDirect Topics. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/habitat-fragmentation. Accessed 17 May 2022.

13 Too Much Fire. https://californiachaparral.org/threats/too-much-fire/. Accessed 17 May 2022.

14 "Foehn Wind." Wikipedia, 15 May 2022. Wikipedia, https://en.wikipedia.org/w/index.php?title=Foehn_wind&oldid=1087958772.

# It is time to think about a new human-fire relationship

**Introduction**

As part of the natural ecosystem, fire has played an essential role in human history. People captured fire ignited by lighting and utilized it for protection, heating, hunting, forestry, and agriculture production, controlling soil fertilization and plants growth.[15] However, the human-fire relationship is complicated, like the human-water relationship encompassing negative and positive aspects. Dealing with these natural forces is always about natural resource management. In the different periods in the United States history, people have dealt with varying fire issues. In the pre-colonization period, fire is mainly modified by indigenous people. From 1910 to 1970, experiencing a frontier fire, backcountry fire, and mass fire, the land was managed by hour control and conflagration control, leading to a large amount of fuel accumulation. From 1971 to the present day, people have been working on wildfires by combining fuel modification strategies and prescribed burning practices.[16] Fire is not always destructive, 'Good fire' refers to the controllable, low-temperature fire set mainly by humans to burn the over-accumulated fuels.[17]

To further elaborate, when the fire is limited in shrub height, it is manageable since it is easier to be put off. However, it becomes a disaster when wildfire expands to tree crowns transported by wind from one forest to another. The former type of fire has excellent cultural and recreational values and can improve biodiversity by increasing soil nutrients and assisting plants regeneration.[18] In the old days, indigenous people worldwide applied these "good fires" to their lands, and some of the ancient fire landscape patterns can still be recognized today.[19] Thus, more resiliency than complete suppression should be discussed when considering fire management under climate change and urbanization. And what landscape architects could help with living with fire is worthy of being explored.

15 Pyne, Stephen J. Fire in America: A Cultural History of Wildland and Rural Fire. University of Washington Press, 2017.
16 Pyne, Stephen J. Fire in America: A Cultural History of Wildland and Rural Fire. University of Washington Press, 2017.
17 Cagle, Susie. "'Fire Is Medicine': The Tribes Burning California Forests to Save Them." The Guardian, 21 Nov. 2019. The Guardian, https://www.theguardian.com/us-news/2019/nov/21/wildfire-prescribed-burns-california-native-americans.
18 "Quiet Fire." The Nature Conservancy, https://www.nature.org/en-us/magazine/magazine-articles/indigenous-controlled-burns-california/. Accessed 18 Apr. 2022.
19 "Good Fire Podcast." YourForest, https://yourforestpodcast.com/good-fire-podcast. Accessed 18 Apr. 2022.

Fig 1. Prairie on Fire.

Chapter One

# The New Fire Normal

Fig 2. The Paradise Community After A Wildfire

**Increasing Threats of Wildfire**

In recent summers, people have been exposed to deadly wildfires worldwide, especially in Australia and California. Residents in those areas suffer from severe drought, property loss, life-threatening, and other post-fire impacts. The biodiversity damage caused by mega-fire makes the whole natural system more susceptible to natural disasters, leading to a vicious ecological-degrading loop. [20] It is time for society to rethink cities' future and how people deal with fire.

According to the research from NASA earth observatory, [21] enormous wildfires are happening globally, among which burn-on-burn is becoming common. This means habitats that experienced fire can not get enough time to recover before the subsequent fires. [22] As a result, the repetitive action of burning-rebuild-burning will happen more and more frequently. Therefore, facing a new fire normal, a collaborative effort should be made between fire experts, firefighters, government, urban planners, and landscape architects to invoke the discussion, educate the fire-prone communities about the situation and prepare them for a more resilient future.

In the United States, most wildfires occur in the southern and western states. However, some areas are easier to catch fire because of their drought weather and plants compositions. Among all vegetation land cover, conifer forests, shrubland, and grassland are the majority types of habitat that are frequently burned.  Overtimes, some plants are getting adapted to the fire by growing thick barks, stiff cones (Jackpine), and tall crowns (stone pine), [23] and some even require fire to resprout (Australian Gum tree). [24]

20 Scott, Andrew C., et al. "The Interaction of Fire and Mankind: Introduction†." Philosophical Transactions of the Royal Society B: Biological Sciences, vol. 371, no. 1696, June 2016, p. 20150162. royalsocietypublishing.org (Atypon), https://doi.org/10.1098/rstb.2015.0162.
21 Earth Matters - 6 Trends to Know about Fire Season in the Western U.S. NASA Earth Observatory, 29 Nov. 2018, https://earthobservatory.nasa.gov/blogs/earthmatters/2018/11/29/6-trends-to-know-about-fire-season-in-the-western-u-s/.
22 Too Much Fire. https://californiachaparral.org/threats/too-much-fire/. Accessed 3 Apr. 2022.
23 5 Amazing Adaptations of Pyrophytic Plants | Britannica. https://www.britannica.com/list/5-amazing-adaptations-of-pyrophytic-plants. Accessed 18 Apr. 2022.
24 How Trees Survive and Thrive After A Fire. https://www.nationalforests.org/our-forests/your-national-forests-magazine/how-trees-survive-and-thrive-after-a-fire. Accessed 18 Apr. 2022.



Figure 3. Satellite Image of Fire Paradise, California

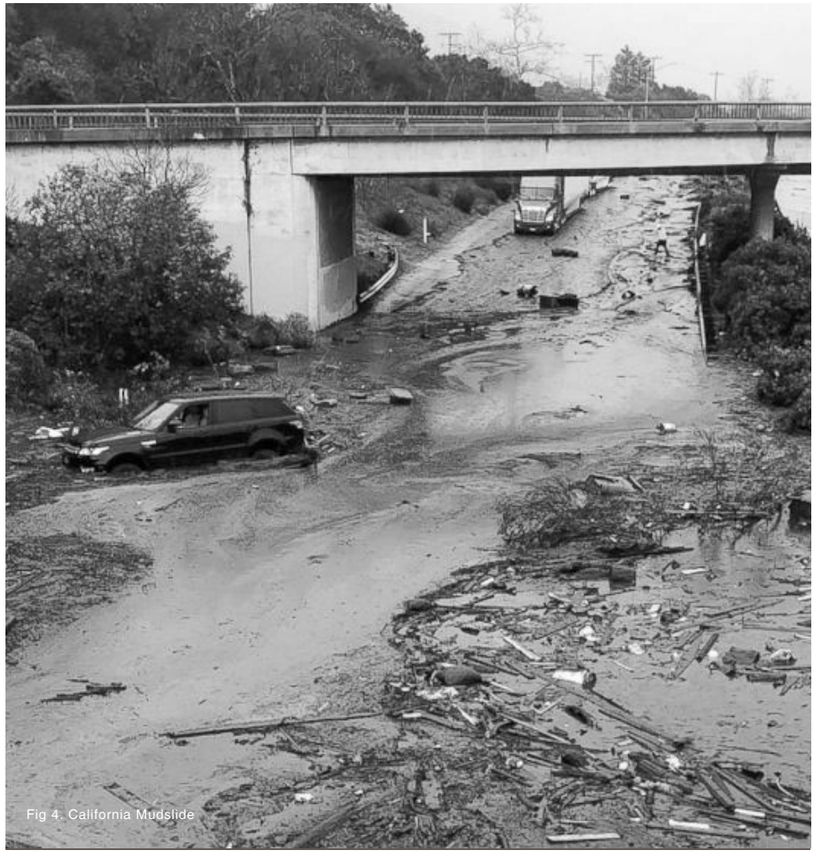
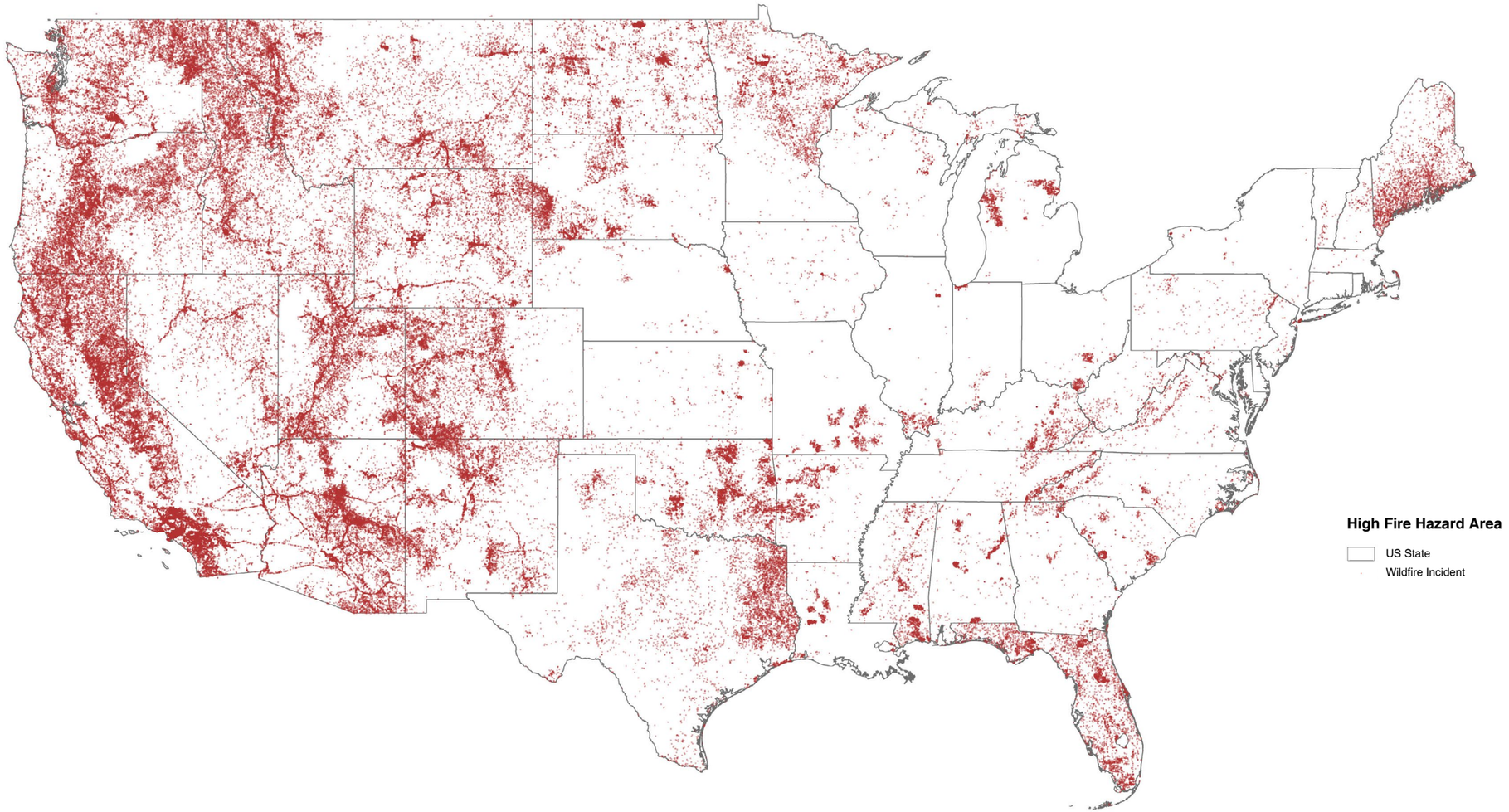


Fig 4. California Mudslide

**Post-Fire Debris Flow**
Wildfires usually cause debris flows since fires kill plants and heat the soil. When heavy rain, mudslides happen, causing severe soil erosion and destroying properties.

Fig 5. Australian Fire Tornado

**Fire Tornado**
Wildfires also change climates, especially when it meets the intense wind. A fire tornado is when a fierce fire is blown up by the high-speed wind creating a tornado with fires.


High Fire Hazard Area
US State
Wildfire Incident

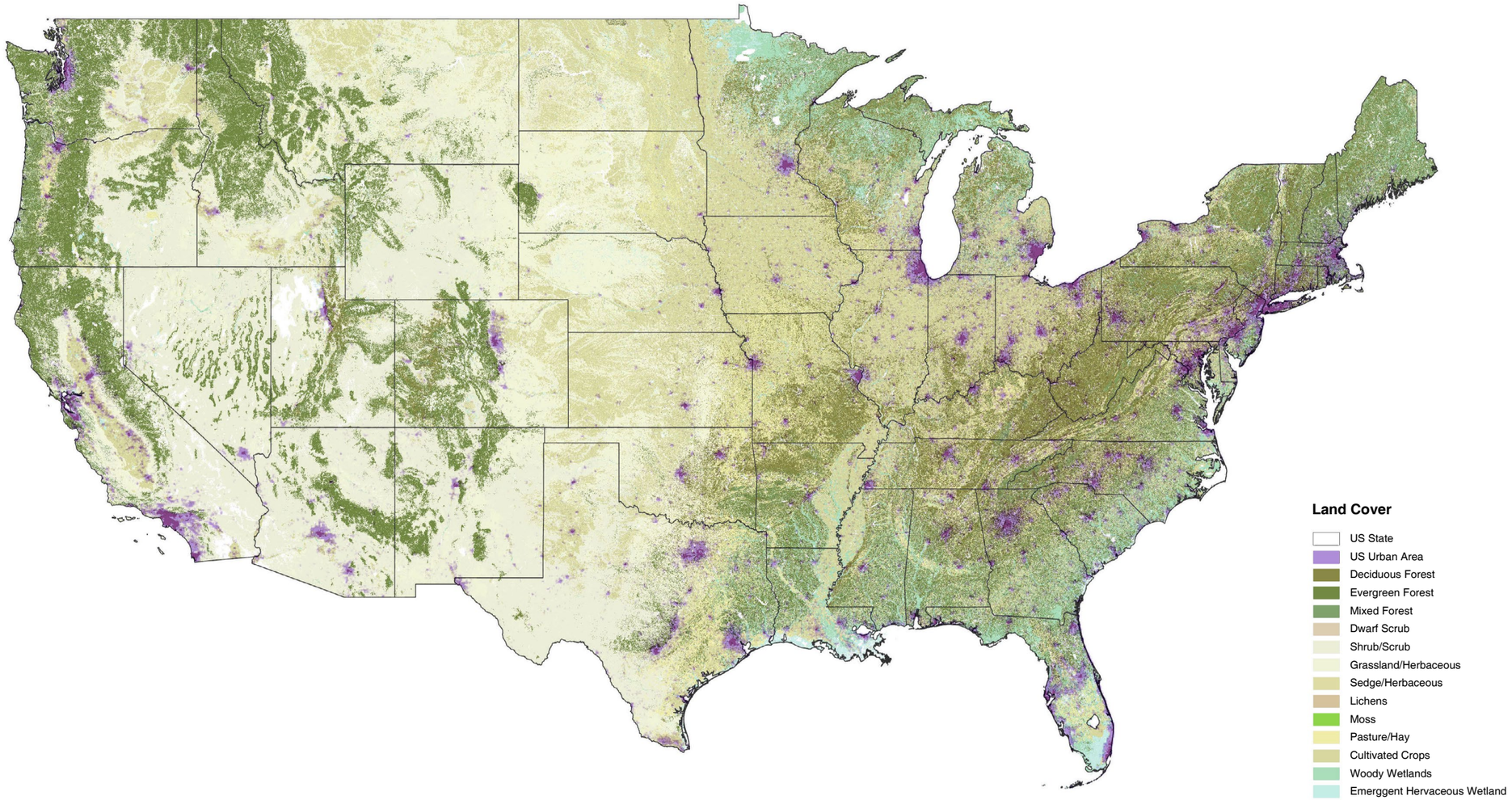

Land Cover
US State
US Urban Area
Deciduous Forest
Evergreen Forest
Mixed Forest
Dwarf Scrub
Shrub/Scrub
Grassland/Herbaceous
Sedge/Herbaceous
Lichens
Moss
Pasture/Hay
Cultivated Crops
Woody Wetlands
Emerggent Hervaceous Wetland

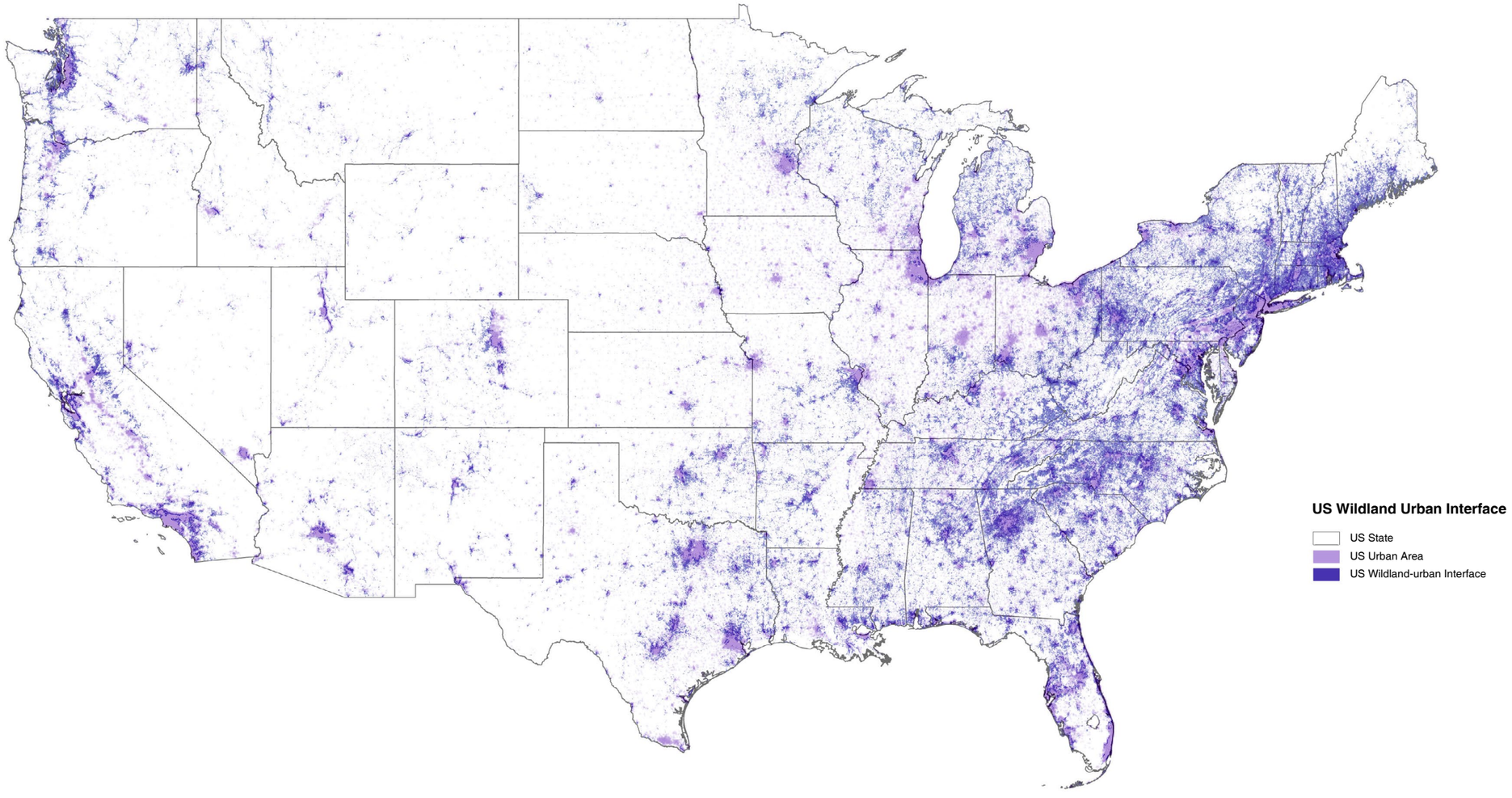
Fig 6. Fire Smoke

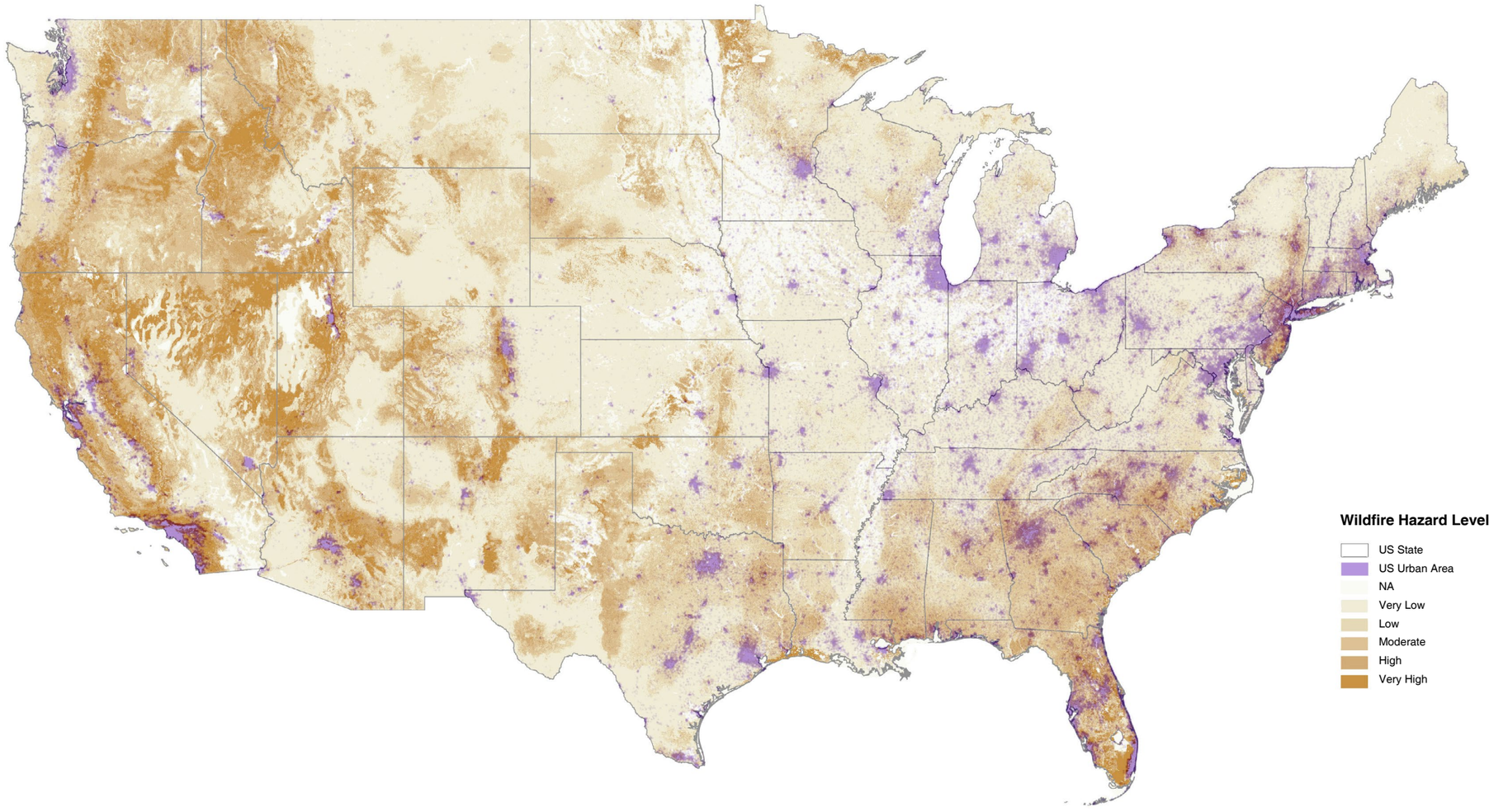


**Wildland-Urban interface is the fastest growth landcover in the United States**

Wildland-urban interface is where urban development meets with suburban and natural landscapes. Depending on the level of human occupation, it is also further divided into intermixed areas and the interface area. The thesis chose to study these types of land because there are intensive human and nature conflicting issues. [25] More specifically, it is the forefront place where people suffer from wildfire disasters and natural conservation conducted. Therefore, it would work as an excellent experiment site discussing topics of living with fire. [26]

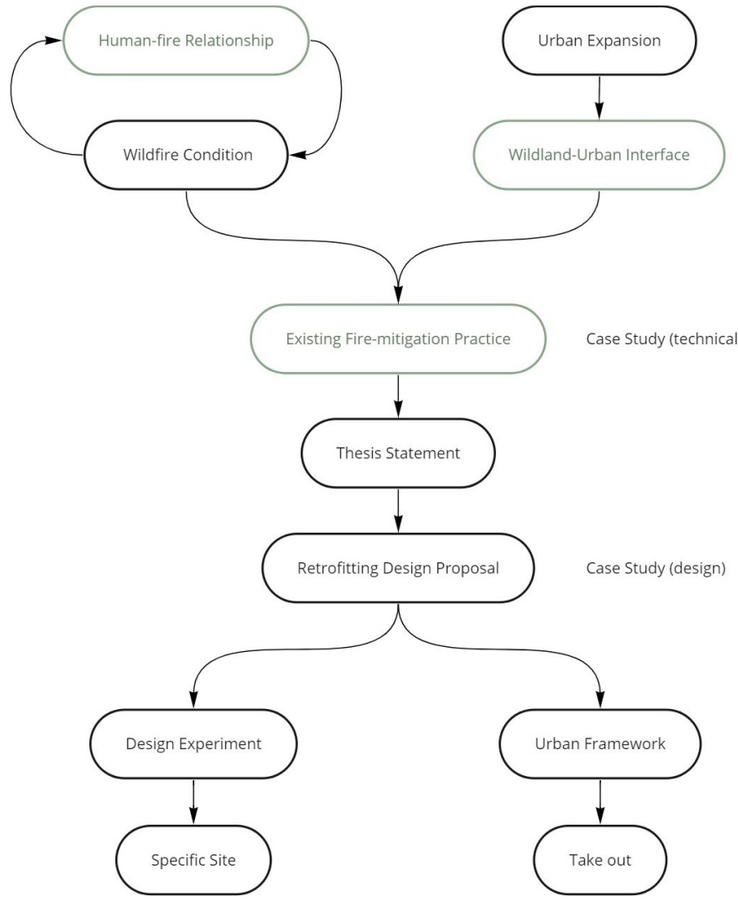
25 “Wildland–Urban Interface.” Wikipedia, 22 Mar. 2022. Wikipedia, https://en.wikipedia.org/w/index.php?title=Wildland%E2%80%93urban_interface&oldid=1078712441.
26 Keeley, Jon, et al. Challenges of Managing Fires along an Urban-Wildland Interface–Lessons from the Santa Monica Mountains, Los Angeles, California. Jan. 2004. University of Washington Press, 2017.


US Wildland Urban Interface
US State
US Urban Area
US Wildland-urban Interface


Wildfire Hazard Level
US State
US Urban Area
NA
Very Low
Low
Moderate
High
Very High

## Thesis Question


- What role can landscape architects play under the new normal with more frequent and intensive fire?
- What kind of attitudes, knowledge, views, and emotions are valuable to be conveyed and presented in the fire educational park, the hub?
- How do multifunction installations as field campuses add ecological and cultural value to fire-touched wildland?
- How can design respond to seasonal change and the long-term evolution of fire landscapes?



Chapter Two

# Dealing With Fire

Fig 9. Bonfire

**North America**
**Human & Fire Relationship History**


**Before 1800s Indigenous American**
Regularly burning practice.

**Industrial Forestry & National Conservation Park System**
Exclude indigenous people and require large scale fire suppression.

**Smoky Bear Campaign**
Start journey of fire extrusion causing heavily accumulated fuel load.

**Restoration of Prescribed Burning**
In order to a health ecosystem and preserve wildness.

**Prescribed Fire Education**
Set in indigenous conservation and governments' experimental area.

**What will be the future like?**

### Indigenous Forest Management

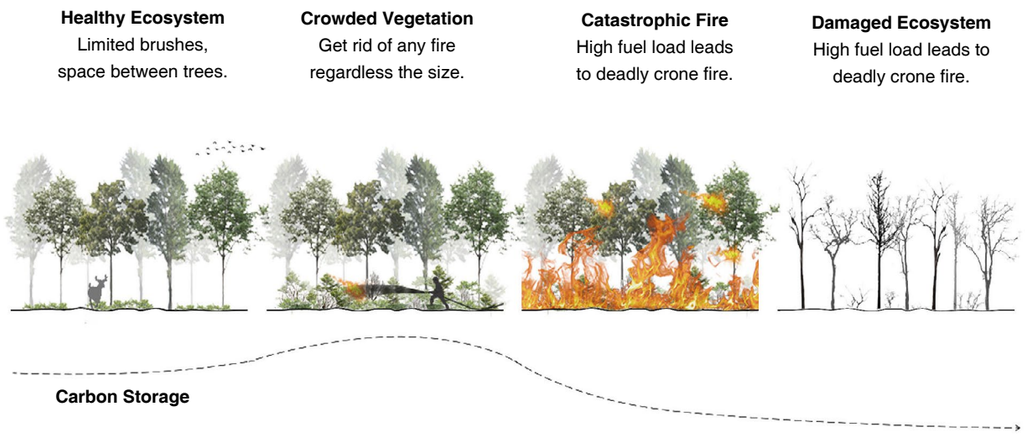
Indigenous people have managed forests for thousands of years. By studying their traditional ecological burning knowledge, basic strategies can be concluded. In the short forest growing terms, indigenous people periodically trim shrub plants to limit the fuel loads. [27] Then, when there accumulated too many fuels or encountered an untouched forest, they would use cultural burning to get rid of the ground and middle layer vegetation to create space for agriculture or hunting. [28] This practice usually happens in early spring or late summer, depending on local weather, humidity level, and vegetation types. [29] Besides, time of the day, wind direction, and speed are other crucial elements that need to be considered to determine when and where to set fire since people don't want escaped fire causing disasters. [30] These two strategies were conducted regularly to protect a forest from large uncontrollable wildfires throughout the year. [31]

27 Cagle, Susie. "'Fire Is Medicine': The Tribes Burning California Forests to Save Them." The Guardian, 21 Nov. 2019. The Guardian, https://www.theguardian.com/us-news/2019/nov/21/wildfire-prescribed-burns-california-native-americans.
28 Cagle, Susie. "'Fire Is Medicine': The Tribes Burning California Forests to Save Them." The Guardian, 21 Nov. 2019. The Guardian, https://www.theguardian.com/us-news/2019/nov/21/wildfire-prescribed-burns-california-native-americans.

### Agricultural Prescribed Burning

Fire is also widely used in agriculture management, especially in shifting agriculture. The two primary purposes of using prescribed burning in pasture land are to control weeds from growing and prevent woodland from intruding. In addition, farmers set fires to help plants that have dominant seeds or are located beneath the soil regenerate, improving land biodiversity since fire produces food that attracts animals and insects. Different plant species can germinate after a "cool fire." In shifting agriculture, lands are burned within a specific period in a sequence that provides a resting time that makes production more efficient and sustainable. However, there are strict procedures that farms are required to follow, like forest management. No one wants the fire to be expanded to undesirable land.

29 Pyne, Stephen J. Fire in America: A Cultural History of Wildland and Rural Fire. University of Washington Press, 2017.
30 Eriksen, Christine, and Don L. Hankins. "The Retention, Revival, and Subjugation of Indigenous Fire Knowledge through Agency Fire Fighting in Eastern Australia and California." Society & Natural Resources, vol. 27, no. 12, Dec. 2014, pp. 1288–303. DOI.org (Crossref), https://doi.org/10.1080/08941920.2014.918226.
31 "Good Fire Podcast." YourForest, https://yourforestpodcast.com/good-fire-podcast. Accessed 18 Apr. 2022. 13 Cagle, Susie. "'Fire Is Medicine': The Tribes Burning California Forests to Save Them." The Guardian, 21 Nov. 2019. The Guardian, https://www.theguardian.com/us-news/2019/nov/21/wildfire-prescribed-burns-california-native-americans.



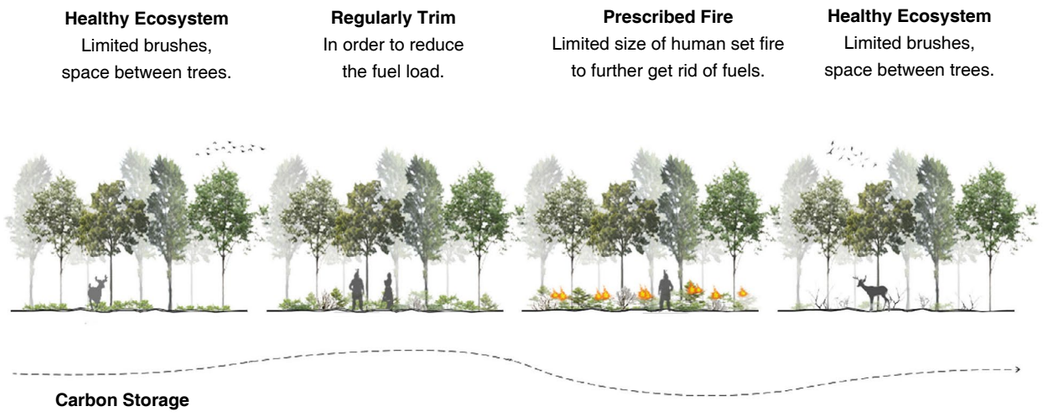
### Industrial Forestry Management

Industrial forestry management is the opposite of indigenous forest management in the early stage. Trees under this circumstance are commercially valuable resources to companies and the public. Any fire would harm the quantities or quality of log products. Industrial forest managers were responsible for putting off any fire when it started.[32] As time went by, more and more fuels accumulated in the industrial forests. It became catastrophic once they caught fire. Everything was burnt, destroying the habitats and causing subsequent problems like soil erosion and air pollution, [33] which not only influences the industrial forests but also deteriorates the whole ecosystem. Nowadays, with more people realizing the downside of massive fire suppression, industrial forests owners have started experimenting with combining prescribed burning in the management. [34]

### Other Habitat Prescribed Burning

Besides the industry mentioned above, prescribed fire can also be applied in other habitat management. Some of the well-known ones are prairies, savannas, and some shrubland. Prairie refers to an ecosystem that is mainly dominated by grass. Because of the unique flat topography in the Great Plains, prairies there are widely managed by fire. The reasons are similar, to preventing weeds from growing and improving soil nutrients and biodiversity. However, large-scale prescribed burning is not recommended in southern California chaparral, coastal sage, and oak savanna habitats because there are too many fires for the habitat to recover. To conclude, even though prescribed burning is a very effective strategy, careful site analysis regarding local fire frequency, weather, and topography should be studied before deciding whether to apply it.

32 “U.S. Forest Service Fire Suppression.” Forest History Society, https://foresthistory.org/research-explore/us-forest-service-history/policy-and-law/fire-u-s-forest-service/u-s-forest-service-fire-suppression/. Accessed 18 Apr. 2022.
33“Air Pollution Is Ravaging What’s Left of California’s Native Coastal Sage Scrubland.” ANR Blogs, https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=16524. Accessed 13 Apr. 2022.
34 Pyne, Stephen J. Fire in America: A Cultural History of Wildland and Rural Fire. University of Washington Press, 2017.



**“Fear of fire is what brought us to this place where we are at today, where we really have a reason to fear fire.”**

**—Leaf Hillman, Director of Natural Resources and Environmental Policy, Karuk Tribe**

**Fire Sectional Impact**

It is crucial to thinking fire’s impact on the ecosystem sectionally. The particles created by burning turn into smoke, and high heat destroys deep roots making the soil unhabitable.



## Strategy Study 01: Patch Burning

Fig 10. Fire Corridor Of Prescribed Burning

Patch burning is a section of a landscape or management unit that has been prescribed burned. People conduct this burning to eliminate excessive fuel loads in the forests, thus preventing large wildfires.

Fig 11. Fire Patches Of Prescribed Burning

Patch burning can be applied in many different ways, considering the site's topography, land cover, wind speed, and humidity at the burning time.  Farmers use prescribed burning to prepare lands for shifting agriculture and increase the soil's nutrients.

## Strategy Study 02: Fire Break

Fig 12. Fire Break

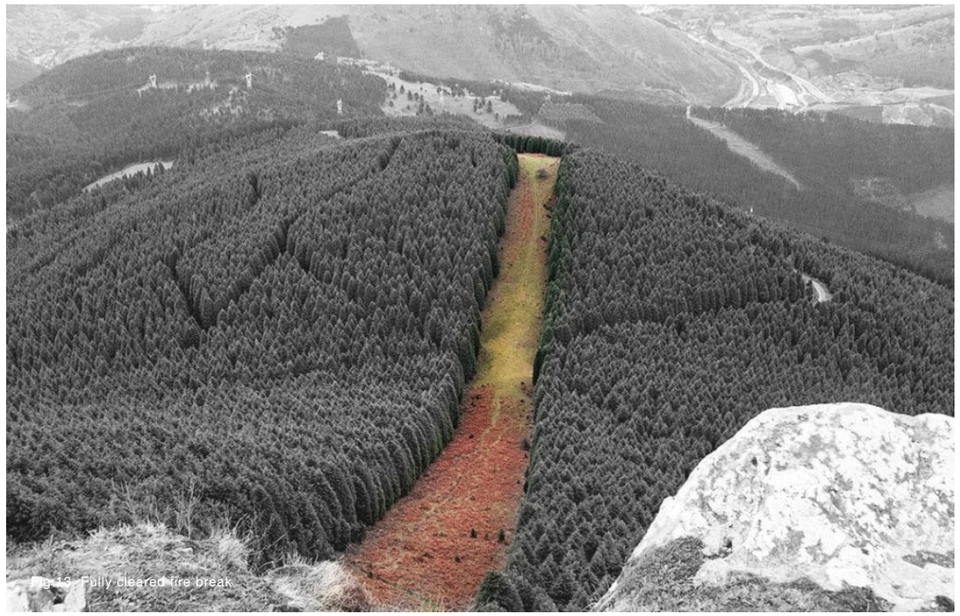
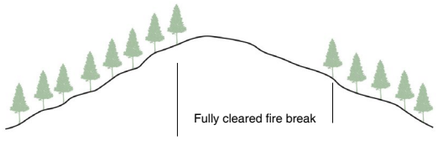
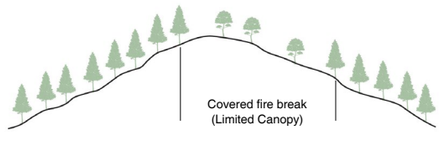
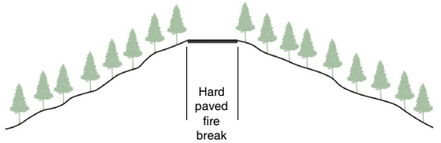


Fig 13. Fully cleared fire break

Also called fire line and fuel break, is a gap in vegetation or other combustible material that acts as a barrier to slow or stop the progress of a bushfire or wildfire.



## Strategy Study 03: Pyrophyte (Fire-tolerant Plant)

Fig 14. Burning in the Forest

Fig 15. Ponderosa pine with a healed scar caused by frequent, low-intensity fire

Pyrophytes are plants which have adapted to tolerate fire.

**Passive Pyrophytes**
Plant resist the effects of fire, particularly when it passes over quickly, and hence can out-compete less resistant plants, which are damaged.

**Active Pyrophytes**
With a similar competing advantage to passive pyrophytes, but they also contain volatile oils and hence encourage the incidence of fires which are beneficial to them.

**Pyrophile**
Plants require fire in order to complete their cycle of reproduction.

## Strategy Study 04: Fire Retardant

Fig 16. A Neptune Aviation air tanker working the King Fire in California.

A fire retardant is a substance that is used to slow down or stop the spread of fire or reduce its intensity. This is commonly accomplished by chemical reactions that reduce the flammability of fuels or delay their combustion.

## Strategy Study 05: Wildfire Smoke Monitor

Fig 17. Environmental Beta Attenuation Monitors

A wildfire smoke monitor is a tool for fire danger prevention and operational fire-fighting decision. It monitors the smoke and delicate particulate matter emitted from burning.

Fig 18. Overview Fire

**Cultural Value of Fire**

Does fire have cultural values? What role does fire play in myths and legends of different cultures? Do people celebrate fire? How? And what kind of activities and space forms are related to fire?

Fire is a mysterious and tremendous power. Starting from the first combustion bringing warm and bright, people's interaction with fire never stops. Aside from destruction, fire also represents renewal and rebirth, regarding things tuning into ashes and the post-fire scene of plants sprouting and new buildings being reconstructed. People like to celebrate around the bonfire. [35] There are famous night festivals like British Guy Fawkes Night and Scandinavia's Walpurgis Night. During those events, hundreds of people dance and sing with fire. They jump through it and burn aromatic plants. Artists painted fire-burning cities, landscapes, and lives as well as happiness and celebrations, which recorded the fear and beauty that shaped the culture throughout history. [36]

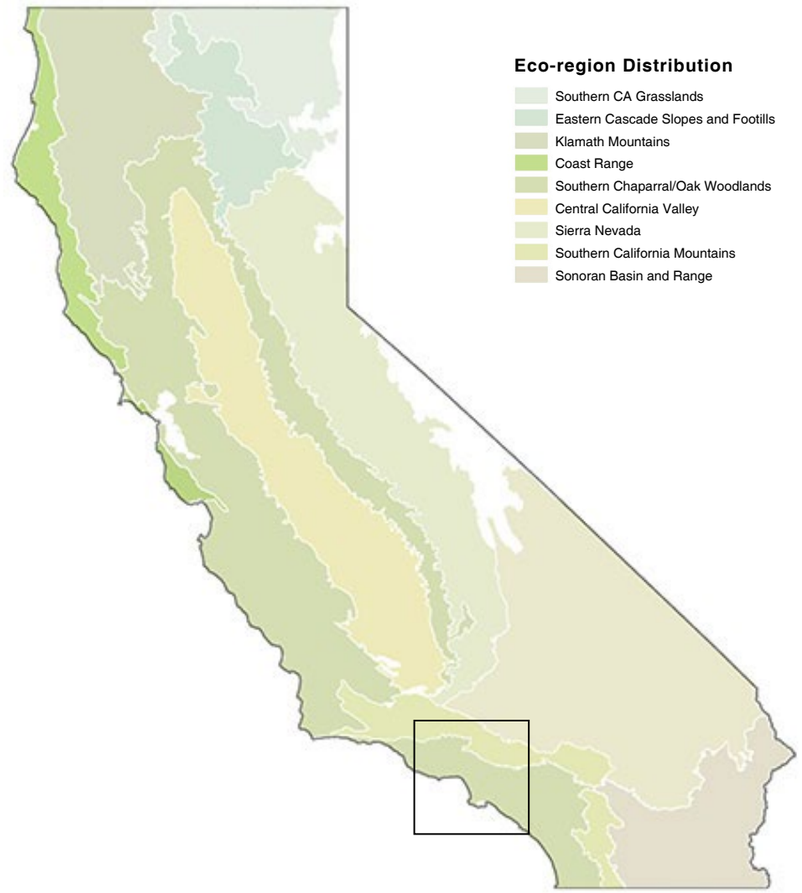
35 "Bonfire Night." Wikipedia, 31 Jan. 2022. Wikipedia, https://en.wikipedia.org/w/index.php?title=Bonfire_Night&oldid=1069114536.
36 Narwhal, The. "The Art of Fire: Reviving the Indigenous Craft of Cultural Burning." The Narwhal, https://thenarwhal.ca/indigenous-cultural-burning/. Accessed 18 Apr. 2022.

**Burning Experiment**
Images documenting I burning dried bay leaves in an iron bowl

Chapter Three

# Santa Monica Moutain

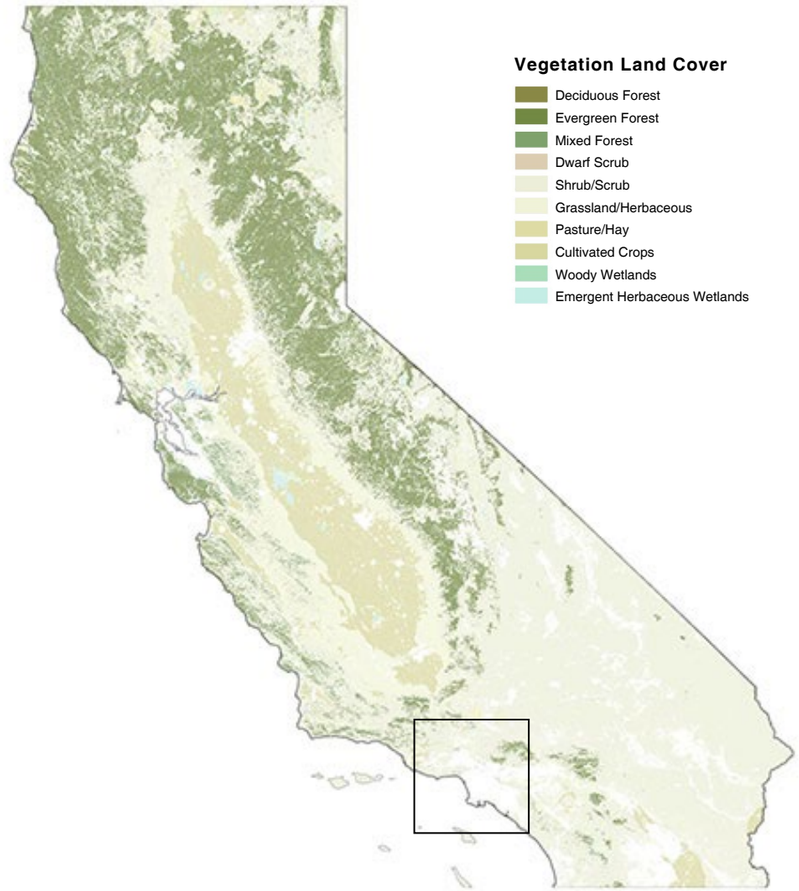
Fig 19. Prescribed Burning

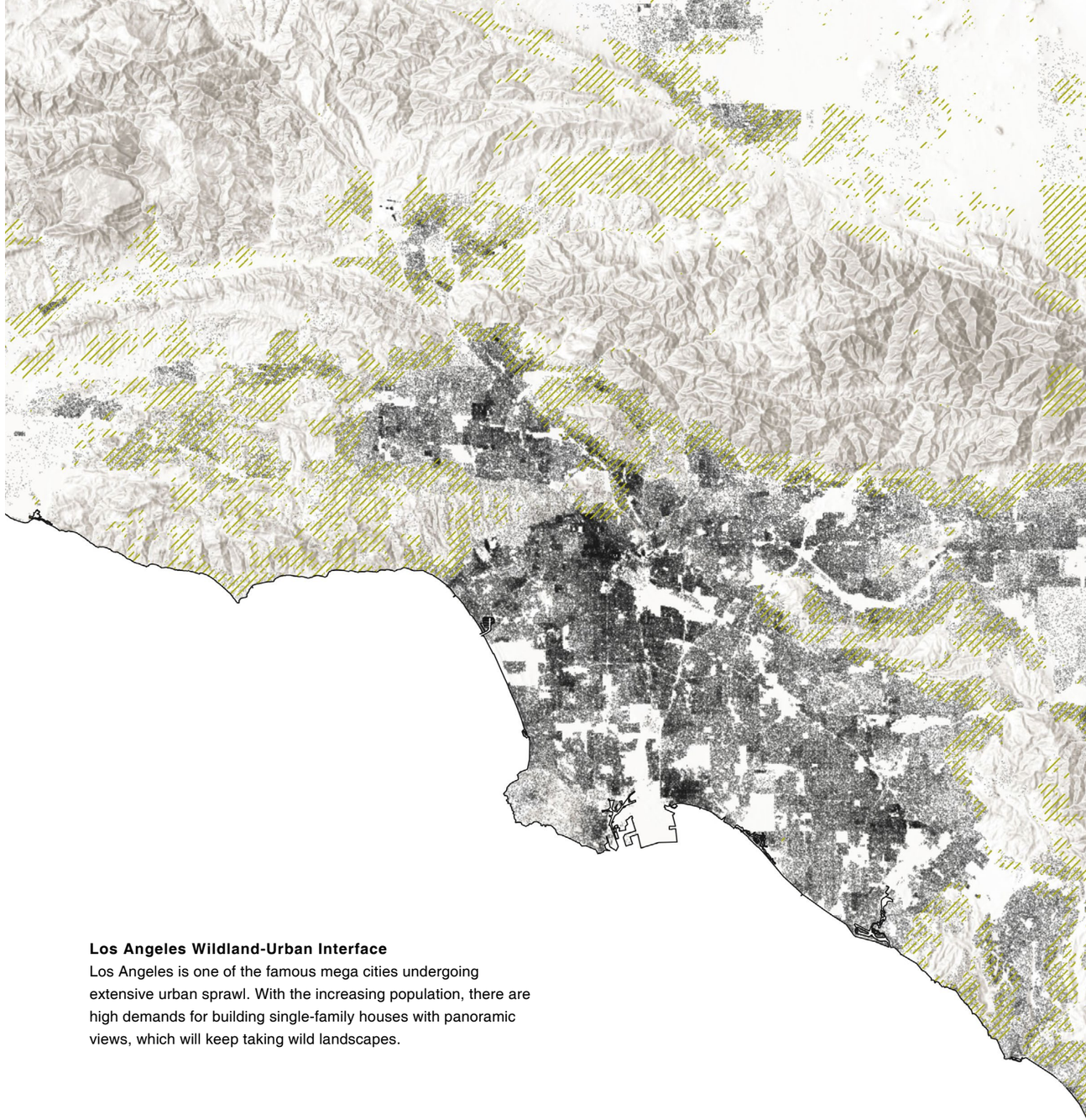



## Firescapes in California

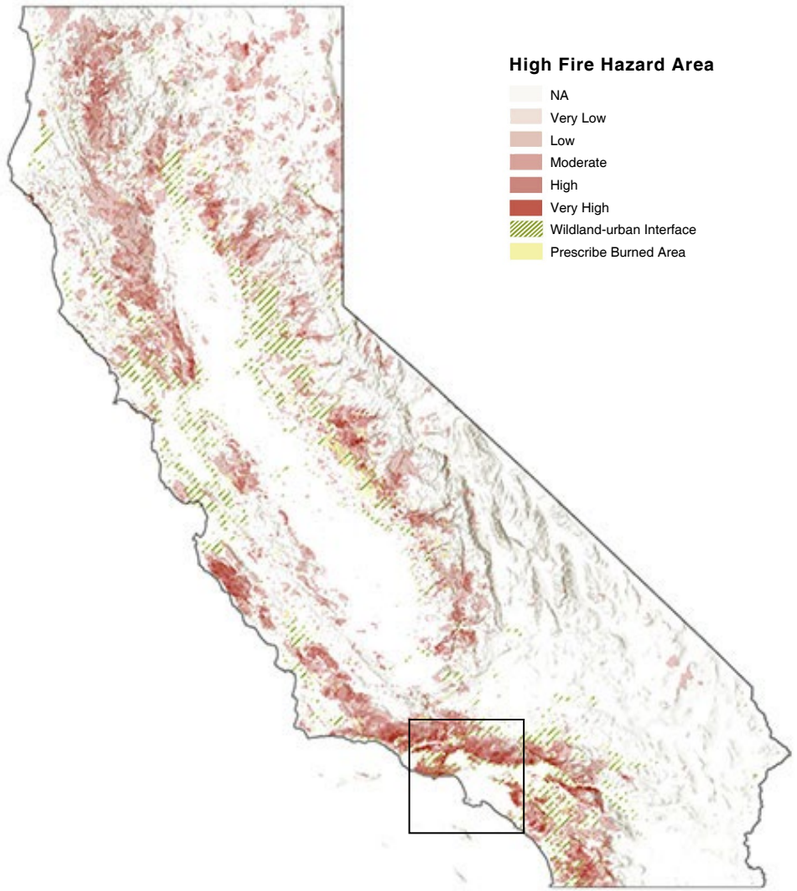
California has a long history of wildfire issues, and it is getting more frequent and more catastrophic these days. Why does California burn so much, and what will be the future for the landscape? The high risk of wildfire is caused by the states' great hot and dry weather accompanied by winds coming from the northwest desert.

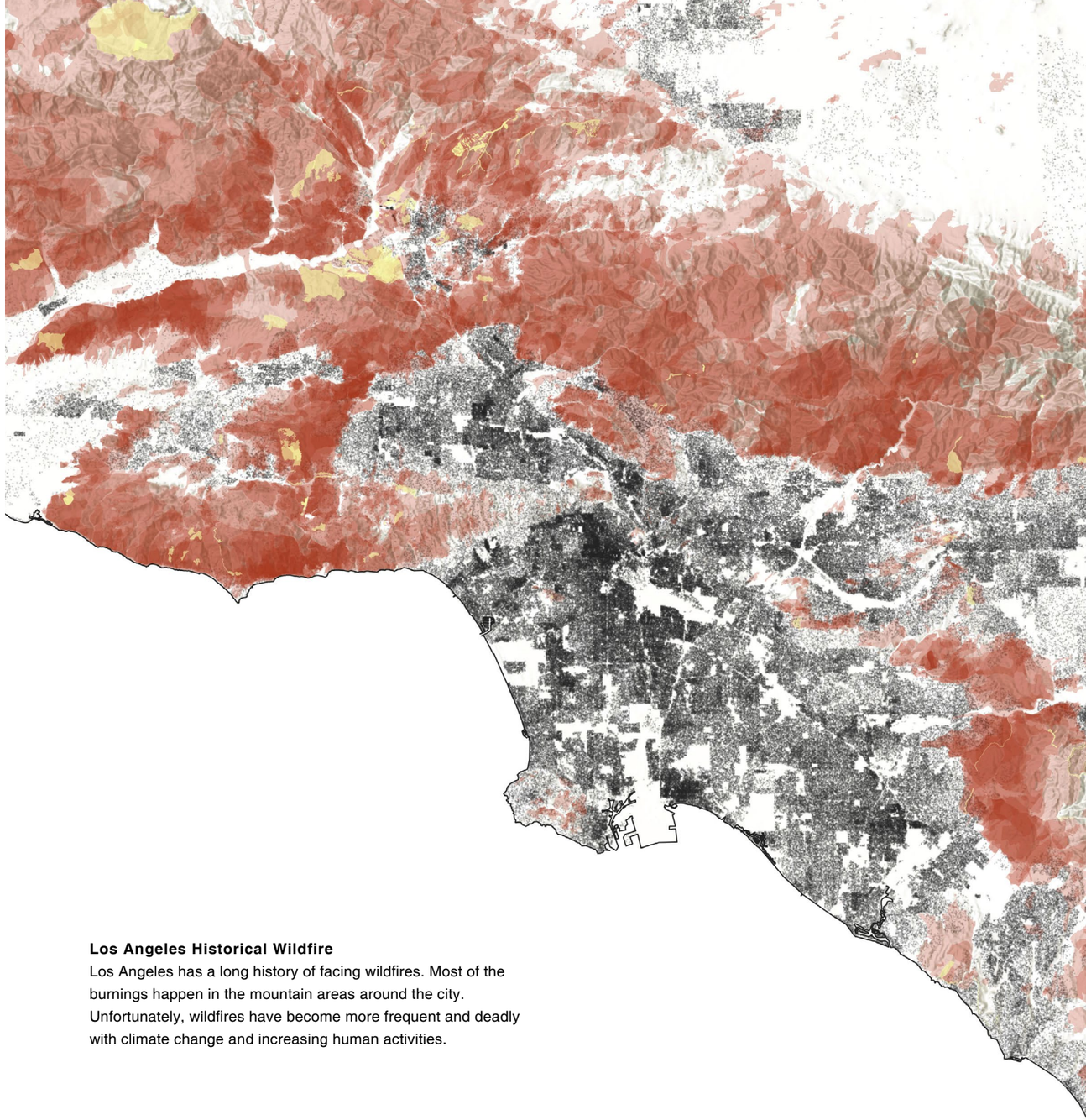
The fire patterns in northern California are more fuel-dominated due to the denser woodlands distribution. However, Southern California has more wind-dominated fires, which are challenging to manage since irregular winds are hard to forecast and blow fire over artificial fire breaks, causing dangerous crown fires.



**Los Angeles Wildland-Urban Interface**
Los Angeles is one of the famous mega cities undergoing extensive urban sprawl. With the increasing population, there are high demands for building single-family houses with panoramic views, which will keep taking wild landscapes.



**Los Angeles Historical Wildfire**
Los Angeles has a long history of facing wildfires. Most of the burnings happen in the mountain areas around the city. Unfortunately, wildfires have become more frequent and deadly with climate change and increasing human activities.

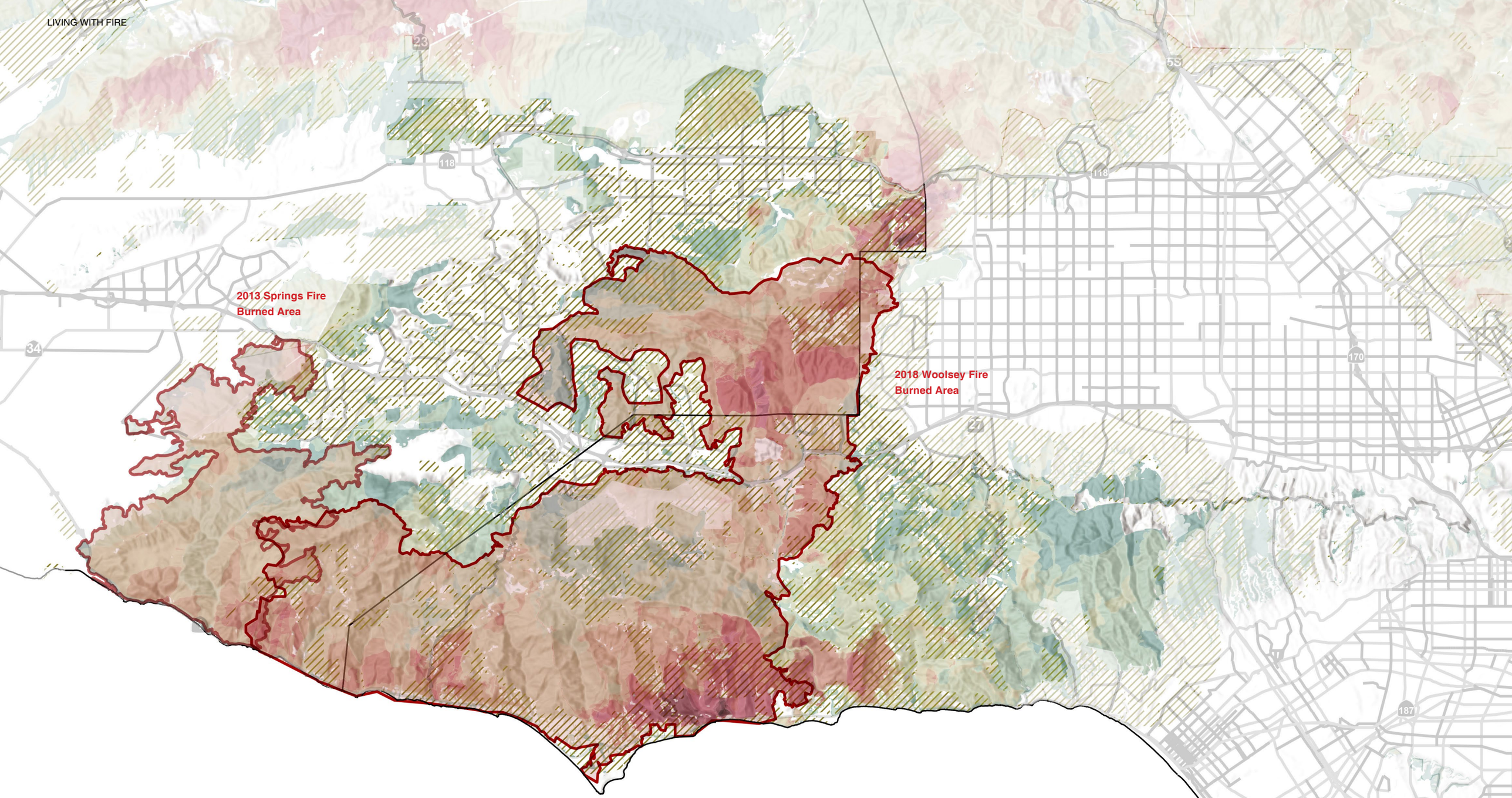
**“The four most important factors that influenced the fire history in the Santa Monica Mountains are climate (fire winds), land use, vegetation, and fire topography.”**

**—Klaus W-H Radtke, Arthur M. Arndt, and Ronald H. Wakimoto, Fire History of the Santa Monica Mountains.**

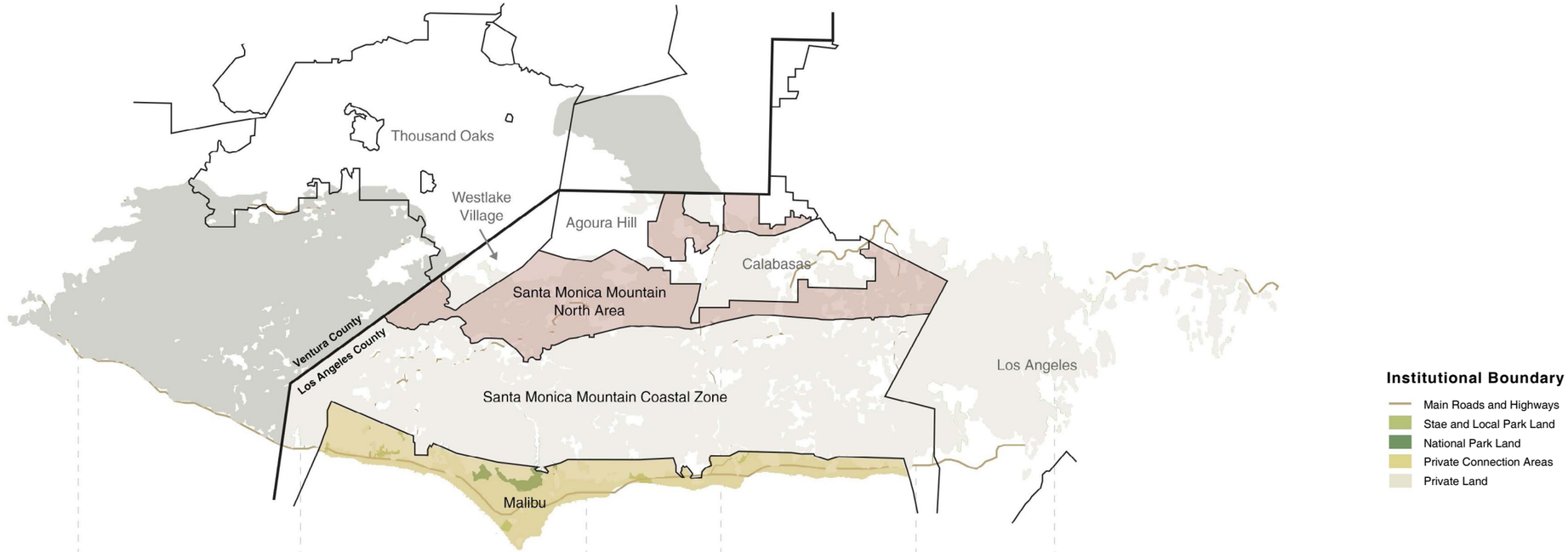


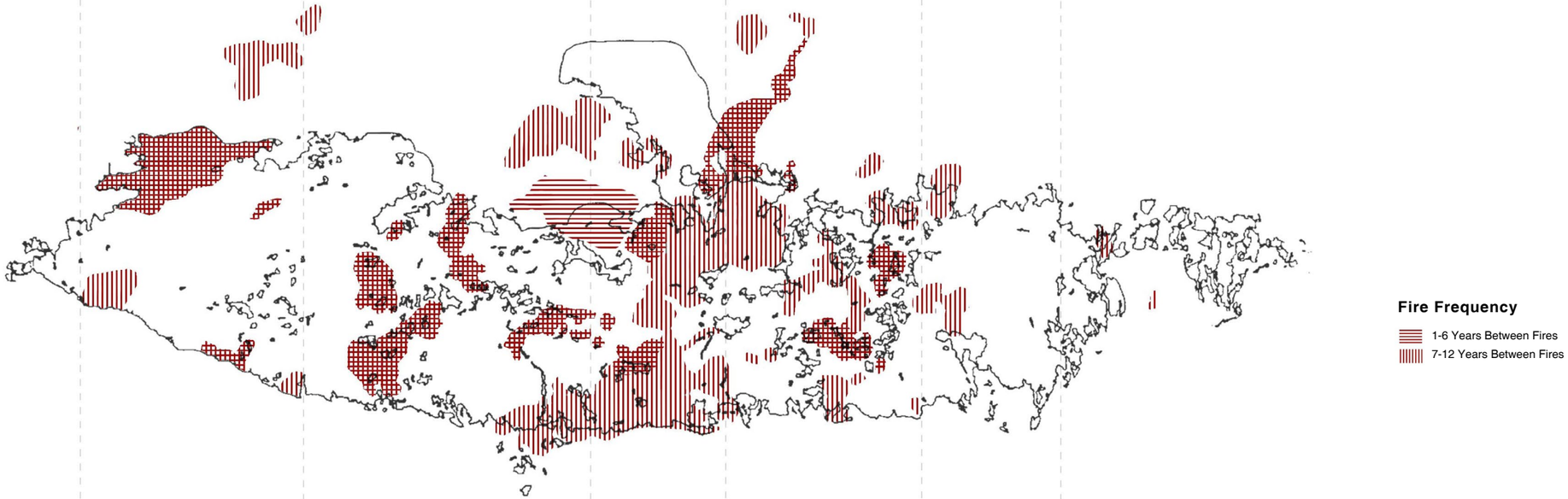
**Santa Monica Mountain Region**

**Los Angeles Metropolitan**




**Santa Monica Mountain Region Firescape**


Thousand Oaks
Westlake Village
Agoura Hill
Calabasas
Santa Monica Mountain North Area
Ventura County
Los Angeles County
Los Angeles
Santa Monica Mountain Coastal Zone
Malibu
Institutional Boundary
Main Roads and Highways
Stae and Local Park Land
National Park Land
Private Connection Areas
Private Land

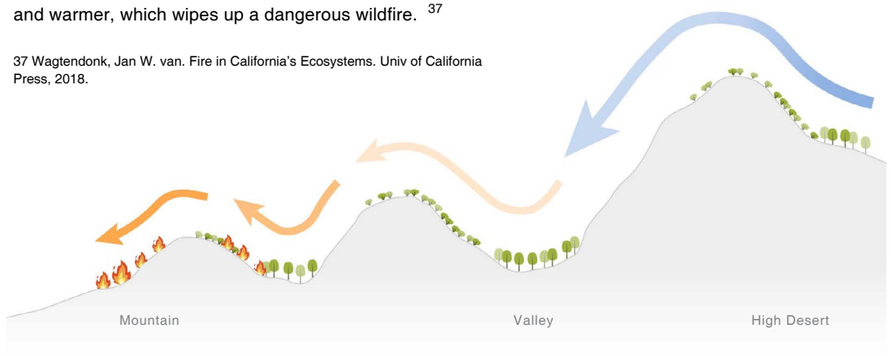

Fire Frequency
1-6 Years Between Fires
7-12 Years Between Fires

**Fire Pattern Study |** Wind Factor

**Santa Ana Wind**

Santa Ana wind is a kind of foehn wind. The cooler air blow from the high-pressure inner desert land to the lower-pressure coast. While passing down the mountain, the wind gets drier and warmer, which wipes up a dangerous wildfire. [37]

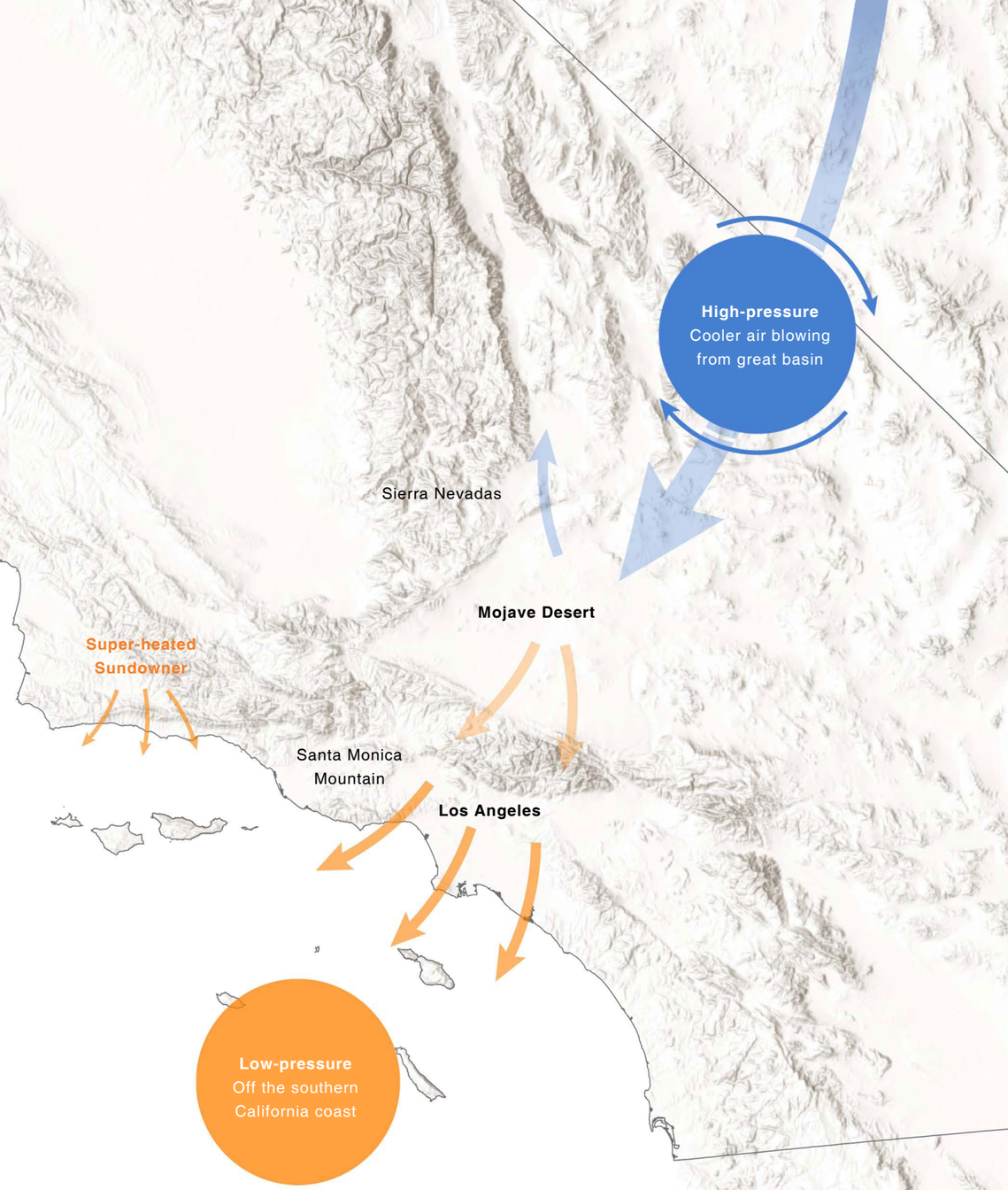
37 Wagtendonk, Jan W. van. Fire in California's Ecosystems. Univ of California Press, 2018.

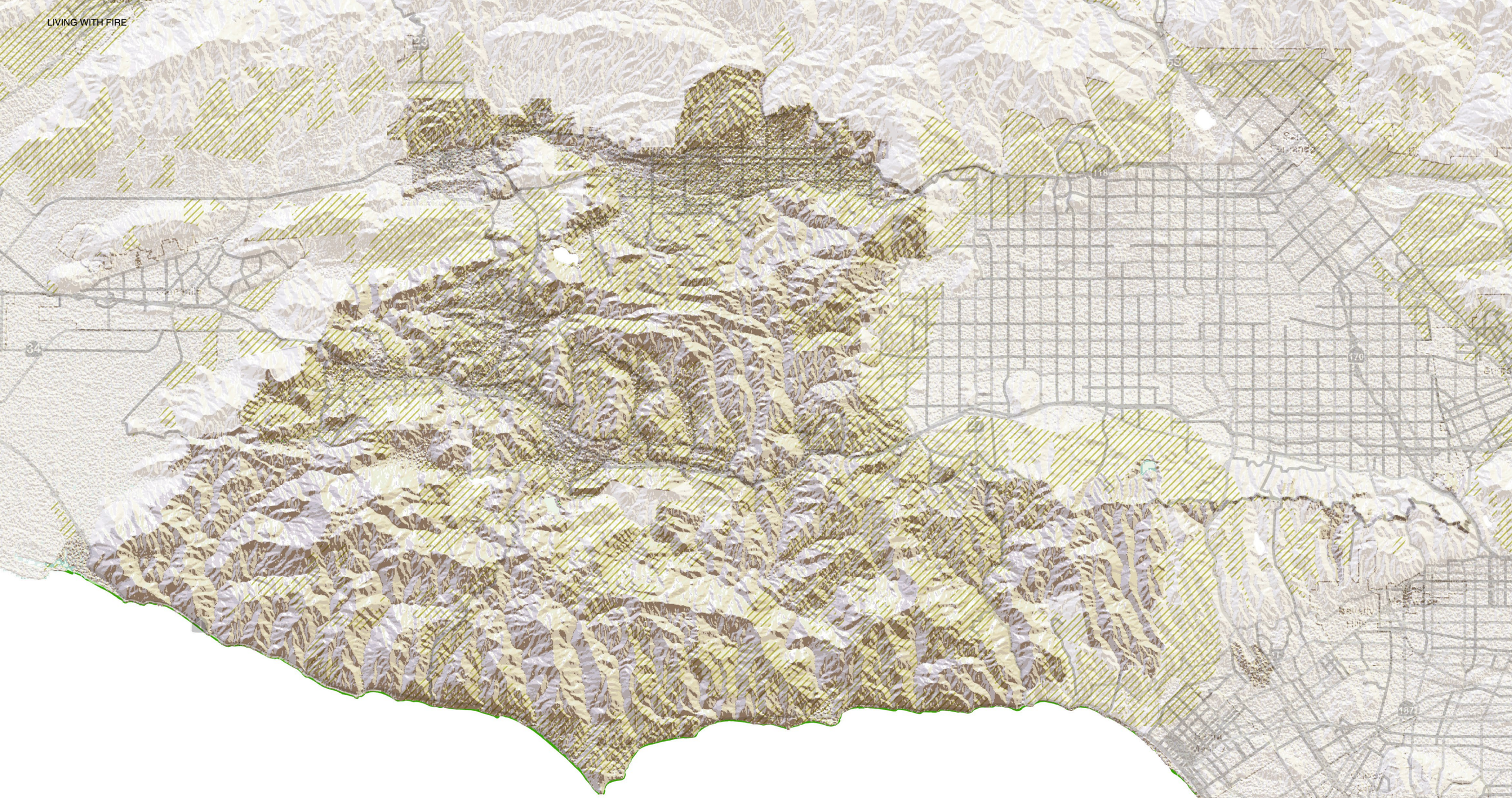



Coast
(Pacific Oacan)

Santa Monica
Mountain

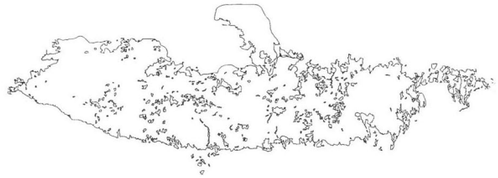
Desert
(Great Basin)



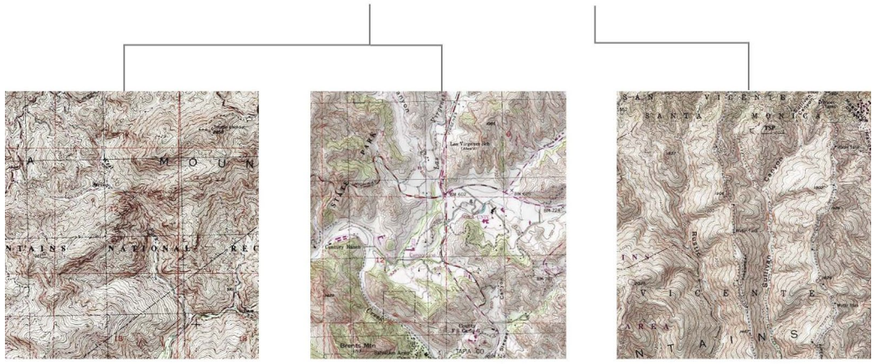



**Santa Monica Mountain Region Hill Shade**

## **Fire Pattern Study |** Topography Factor



**Generally, the linearity of the mountain ridges is parallel with the fire wind.**



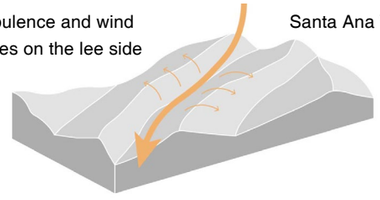
**West & Center Section**
The slopes are steeper and wildfire in this section, controlled by the wind, which is more irregular and difficult to control.

**East Section**
Most of the canyon runs northeast to southwest parallel with the fire wind.

**Fire Pattern**
Airflow is guided by topography into the north-south facing the canyon. Onshore winds are channeled up the canyon as well as upslope, and foeh or Santa Ana win down the canyon. [38]

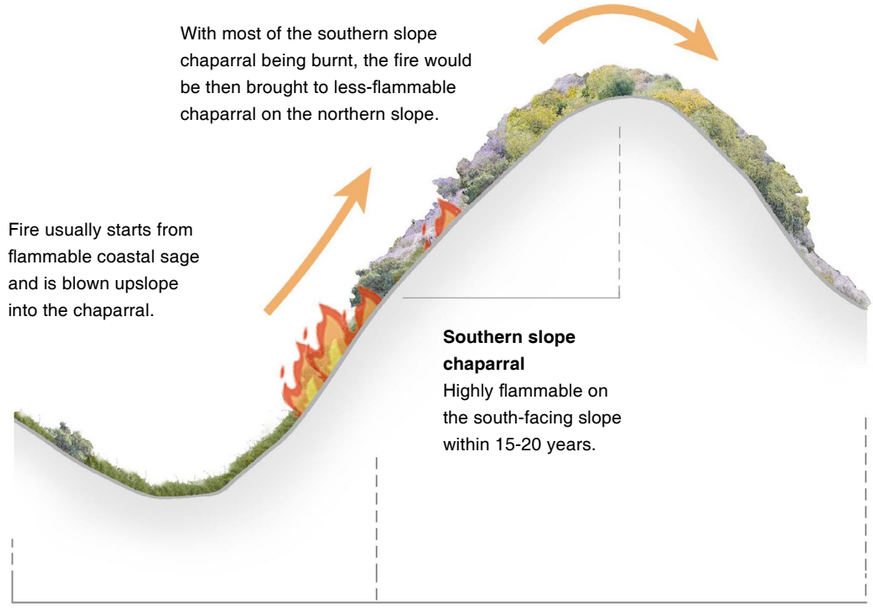
Turbulence and wind eddies on the lee side

Santa Ana Wind



With most of the southern slope chaparral being burnt, the fire would be then brought to less-flammable chaparral on the northern slope.

Fire usually starts from flammable coastal sage and is blown upslope into the chaparral.

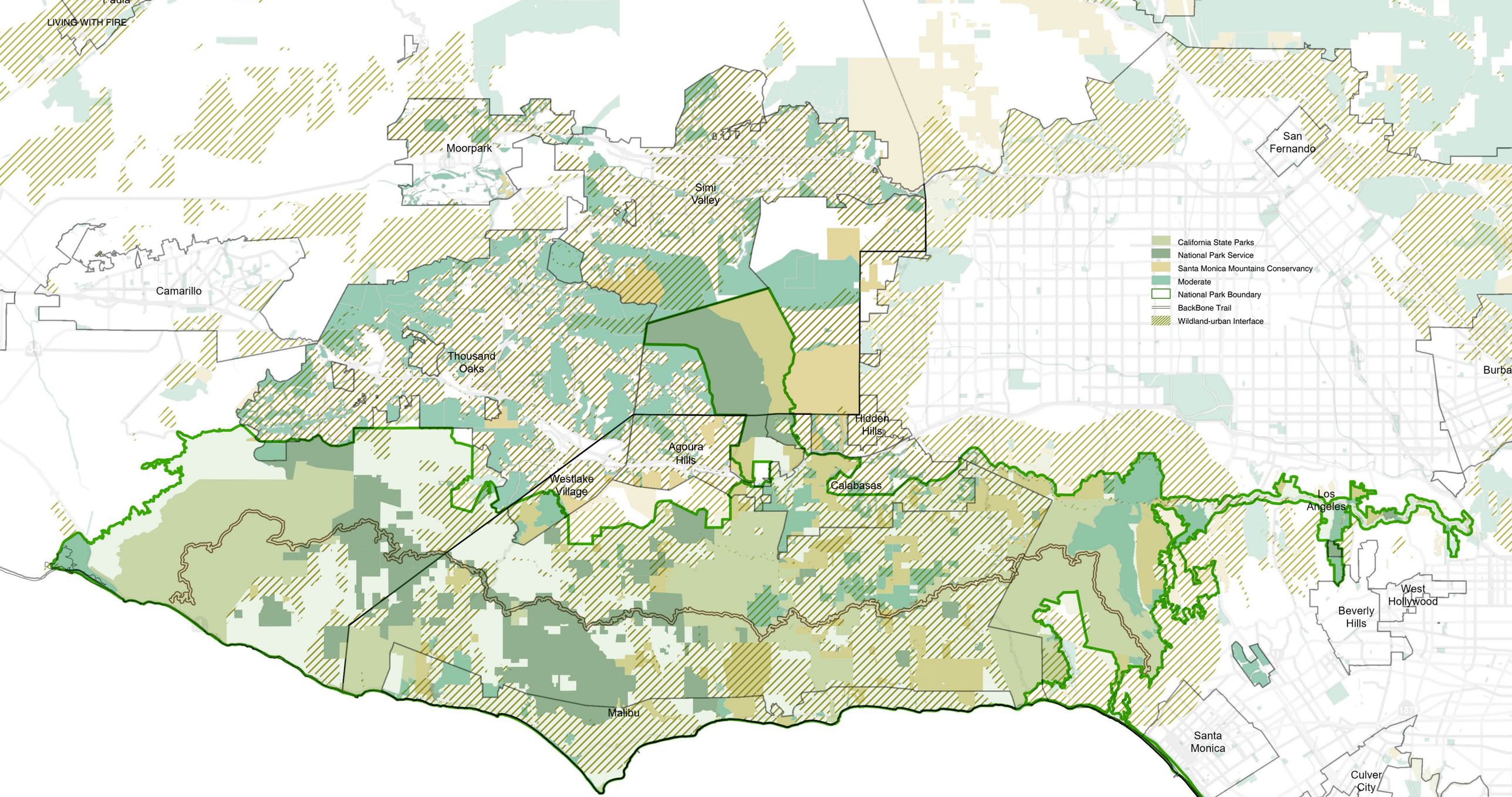


**Southern slope chaparral**
Highly flammable on the south-facing slope within 15-20 years.

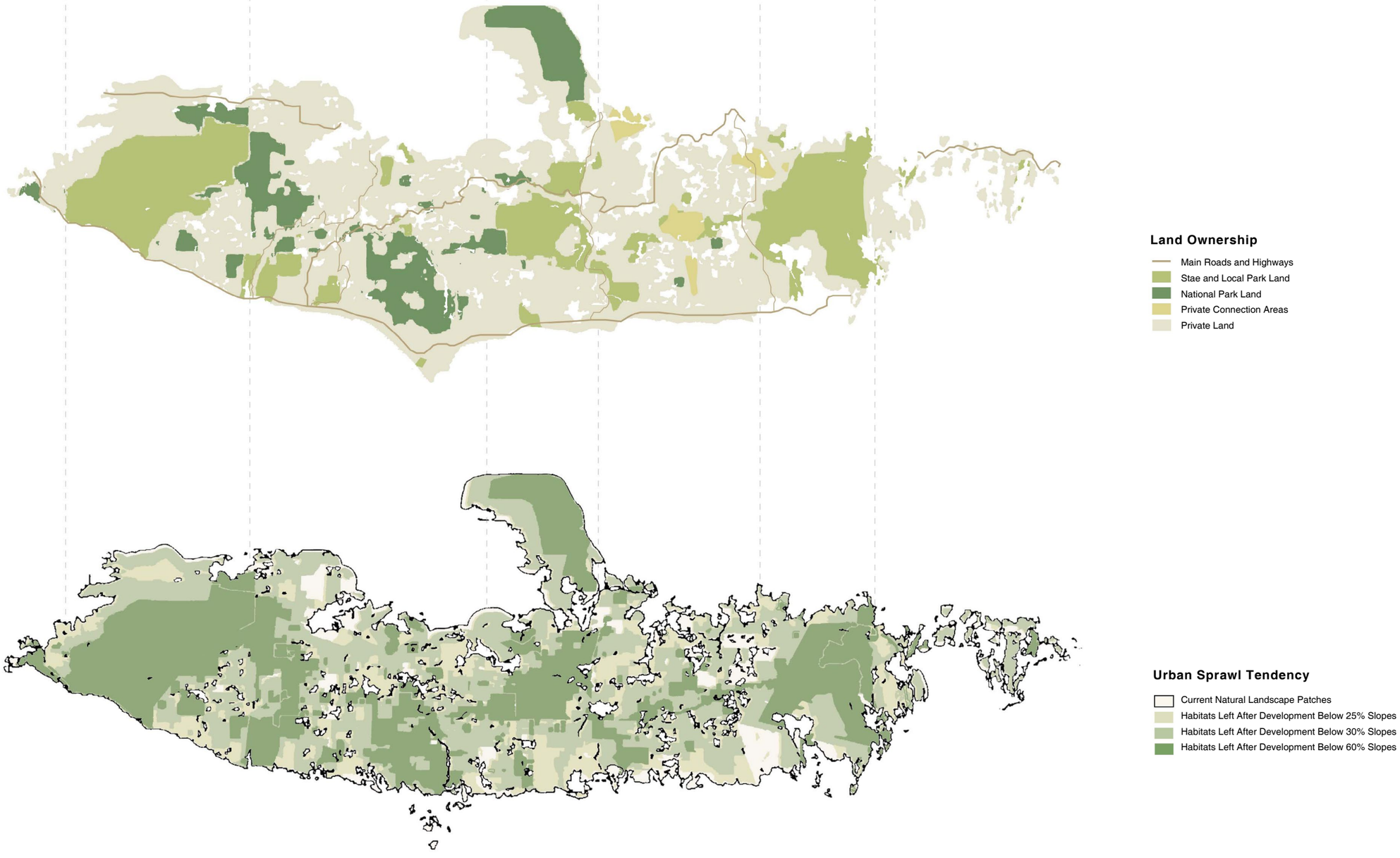
**Coastal Sage**
Drought deciduous short-lived shrub carry fire style in 7-10 years .

**Chaparral**
Carry fire cycle in 5-15 years. [39]

38 Calabasas, Mailing Address: 26876 Mulholland Highway, and CA 91302 Phone: 805 370-2301 Contact Us. Fire Ecology - Santa Monica Mountains National Recreation Area (U.S. National Park Service). https://www.nps.gov/samo/learn/management/fireecology.htm. Accessed 3 Apr. 2022.
39 Radtke, Klaus W. H., and Arthur M. Arndt. Fire History of the Santa Monica Mountains. p. 6.




**Santa Monica Mountain Region Land Use**


Land Ownership
Main Roads and Highways
Stae and Local Park Land
National Park Land
Private Connection Areas
Private Land
Urban Sprawl Tendency
Current Natural Landscape Patches
Habitats Left After Development Below 25% Slopes
Habitats Left After Development Below 30% Slopes
Habitats Left After Development Below 60% Slopes

**Fire Pattern Study |** Land Use (Vegetation) Factor

### Santa Monica Mountain Native Vegetation

Fig 20. Vegetation Distribution According to Different Facing Slops

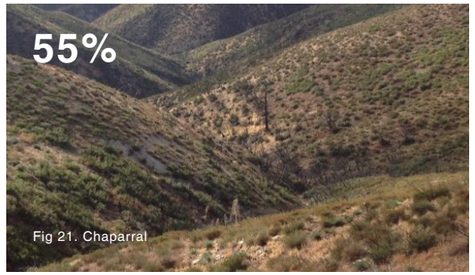
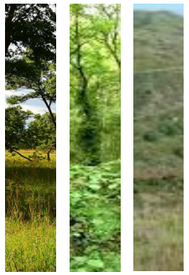



Fig 21. Chaparral

Chaparral


Fig 22. Coastal Sage

Coastal Sage



(Oak Savanna / Woodland Coastal Grassland)

### Vegetation Type-conversion

Vegetation type-conversion refers to the process of ecosystem conversion from one type to another, like the change from native shrubland to a non-native dominated grassland. The main driver of these changes is frequent fire regimes, aridity, and human intervention. [40]

40 Syphard, Alexandra D., et al. “Fire-Driven Vegetation Type Conversion in Southern California.” Ecological Applications, vol. n/a, no. n/a, p. e2626. Wiley Online Library, https://doi.org/10.1002/

Fig. 26 The impact of excessive fire on chaparral.

Fig 23

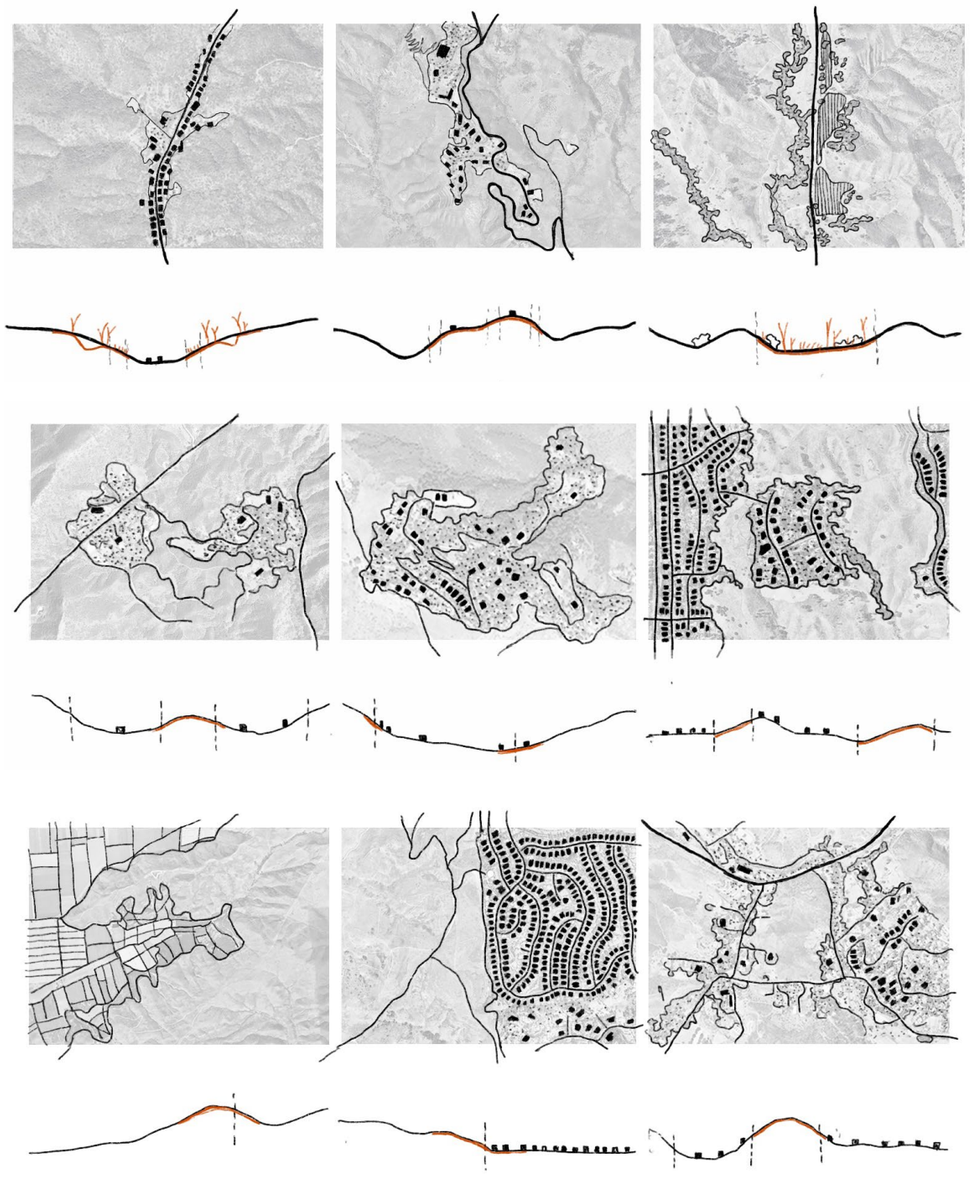
California native coastal sage scrub

Fig 24

Wildfire killed shrubs

Fig 25

Landscape converted to exotic grasses and forbs



**Urabn Expansion Pattern**
In the Santa Monica Mountain area, urban developments usually take place linearly along the mountain range and canyons and then expand into patches, considering the accessibility to roads and water.

**Santa Monica Mountain Region**
**Wildfire & Urban Development Challenges**

Santa Monica Moutain region is facing severe urban expansion challenges. Natural habitats become fragmented because of increasing housing and road construction. It is more difficult to manage the wildfires as wild landscapes interweave with communities creating multiple wildland-urban interfaces. In recent years, most wildfires have been caused by human activities.

Even though there isn't much flat space left for urban development, people's demand for single-family houses is still pretty high. Housing constructions can happen at significant chance on the 25%, 40%, and 60% slopes in the future. Therefore, the unstoppable tendency makes it urgent to propose fire-wise community planning.

In addition, the unique chaparral biome under the Mediterranean weather in the mountains is of great conservation value and sensitive to wildfires, which can only tolerate fires with low frequency. High frequent fires kill the local plants, destroy native ecosystems, and make room for more flammable exotic species.

## Existing Public Space Type

**Delicate and need high maintenance**

Club (golf course)
Adventure Park
(theme park)

Lawn

Civic Park
(memorial park
comunity park /
playground)

Lawn
+
Facitlity

Garden
(botanical garden /
community garden)

Geometric
Planting

National Park
Conservation Park
(hiking trail)

Light-touched
Wild

**Wild and sustainable**

Play &
Relax

Education

Wildness
Conservation

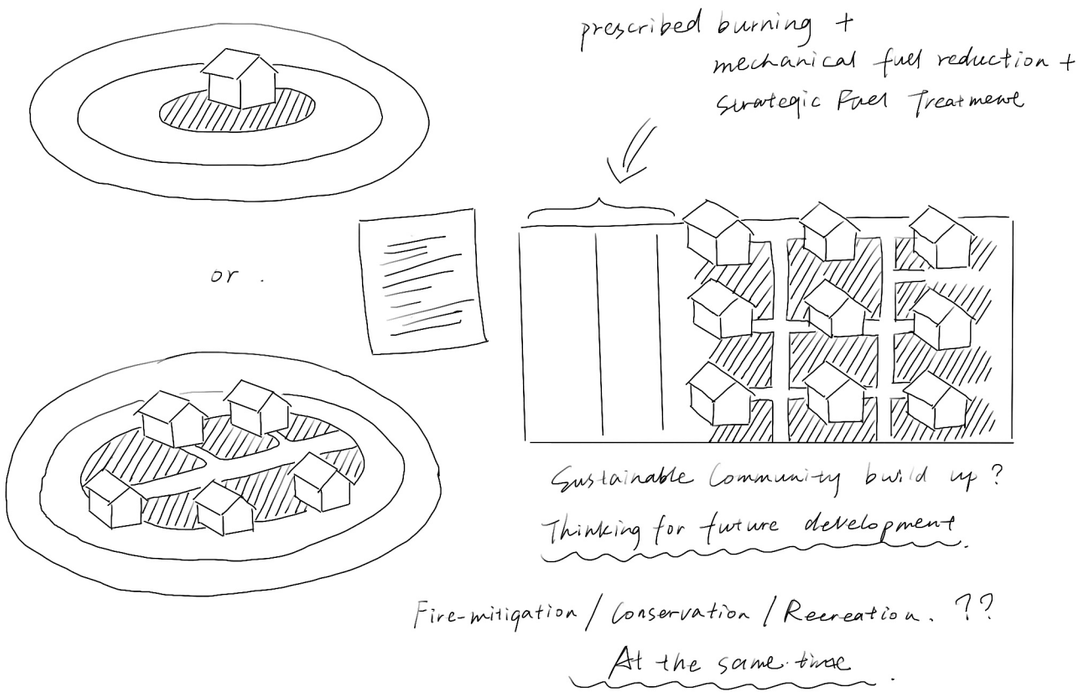
?

Most public spaces near the Santa Monica Mountain area are hard-paved playgrounds, golf courses, exotic botanical gardens, or national parks. There is an opportunity for fire-related public spaces that can celebrate native landscapes.

Fig 27. Public Greenspace Near Santa Monica Mountain Regions

**Conclusion:**
**There exists a blank space in fire-related landscape design on a medium-scale.**

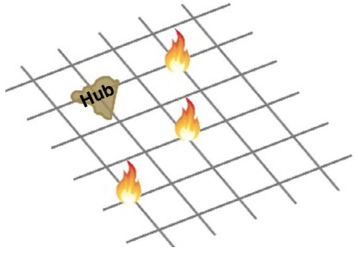
Recent design proposals and projects related to wildfire issues are primarily on an architecture and planning scale. On a small scale, it is about building fire-resistant houses. The design usually works on applying fire-proof materials and creating multiple defensible areas. On a large scale, it is about planning a fire-wise community. Some of the wildly discussed principles are identifying fire lines around the neighborhood, arranging houses into clusters near transportation facilities, and creating buffer zones with fire-prone plants.
Among them is a blank space in fire-related landscape design on a medium-scale, a park scale that can celebrate the native landscape and bring people together to think of living with fire.



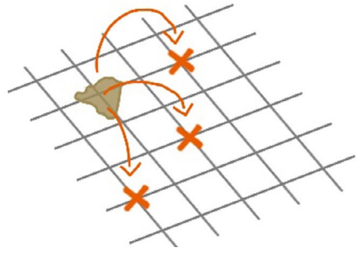
Chapter Four

# Living With Fire

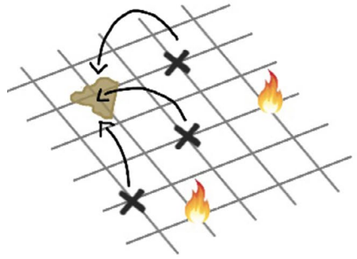
Fig 28. Burnt Trees



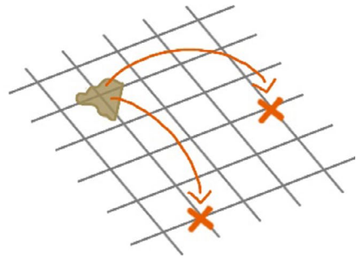

**Step 1**



**Step 2**



**Step 3**



**Step 4**

**Wildfire Educational Hub Model**

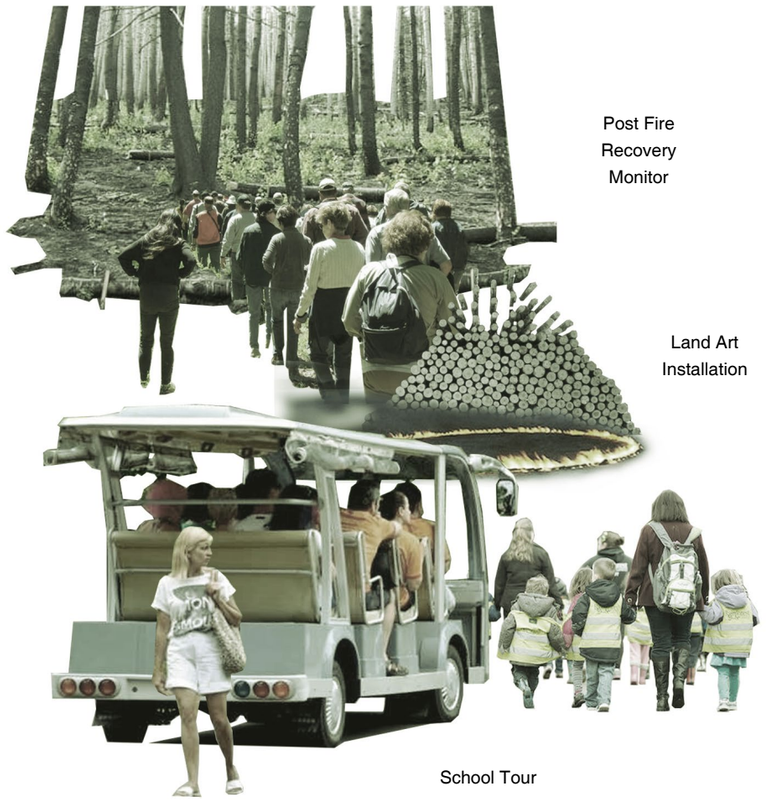
The wildfire educational hub model consists of a hub and many temporary satellite sites, combining small-scale sample studies on the site and multiple large-scale observations in the field.
When there is a wildfire, the hub will respond by monitoring the fire and participating in the post-fire recovery. Besides, multifunctional installations will be placed in burnt fields marking the changing landscape, and there will be tours organized to visit the field regularly.
The hub located at the wildland-urban interface is the center of research and fire landscape recreation, which also archives information collected in the field. Its goal is to study the native plants, their response to fires at different frequencies, and post-fire recovery and fire-mitigation strategies like fire breaks. The experiments in the hub are connected with trials with designed viewing and gathering spots to provide tours for visitors and spaces for community celebrations.

## At The Hub

Lab Research + Wildfire Museum
Experiment Plots + Native Botanical Garden


## In The Field

(Dagradable) Ecological & Recreational & Artistic
Installations + Field Trips



Malibu Junction

US 101

The Oaks of
Calabasas

Paramont Ranch

Cornell

Malibu Creek
State Park

Crater Camp

Malibu

California State Route 1

Malibu Riviera

N

**Paramont Ranch**
Paramount Ranch is located at the wildland-urban interface on the northern part of the Santa Monica Mountain, which is also at the central wildfire corridor of the mountain.

## Paramount Ranch History

Paramount purchase the land in 1927, and turned it into a movie town.

Over 400 thousand people visit the ranch per year.

Most of the property was lost in the 2018 Woolsey Fire, which destroied over 80% of the National Park.

Only the church and train station survived in the fire, and the park are planning to rebuild the West Town.

1016 ft
951 ft
886 ft
821 ft
821 ft
886 ft
951 ft
756 ft
Coyote Canyon Trail
Bwana, Backdrop, and Hacienda Trial
Paramount Ranch Perimeter Trail
Cornell Rd
West (Movie) Town

Fig 29. Paramount Ranch After Fire

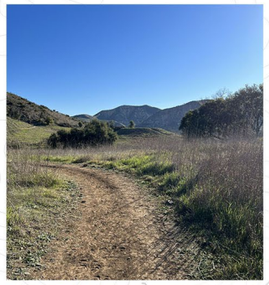


**Paramont Ranch After 2018 Woolsey Fire**
Most parts of the paramont ranch was destroied after the Woolsey fire in 2018. The fire had destroied nearly 80% of the national park, and there are only two buildings left, the white church is one of them.

**Post-fire cleanup and landscape recovery is on-going**

After the 2018 Woolsey Fire, recovery projects are going on, both for the buildings and landscapes. The Paramount Ranch was an valuable memories for many people, and the authority of the park decides to rebuild the place to a new movie town for the communities.

**Paramount ranch has a diverse landscape cover**



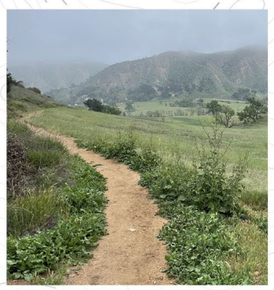
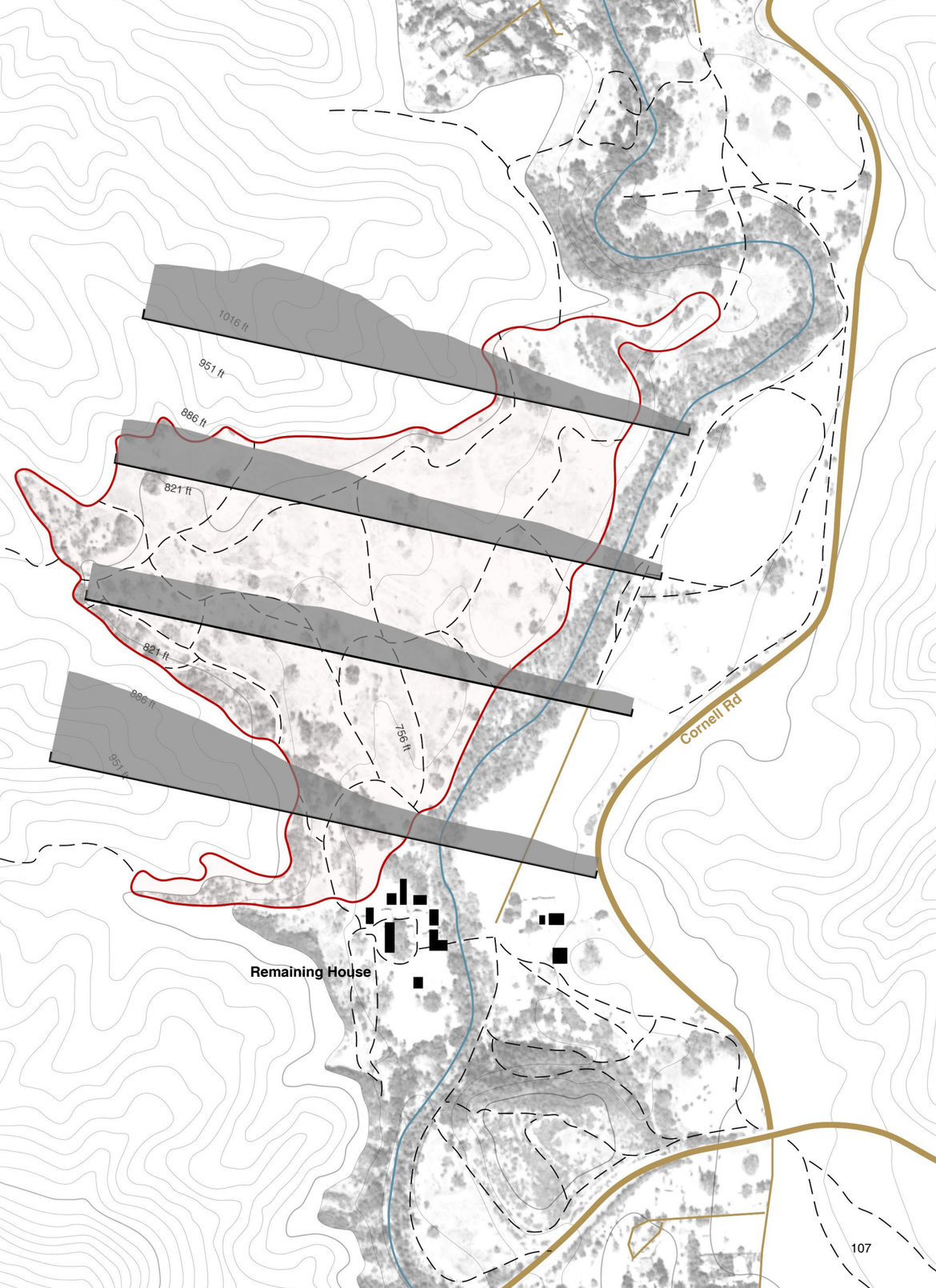


Fig 30. Landscapes Along The Hiking Trail At Paramount Ranch

**Post-fire landscape recovery**

Fig 31. Dead Trees Post Fire

Fig 32. Post-fire Recovery At Paramount Ranch



## Design Principle

### No.1 Celebrate native plants

Creating botanical gardens with local chaparral, coastal sage, grasses, and oak trees to celebrate the native landscape. The gardens have recreational and experimental functions, part of which will be managed by prescribed burning.

### No.2 Create aesthetic dialogues

Spacing making inspired by wildfire-related landscapes, like saplings sprouting after a fire, vegetation type conversion caused by different burn-on-burn frequencies, and fire breaks maintained by humans.

### No.3 Utilize fire-made materials

Harvesting fire-made materials, like burnt shrubs, tree branches, as well as soil, and leaves ashes. Then, with proper treatment and design, turning them into on-site facilities, amenities, and art sculptures to provide an intimate interaction for visitors.

### No.4 Mark the landscape change

At the fields that are just burnt by wildfire or used to be burnt, placing multifunctional installations with the same design language that the educational hub is using to build markers that visualize the ongoing landscape changes.

## Design Framework

### Hub Alternitive 01: Ring

Inspried by traditional defensible ares surrounded by single family houses.

### Hub Alternitive 02: Corridor

The whole journey of the hub will be a corridor, with fire break sample sites connecting each other.

### Hub Alternitive 03: Patch

Experimental plots are arranged dis-connected arrounded the museum with trails going through to connect each one.

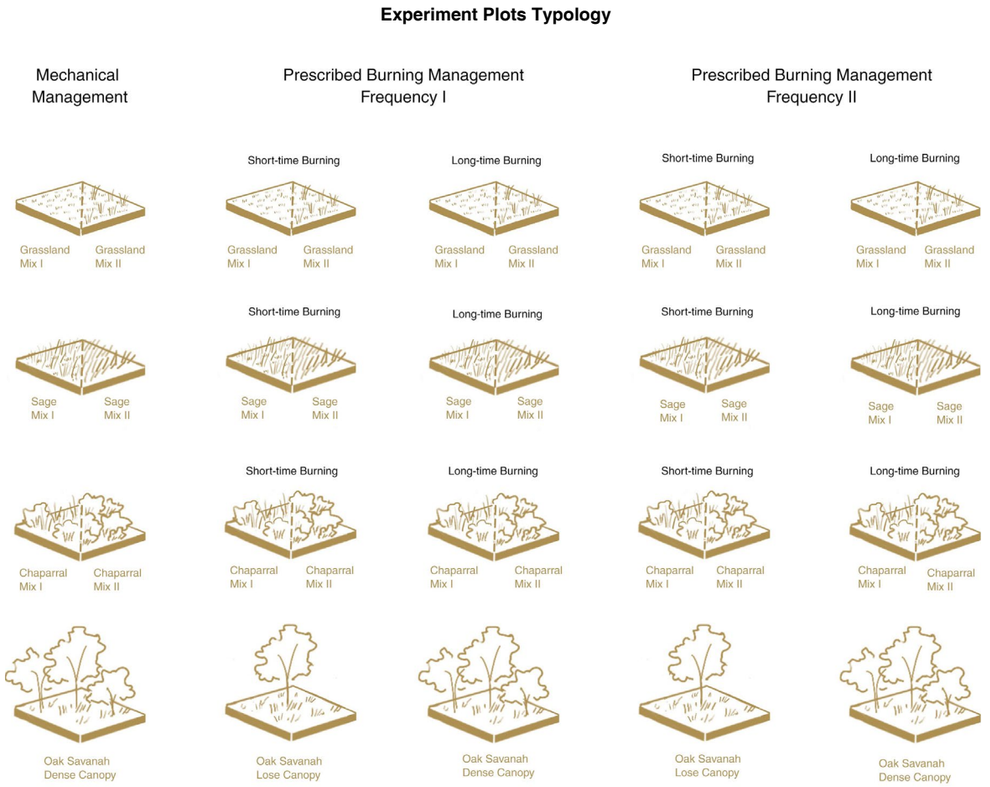
**Ring**

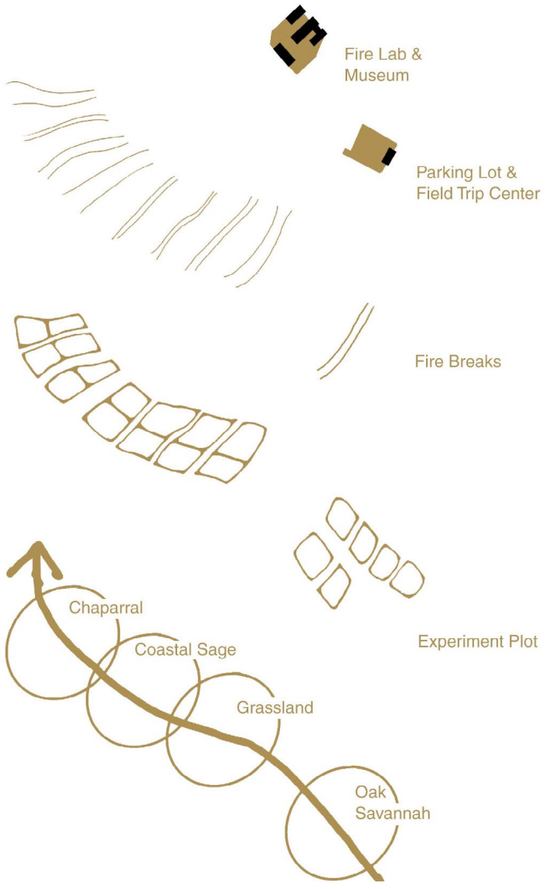
**Corridor**

**Patch**

## Hub Master Plan


## Experiment Plots Typology



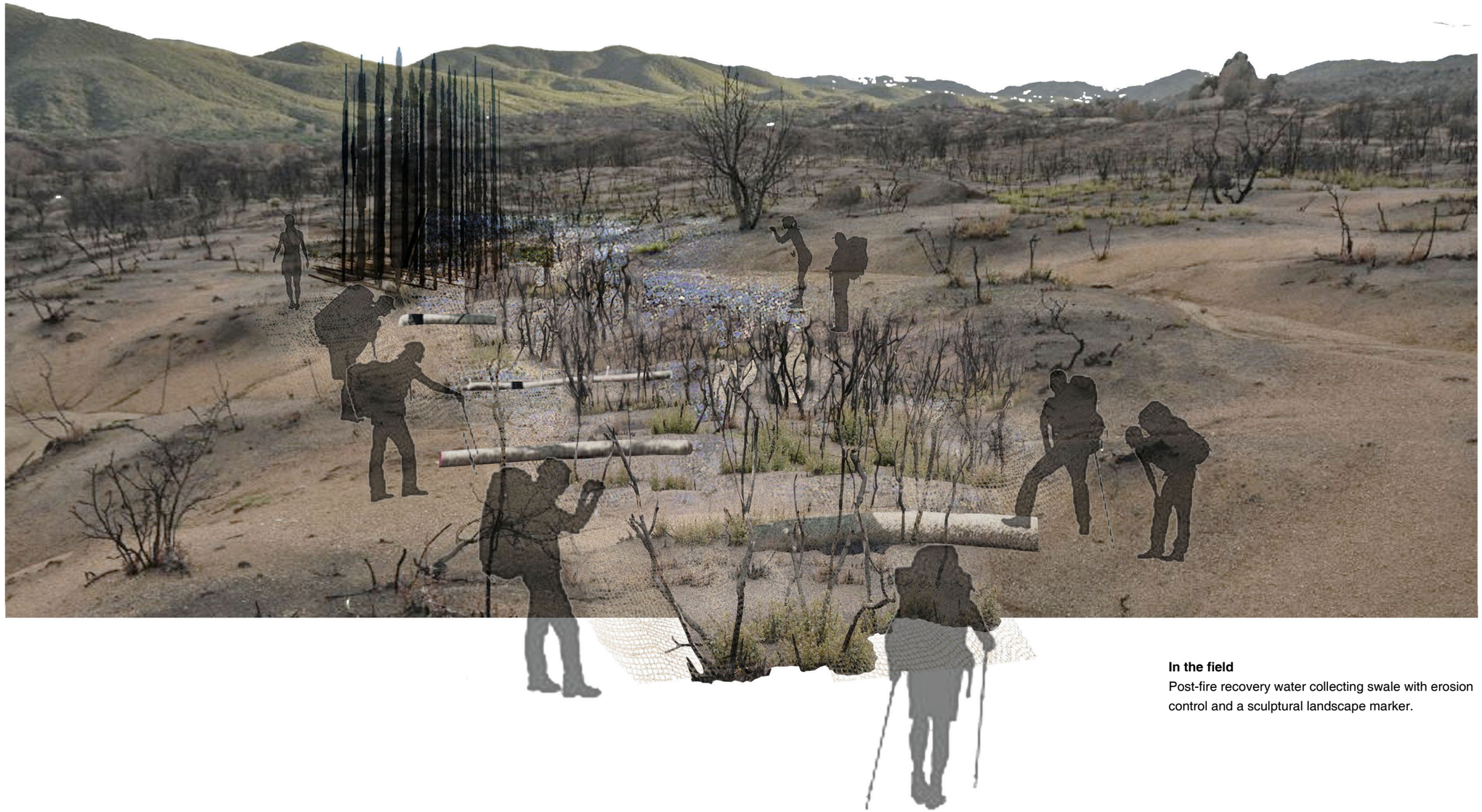

Fire Lab &
Museum
Parking Lot &
Field Trip Center
Fire Breaks
Experiment Plot
Chaparral
Coastal Sage
Grassland
Oak
Savannah


17
18
15
16
13
14
11
12
9
10
7
8
5
6
4
3
2
1
Experiment
plots & fire
Native
botanical
garden
Wildfire
museum
& lab
Parking lot &
field trip center


**At the Hub**
Fire breaks sample sites connecting with existing hiking trails goes througth the experimental plots.


**At the Hub**
Community bonfire gathering by the native botanical garden near the wildfire museum.


**In the field**
A on site field trip observing at the edge of recently burned chaparral land and the land burned a year ago.



**In the field**
Post-fire recovery water collecting swale with erosion control and a sculptural landscape marker.

## Reflection

Fire is a critical and powerful natural force with significant cultural value, as seen in its role in myths and legends. People live on fire but interact with it limitedly regarding its destructive power. With climate change and urban development, wildfire issues nowadays are catching more eyes. It is a complicated problem without simple solutions. When conservation needs meeting with development demand and population growth, figuring out a balanced and sustainable way is the key. Landscape architects as space makers are essential in contributing to a resilient future. However, what a designer can do is limited. When I got to know about the conflict between wildfire intrusion and urban development, and the situation of the burn-on-burn in wildland-urban interface, I strongly felt that living with fire would be the new normal, and landscape architects should help prepare people for it.

My thesis study aims to create an experimental and documenting model that visualizes the ongoing study of wildfire and recovery and brings the public together on this topic of native celebration and sustainable development. I hope to draw more attention to seeking innovative ways to live with fire. My proposal of the wildfire educational hub model in the thesis is based on the southern California landscapes, the chaparral and coastal sage biome, primarily influenced by wind-dominated fires. Thinking about the next step, I would like to study further the application of this hub and field model in other landscapes, like Florida and northern California, which has a large amount of forests and fuel-dominated wildfires.

Therefore, the hub and field model setting will need adjustment according to different land cover, climate, topography, and wildfire types. For example, when considering the plant choice of the botanical garden at the hub and the multifunctional installations in the field, the materials and specific functions may become localized; in some places, more frequent prescribed burning could be considered in the schedule. However, the principle always celebrates the native plants and utilizes local fire-made materials. Besides, more research on the experiment plots typology, especially about the scales, and physical model studies of the fire and the burning process are needed to inspire the design for the space of the educational hub and artistic installations in the field.

## Image List


Fig 1. “Prairie on Fire.” The Walters Art Museum, https://art.thewalters.org/detail/22342/prairie-on-fire/.

Fig 2. “The Paradise Community After A Wildfire”, “California Already Has a Housing Crisis. The Fires Just Made It Worse.” Talk Poverty, 15 Nov. 2018, https://talkpoverty.org/2018/11/15/california-already-housing-crisis-fires-just-made-worse/.

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