Fire and Society: A Comparative Analysis of the Social Context of Wildland Fire in Greece and the United States

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Abstract

The paper compares Greek and American social experience of wildfire management. Regional comparison of the two countries' tenets with wildfire reveals a common thread of experience and management regimes. Efforts to control the risk of fire damage over time have created an equal level of crisis and management tools. A comparison of environmental histories, wildland events, and management goals indicate that the two countries, while seemingly un-comparable, have much in common. On a grander scale, this research indicates that catastrophic world wildfire events may be evaluated across spatial and temporal systems. Both countries share similar forest ecosystems within Mediterranean climate zones and at specific mountain elevations. An analysis of preferences and methods of selective ecosystem management and risk management at the national and local level overcomes the differences of absolute geography to create an equal area of investigation between the two countries. Historical and contemporary wildland fire in both countries can be linked to social patterns, cultural beliefs, diffusion of science and forestry methods, and changes in political administration. National policies to prevent wildland fire, processes of environmental history, modes of public administration and risk management, and ecosystem management goals are compared. The global loss of traditional fire practices and the increasing efforts to manage fire are establishing new social boundaries of catastrophic fire.

Keywords: Human Geography; Cultural Geography; Environmental History

I. Introduction

Wildland fire is an event with which humans have both benefited and suffered. Fire, and its uses by humans, is being an essential element of the human experience on Earth. Anthropologists identify the capture and control of fire as equal to the evolution of language. Over time, naturally occurring wildfire and fires set by humans have altered the ecosystems of Earth until it is now possible to see the cultural landscape of Earth as the product of fire. Social groups use or manage wildfire in different ways; consequently, it is possible to discover major tenets in the relationship between humans and Earth through a regional comparison for fire management. This paper compares the Greek and American social experience of wildfire management.

Historic and contemporary wildland fire is not a random event. It is the consequence of natural, social, and cultural conditions. How and when wildland fire occurs, outside of naturally caused fires due to lightening, volcanic eruptions or spontaneous combustion, requires an analysis of environmental histories, social structures, and cultural beliefs. The control of wildland fires has become increasingly important as the risks from catastrophic fires have risen. A comparison of risk management and fire policies between Greece and the United States provides an opportunity to compare and evaluate catastrophic fire as shaped by culture and society.

Any comparison of Greek and American environmental history must be placed within a context of varying temporal and spatial scales. A comparison of land mass and ecosystems is a bit more problematic given the size of the North American continent relative to the Greek mainland and Archipelago. However, an analysis of preferences and methods of selective ecosystem management and risk management at the national, regional and local level overcomes the differences of absolute geography to create an equal area of investigation between the two countries.

Historical and contemporary wildland fire in both countries can be linked to social patterns, cultural beliefs, diffusion of science and forestry methods, and changes in political administration. Current national policy statements by both countries establish a national outlook of total management within the current period of catastrophic wildland fire events. National policies to prevent wildland fire, processes of environmental history, modes of public administration and risk management, and ecosystem management goals are compared.

This paper reviews the social and physical context, and national policies of wildland fire in Greece and the United States. Forms of public administration with respect to land tenure, forest management and the role of agriculture in both countries are identified. The increasing risk of catastrophic fire and the efforts to contain fires are described within the context of national, regional, and local policies.

II. Brief Outline of Comparative Environmental Histories and Wildland Fire Policy

Anthropocentric wildland fire pre-dates archaeological records on both the European and North American continents. Fire appears to have moved from a natural to anthropocentric position in both cultures and ecologies when indigenous peoples gained control of naturally occurring fire. Greek mythology invests this event in Zeus, the progenitor of a plethora of gods and goddesses who interacted with humans in various ways, and "Prometheus bound" who stole fire from Zeus and gave it to the primitive mortals on the Earth. Native peoples of North America have parallel stories of human acquisition of natural fire. The long historical road from acquiring natural fire to the current situation where the majority of wildland fires are human caused differs between the two nations.

Environmental histories document those forces that have transformed the surface of Earth over time. Most environmental historians agree that social and cultural ideas and events play a fundamental role in altering ecological and environmental conditions. Only in the case of catastrophic events such as earthquakes can environmental conditions be altered. Fire holds a unique position in environmental histories. It is both a catastrophic natural event and the product of human modification of ecological and environmental conditions. In fact, it is evident that human modifications are now a major cause of catastrophic fire.

Indigenous peoples used anthropocentric fire for many purposes besides warmth and cooking. Native peoples used fire to maintain ecosystems that promoted specific flora and fauna. Fires were set on a regular basis to promote grasses and provide forage for wildlife. Native Americans actively burned areas of forest and grasslands. The origins of this practice may never be known yet it is interesting that, assuming the theory of Beringia migrations, native peoples in North American may have acquired this knowledge in Asia. There is some evidence that Asian pasturalists, migrating west, passed this knowledge on the native groups of Asia Minor and eventually to ancient Greeks.

Fire, having lost its wildness, became a tool of Greek and American agriculturalists. Pasturalists used fire to promote grass and forage, and farmers used fire to clear fields and reduce woody debris. Out-of-control fire signaled danger and the potential loss of property and the means of production. The potential lose of standing timber in forestlands rose from a maritime problem to national levels of concern for lumber and other forestland benefits such as watershed management and wildlife habitat. In Greece, the most significant problem resulting from fire disturbance is soil erosion and mass wasting on steep slopes.

Fire suppression has become a major element of national planning and risk management. As populations in both countries have become urbanized, the demand for land on the urban fringe has increased. At the same time, economic abilities in both countries have provided the opportunity for people to seek recreation home sites within forest and grassland ecosystems. The demand for fire suppression has increased as these populations have invested in structures and the habits of outdoor lifestyles.

National response to the need for fire management in both the United States and Greece must adjust to national, regional, and local conditions. A similar response in both countries has been to create specialized firefighters and invest in technologies that allow for improved prediction and management of fire events. The specific histories, needs, and abilities to control fire in both countries reveal the complex nature of fire and firefighting. These differences are worth reviewing in order to secure a better understanding of the role of fire in the contemporary landscapes of physical and human systems.

III. The Greek Experience

Destruction of forests started in ancient Greece and intensified in contemporary years as a result of social and environmental conditions during the millennia of stormy history in this birthplace of western civilization. Catastrophic wildfires have always constituted the most serious risk for the Greek forest and agricultural lands. Although the Mediterranean coastal zone of pine forests and maquis shrublands is well adapted to fire, frequent and repeated fires with subsequent overgrazing and urbanization have denuded the Greek landscape (Konstantinidis 2003). The natural vegetative cover has been severely reduced and the once productive soils are susceptible and depleted to widespread erosion. Anthropocentric wildland fire in the Greek peninsula and Archipelago is partially understood both historically and in the contemporary period. The ecology of the predominant forest types and agricultural land covers has been well-researched including the impacts of fire and forest regeneration in post-fire regimes. Adequate attention has been paid to fire prevention and protection from the ecological perspective. However, the majority of the wildland fires on the western and eastern shores of the Greek mainland and islands are human-caused (Alexandrian and Esnault 1999). These fires are social and environmental histories that require extended research.

Physical Context

Greece, located in the Mediterranean Basin and the southeastern part of the European continent, is extended over an area of 132000 km^2 along 16000 km of coastline and thousands of islands spread mainly in the Aegean Archipelago. The country is characterized by rugged and mountainous topography in almost two thirds of its territory and the unique Aegean Basin. The Aegean Basin is outlined by the foothills and coastal plains of the Pelion Mountain, the mountains of Macedonia and Thrace of the Greek peninsula, and the coastline of Anatolia in Asia Minor. Between the Greek mainland mountains and the Turkish coast are the islands of the Aegean Archipelago. The western and northern sides of the basin consist of a narrow strip along the Greek mainland while the eastern side of the basin extends into Anatolia. This regional "shift" towards Asia Minor is found in geologic and botanical indicators as well as cultural and historic indicators.

The climate of Greece is typically Mediterranean, with warm and dry summers and mild and moderately rainy winters across the foothills and coastal plains of the mainland peninsula and the islands (at lower elevations from 0 to 700 m asl). Besides this general

Mediterranean climate zone, there is a climatic gradient ranging from a sub-humid continental type of climate on the North and Central high elevation ranges and plains to a semiarid type of climate down South. Greek fire climate is also characterized by a yearly northerly wind regime (meltemia) that is responsible for wildfire occurrence and propagation during the summer season in the Archipelago and the surrounding coastal areas.

The primary vegetation cover types of the Mediterranean climate zone and the low to middle elevation ecosystems are flammable coniferous forests and evergreen shrublands. Vegetation, defined on the basis of the dominant species, includes phrygana (Sarcopoterium spinosum, Genista acanthoclada, Cistus spp., Erica manipuliflora) that are dominant in pastures, evergreen sclerophyllous shrubs (Quercus coccifera, Quercus ilex, Pistacia lentiscus, Arbutus unedo, Phillyrea latifolia, Erica arborea), olive trees (Olea europea), pines (Pinus halepensis, Pinus brutia, Pinus nigra), deciduous oaks (Quercus macrolepis, Quercus pubescens, etc.), grasslands and agricultural crops. The extent of the pine forests has changed over the centuries primarily due to human influences (Stamou et al. 1998). The pines and their products such as resin are highly valued yet much of the forests have been cleared for other types of land use, as explained below.

Historical Context

From the moment that the Greek peninsula was formed on the border of the proto-continent Laurasia and the Tethys Sea, it is covered by forests. These forests varied in composition according to the ecological conditions of the area. The ancestors of Mediterranean evergreen sclerophyllous shrubs began to appear during the middle Miocene and so did wildland fires, due mainly to lightning and volcanic eruptions. Later as the Homo sapiens appeared in the Greek peninsula and the Aegean Archipelago, the Mediterranean vegetation had grown under the bright Mediterranean sun at the same time with development of the Greek civilization. The economy of the pre-historic Greek tribes was based mainly in stock raising and agricultural activities, which required appropriate open-clear lands. Only rich forests that covered the whole Greek peninsula could have provided these areas. From the beginning, the easiest and most efficient method for clearing the forests was with fire. Anthropogenic fire has been and continues to be a significant factor in Greek ecosystems.

During the second and first millennium, the colonization of the Greek peninsula started by Greek tribes that were coming down south gradually, following an almost identical procedure; movement, discovery of suitable area, clearing the local forests by fire, cultivation and grazing, abandonment of the region after a few years because of reduction in production, and new movement south to start the whole procedure again elsewhere. The restoration of abandoned regions was short and fast. New settlers were localizing the old sites as new tribes were moving south and repeating the procedure. The ancient Greek forests had been burnt down many times, but on the other hand this tactic slowed down the movement of the settlers. Thus, the contact between natives and newcomers was gradual and peaceful. The ancient Greek civilization was born from this bloodless

assimilation, and it is not an exaggeration to claim that the Minoan, Cycladic, Pelasgean, Mycenaean and classic ancient Greek civilizations were developed on the ashes of forests.

Greek environmental history for the latest 3500 years can be roughly divided into periods of different political control structures. The historic periods are evident in the political and social history of the Greek peninsula and islands although the dialogue between administrators and local communities varied from place to place over long time periods. The necessity of food acquisition coupled with a rugged terrain and island separation set the stage of four time frames. Anthropocentric fire, aside from its military importance, played a critical role in transforming the Greek landscape (Konstantinidis 2003).

Archival data and archaeological materials dating from 3300 BC provide sufficient evidence to initiate an environmental history of Greece. Greek city-states and Roman imperial control defined Greek environmental history from 3300 BC until 200 AD. During this time frame, fire was used as a means to clear land, and to reduce unwanted woody debris. Greek farming communities enlisted fire as a means for opening up new agricultural lands (Konstantinidis 2003). Field crops especially wheat were planted in areas surrounding the villages. Tree crops, including olive and fruit trees slowly replaced the pine and oak forests in local areas. The Romans expanded the agricultural land base with extensive forest clearing wherever possible. Wood was used for cooking and heating at the local level. The pine forests also provided the Romans with a ready source of timber and other wood products for shipbuilding. At the close of the Roman period, a larger percentage of arable land had been created with the use of fire.

The collapse of the Roman Empire during the fourth century AD led to the rise of Byzantium, a period of time when the Christian Church became the dominant religious, social, economic, and political entity in the Eastern Mediterranean. Villages and church lands were used to satisfy local needs. Over time, vineyards were expanded to meet the demands of the church. Stock-raising also became a primary food and export product. Higher protein grass production was encouraged with the use of fire. Fire became an essential component of the landscape.

Around 1400 AD, the Ottoman Empire expanded into Greece, transplanting the Christian Orthodox Church (after the schism with the Roman Catholic Church) as the primary form of governance and safe haven for the enslaved Greeks. Ottoman expansion brought more pressure to convert forested lands into terraced olive groves. Fire became a difficult entity within the Ottoman production and export of high-grade olive oils. Fire was the most immediate threat to olive groves. Pinelands surrounding the groves were deforested as a means of controlling the spread of fire into the groves. The practice of firing pasturelands to improve grasses persisted. The use of fire for forest and field management had several benefits beyond improving grass production. Fire was known to enhance pine forest growth, reduce woody debris and prevent intense naturally occurring wildland fire, and promote habitat zones for wildlife.

By the end of the Ottoman Empire and a new map of Greek political boundaries from 1830 and into the early 20th century, Greek forests and agricultural practices experienced a gradual shift towards mechanization and higher levels of production. This process was stimulated by economic collapse following the two world wars, Greek civil war and political unrest, migration and poverty (Marmaras 1991). These factors led to the abandonment of villages and associated practices of transhumance and olive production. As rural populations migrated to urban areas and abroad, wildlands were abandoned "unmanaged" creating unnatural vegetative fuel build ups of flammable biomass.

Fewer people inhabited inland, rural Greece. Employment opportunities shifted from the agricultural sector to industry. Tourist development in highly urbanized coastal zones of the country attracted many people from the interior to the ever popular Greek coastline. This subsequent urbanization, occurring mainly in the second half of the twentieth century, created a few highly populated epicenters (Marmaras 1991) and increased land pressure for legal and illegal residential developments in suburban and coastal areas. Poor land use planning and management, along with the lack of a nationwide cadastre, resulted in a plethora of arson and other human-caused wildfires to "claim" or else "utilize" high value lands that degraded the Greek natural and anthropogenic environments during the second half of the twentieth century.

By 1981, Greece joined the European Union (EU). Membership in the EU provided subsidies and investments in mechanized, industrial agriculture. An expanding global marketing system reduced the role of local villages and villagers. The EU offers subsidy payments to villagers for a limited role in agricultural production and an expanded role in livestock production. Overgrazing especially during drought years has increased the risk of catastrophic fire (Tsiourlis et al. 2001). Wildland fire is now an event rather than a tool employed by local villagers to improve pastureland and forest rejuvenation. At the beginning of the twenty-first century, EU regulations and policies along with strategic planning from the Greek authorities promise to improve environmental and fire management schema, despite a systematic increase in values-at-risk, natural hazards and vulnerabilities due to ecological and societal reasons.

Wildfire Risk

Wildfires (along with floods and earthquakes) constitute the most devastating natural disasters in the Euro-Mediterranean Basin. Greek forest fires have been occurring with catastrophic frequencies and intensities for the last 50 years, in a fire-prone and vulnerable natural environment in terms of vegetation, topography, climate and human geography (Kalabokidis and Stamou 1996). In adverse climatic conditions predicted over the next decades, the wildfire problem of Greece will potentially intensify due to unorthodox land use planning and inherent lag in technological know-how adaptation.

Difficulties in confronting such natural phenomena in the region include not only an assessment of their biophysical causes, territorial distribution and damage inflicted in time, but also their dependence on human socio-economic activities and lack of the necessary technological infrastructure to mitigate their catastrophic effects (i.e., loss of

human lives, resources and property damages). In this context, wildland and other rural-urban interface settings are vulnerable to increased fire hazards. Regional fire prevention organizations must incorporate actions that aim to the harmonization of interdisciplinary research, technology and development (RTD) for systematic and quantitative wildfire vulnerability assessment, in addition to prompt and reliable fire prevention planning (Kalabokidis 2001).

Urban spread into traditional wildland areas complicates fire safety problems but does not negate effective solutions. Proper infra-structural design, construction and landscaping hold the most promise for controlling wildfire activity and damage while maintaining natural appearances. Vegetation management (e.g., thinning or clearings for adequate defensible space around and within structures) based on potential fire behavior criteria, fire-safe building construction features, adequate water and road systems for fire protection, and technocratic land-use planning and zoning are the key measures that need to be implemented. It is hoped that homeowners will become aware that complete fire-proofing is not possible, and residential developments are built at owners' risk in wildland surroundings. The above fire safety measures provide possibilities for proactively reducing fire hazards and protecting life and property (Kalabokidis 1996).

Systematic fire risk assessment of hazards and vulnerability should compose quantitative indices of wildfire behavior and effects with spatial layers of meteorological, vegetative, topographic and socio-economic information that will eventually develop geographical fire danger indices (Kalabokidis et al. 2002). The use of Geographic Information Systems and satellite technology supports the input, management, processing, spatial analysis, cartographic modeling and visualization of complex environmental data, referenced in space and time, for wildfire risk assessment. Such an information and computing infrastructure, developed a priori, can provide for on-time and realistic assistance in fire prevention planning and real-time fire suppression operations that will ensure public safety, maintain natural resources physically and aesthetically intact, and allow people to live in “natural” environments.

All in all, Greece has to confront the challenges of surviving in a biophysical and anthropogenic environment exacerbated by periodic catastrophes that propagates a continuous air of crisis. Such efforts, however, should point out that there must be a fundamental shift from a prevailing crisis management approach (short-range preoccupation and technological fixes) to a more anticipatory risk management that allows concentrating on contingency planning and reasonably foreseeable futures. Thus, the approach of policy formulation, management and implementation entails fundamental changes in outlook, visionary and goal-oriented commitment, as well as acceptance of the central premise that social, technical, economic and environmental problems are intertwined and must be resolved together (Kalabokidis et al. 2004).

Fire Policies

Originated back in the 1920s, Greek forest management and policies were inspired by the Germanic “school of thought” in all aspects of forestry, including fire management and

total fire suppression. Fire has not been an ecological factor of the cool and moist northern European ecosystems and an issue to be dealt with, and thus it was attempted to be also excluded from Greece's fire susceptible Mediterranean-type of ecosystems by all means and costs. This doctrine has complicated a great number of factors and issues dealing with Greek fire policies and land management in the decades to come. For the last 50 years, the Greek Forest Service of the Ministry of Agriculture has been exclusively responsible by law for holistic forest management and protection, including fire prevention, total fire suppression and post-fire rehabilitation activities; however, Forest Service's total effectiveness and results had been considered marginal and questionable. As of May 1998, fire suppression duties have been transferred to the Greek Fire Corps that until then was responsible for structural fires and only contributed to forest firefighting.

Most aspects of fire prevention remained with the Forest Service, which was reorganized into a regional structure without any provision for effective and consistent central coordination of activities across the country. Also, its aging scientific personnel has started to retire at high rates without proportional new recruitments, thus all in all, limiting its capability to successfully carry out all the forest management and protection tasks required. For example, range management has been minimal and prescribed burning is only considered at a theoretical level. Lack of technological know-how and appropriate funding for fire prevention (e.g., fire detection, fuels management, road maintenance, law enforcement, education and training) further deteriorates the situation. As a result of these nonsolid and multifaceted fire management and policy schemes, poorly managed forest ecosystems without any significant fire prevention and protection works could potentially worsen the wildfire problem in Greece, especially under extreme weather events and climatic anomalies of increasing frequency and severity.

The Greek Fire Corps (GFC) of the Ministry of Public Order has carried the responsibility for total forest fire control since 1998. The ground forces of the Fire Corps have outgrown significantly during the last few years. Currently, there are more than 10000 officers and permanent firefighters, assisted by 5000 seasonal firefighters during the summer; the number of fire trucks has exceeded 1100 units of various types. Furthermore, the Fire Corps has acquired experience and its organization has improved significantly. The ground forces are augmented every fire season by heavy aerial support. The aerial means in the country have become among the strongest in the world, compared to the size of the country. The national fleet of Canadair water-bombers, operated by the Greek Air Force, includes 14 older CL-215 and 10 new CL-415. There are also 20 single-engine PZL M-18 Dromader. Also, GFC has acquired 2 twin-engine helicopters and uses them for coordination of firefighting operations. In the summer of 2003, the national aerial fleet was augmented by a large number of contracted firefighting helicopters which provided an unequaled firefighting capacity: the helicopter fleet for this fire season included three Erickson S-64, four MI-26, three Kamov-32, and one MI-14 (Xanthopoulos et al. 2003).

The General Secretariat for Civil Protection (GSCP) of the Ministry of Interior is another state agency now involved in Greek fire policy; it has planning and coordination duties

for all types of disasters, including forest fires. Among other tasks, GSCP prepares a daily Fire Danger Prediction Map based on meteorological records and forecasts, historical records of fires and monitored vegetation conditions (NDVI) of the country. Local authorities, volunteers, the Army and Police also support fire related activities upon request.

The efforts of all authorities mainly on pre-suppression planning, in combination with the strong fire fighting efforts of the GFC (assisted, however, by favourable fire weather) resulted in reduced burned area and damages in the beginning of the 21st century, despite some recent catastrophic wildland fires in Greece and the rest of southern Europe. For example, Samos island, Peloponnesus, Attica and other large wildfires only in year 2000 burned a record high of 150000 hectares across Greece; over 0.7 million hectares of forests in Portugal, Spain, France and Italy went up in flames causing loss of life, destruction of homes, and millions of Euros in damages due to 2003 fire season's unprecedented heat wave (Fabbri 2003). Nevertheless, the effort and effectiveness demonstrated in Greece between the years of 2001 to 2003 should carry on into the next years with similar momentum, since the whole Euro-Mediterranean Basin is faced with multiple biophysical and anthropogenic risks and challenges in all aspects, including civil protection and emergency management planning.

IV. The American Experience

Catastrophic wildland fire in the United States is now an annual event. Fire, once a tool utilized by native populations to maximize forage and selected flora and fauna, is now a challenge for forest managers, public administrators, and ecosystem managers. Public fire policy has changed over more than a century of land and resource management. At the same time, the role of fire in ecosystems has been vastly miss-understood and is still a matter of intense investigation (SA&ID 1995). What is evident are increasing numbers of large fires with high rates of infrastructure damage. The number of lives lost in these fires continues to rise. Overall, the risk of catastrophic fire has increased (OP 2003). The response to the increased risk has been to expand prevention and suppression at all levels of government. The road to fire control, however, is not as clear as it may seem.

Physical Context

The United States, excluding Alaska and Hawaii, is located in the mid-latitudes. The large land area is extended from the Rio Grande and Mexico to the Canada. Across this area there are major landforms including the Appalachian Mountains along the east coast, the Great Plains in the central part of the country, the Rocky Mountain orogeny, the Great Basin and Southwest deserts, and the Cascades and Sierra Nevada Mountains of the Far West. Each of these areas has a unique set of topographical, climatic, and vegetative features. In terms of wildland fire, regional biogeography and weather patterns become highly significant in determining the causes, extent, and impact of wildland fires (WGA 2001).

In the western United States, large areas of pine and fir forests are interspersed with grasslands, wetlands, and ecotones of mixed forests. These forests are usually at higher elevations and include mountainous and rugged terrain. Naturally occurring wildfire and anthropocentric fires have played a significant role in defining plant species and extent for forest areas. A general pattern of summer lightening storms associated with rain has established a fire regime to which many species are adapted. Fire has historically played a critical role in the release of seeds and provided a thinning process that allowed fewer, healthier trees and forests to mature (WGA 2003).

La Nina (phase of the El Nino Southern Oscillation), an atmospheric disturbance characterized by unusually cold sea surface temperatures in the eastern Pacific Ocean has played a significant role in the temporal patterns of weather across the southeastern and southwestern United States. Weather patterns usually include warm moist air moving inland and resulting in adequate precipitation to keep soil and vegetation moisture levels high enough to counter summer lightening storms. Since the late 1990s, La Nina has altered the weather patterns by reducing the amount of marine moisture reaching the Southeast and Southwest. The lack of moisture has created a severe drought condition, making wildlands particularly susceptible to dry lightening storms and anthropocentric fire (Morehouse 2000). Grasses and small woody plants had reached high levels of productivity in the years prior to La Nina. The grass and plant fuels were added to the already high accumulation of woody debris and slash in forested areas. These factors, as well as a long history of forest management practices, create the current high level of fire risk faced by US administrators and private citizens.

Historical Context

There is a large amount of literature dedicated to the explanation of American forest and forest fire policy. This literature covers a wide range of topics including native and natural landscapes, changes in forest land uses, technology and improved detection of fires and fire fighting, and analyses of fire policy. Two essential sources on wildland fire and forestry are Stephen Pyne's (1997) Fire in America and Michael Williams' (1989) Americans and their Forests. A wider scope of fire and fire policy includes related issues of environmental history, changing timber and forest products economies, outdoor recreation and housing construction on the urban-forest interface, and related global issues such as air quality. A summary of American environmental history, and forest and forest fire management set the context of the current level of wildland fire risk in the US.

The complexity of American fire policies over time is due to a number of factors. Historically, the rate of European and American settlement across the nation's land mass is uneven. Generally, the eastern and southern areas of the land area were settled first. Extensive broadleaf and mixed forests at the time of settlement, dominated these areas. The climate is temperate with seasonal periods of high humidity. Later settlers, unable to find land east of the Appalachian Mountains, became to push westward until they reached the 100th meridian (W). Faced with large expanses of grassland on the Great Plains and a much more arid climate, settlers continued westward until they reached the Oregon Country and other West Coast locations. The western United States included extensive

forestlands. Except for regional variation in aridity and landforms such as deserts and dry lakebeds, the settlers encountered forest areas that appeared to be static ecosystems. Forest fires occurred but except in a few major events, did not threaten American settlement until a much later date in American environmental history and forest management and policy.

Forest management and fire policies exist within a cultural, social, economic, and political context. Fire's movement from a position of a tool utilized by Americans to achieve a preferred ecosystem to a high-risk event with the capacity to destroy structures and lives can be traced along a time-line of changing natural and social systems.

The long history of fire utilization can be traced to indigenous practices of setting fires to increase natural pasture production. European accounts of large open fields within the forested areas attribute the fields to native burning. These fields, abandoned as the native populations declined, were called "old fields." It is unclear as to the degree that settlers continued the practice of setting low temperature slow moving fires in the old fields or to forest areas. However, the practice of encouraging grass production with the use of fire continued in some landscapes especially the southern Appalachians.

Fire was also used to clear lands for agricultural purposes. To some degree, American land clearing followed the old pattern of slash and burn agriculture. Timbered lands were cleared by felling logs that than were utilized for house construction. Slash and woody debris were piled and burned. Burning slash was and continues to be a common practice of private land owners and public forest managers. In an official capacity, slash burning is now carefully controlled as "prescribed burning." However, private land owners burn slash and yard wastes as a disposal method.

The ecosystems that westward moving American settlers encountered appeared to be wild and natural. In reality, large forest areas of the western United States were abandoned landscapes managed by native populations for a specific level of flora and fauna. The lands appeared natural because the native populations had been radically reduced by contact with European diseases and American policies of native de-population. The forests and natural systems, without the presence of anthropocentric fire, were gradually transforming into less diverse ecosystems with higher levels of woody debris and brush. When fire occurred, the results were destructive to the forest ecosystems. American settlers experienced forest fires as destructive events and responded with increasing levels of fear.

Fear of increasingly destructive forest fires became a major national concern by 1900. Demands for forest management and fire detection played a considerable role in the creation of the United States Forest Service. Created in 1906, the US Forest Service (USFS) became the primary forestland management agency in the country. Large areas of forestland from the Rocky Mountains west and smaller areas in the Appalachian Mountains were divided into national forests. The US Forest Service was charged with the scientific management of the lands within the national forest system. Fire detection and suppression were significant goals of the conservation agency.

The federal agency sought to control the threat of wildland fire. Over a period of several decades, the US Forest Service built lookout towers, developed tools and firefighting methods, hired seasonal crews, and focused its efforts on detecting and stopping wildland fire. The national policy was to protect the forest resources and prevent the destruction of lives and private property in proximity to the national forests. Protection of the national forests was accentuated during periods of national crisis including world wars and economic depression. Between World Wars I and II, the Roosevelt administration expanded forest management and fire suppression by enlisting thousands of unemployed men in the Civilian Conservation Corp, a Works Progress Administration program.

The demand for lumber and forest products expanded in the United States after the Second World War. Many communities surrounding national forests expanded their ability to process logs and supply the growing national demand for housing. The need to protect the timber resource from fire also grew. Fire prevention became a form of national security at the local level. Consequently, the forest ecosystems continued to shift from frequent fires to a near elimination of fire. Species that had adapted to fire became stressed. The indicators of forest stress, including disease and pest infestation, increased throughout the forestlands. The accumulation of woody debris and brush also increased over time.

The gradual loss of historic forest matrix, coupled with other environmental problems such as pollution, over harvesting of timber resources, and high levels of cattle grazing in the national forests led to serious questions about habitats and declining diversity of forest flora and fauna. A series of environmental policies were instituted at the federal level of government between 1969 and 1986 that had immediate effects on forest management including grasslands, fires, ecosystems, and public participation in management and planning efforts. Briefly, these Congressional acts include the Clean Air Act, the Clean Water Act, the National Environmental Protection Act, the Endangered Species Act, and the Forest Management Act.

The passage of these acts and their effects on forests and participatory democracy can be directly linked to wildland fire events, detection, suppression, prediction of, and public awareness of healthy forests that include fire. Before these effects can be assessed, other social and ecological conditions must be addressed in order to place the effects within a context.

Public awareness and participation in forest health has evolved over the last century. Two basic lines of thought, almost but not totally opposed to each other, have developed over time. These two ideas play a major role in fire policy and implementation today. Public demand for lumber and wood products has created one line of thought while at the same time, conservationists and preservationists have moved in various degrees towards limiting the extraction of timber from the public forests. The US Forest Service, directed on Congress and sometimes by presidential executive order, has tried to negotiate between the opposing ideas.

Public participation in forest management can be linked to other social movements including outdoor recreation, environmental education, the wilderness movement, and speciesism. These social ideas have been facilitated to some extent by increased accessibility in forests and other natural settings. The last twenty years has seen a gradual but drastic rise in the number of recreation homes and residences built within close proximity to the national forest boundaries. At the same time, forest science, ecology, and social science investigations into the relationship between nature and human experience have clarified the role of forests and ecosystem constituents in the human matrix. Fire plays a significant role in the ways in which people perceive forests and ecosystems as well as solicit support for public forest and personal property agendas.

Recent catastrophic fires have destroyed hundreds of homes primarily on the urban-forest interface (USDA 2003). The loss of lives and property has been extraordinarily high compared to previous decades. The general public perceptions are that forest fires should be controlled and not pose a threat to humans and property. It is interesting to note that what attracts people to live on the forest margins, that is a sense of living in a 'natural environment,' is done within the mystic of eliminating the 'wild' from wild lands. A generational difference in perception and relationship to natural areas and fires is becoming apparent within American society. An older generation participated in preventing and suppressing fire while living at a safe distance from the threat of wildland fire. The current generation is more likely to move closer to a natural area such as a national forest and expect elimination of fire as a threat.

The strict prevention and suppression of forest fires since 1900, to insure a generous timber supply to meet the rising demands of a growing population, altered the forest and ecosystem composition. As already noted, the build up of woody debris due to the lack of fires stressed the ecosystems. Forest fires in the United States are now unusually destructive due to forest management policies and activities over the last one hundred years. Large-scale timber harvesting especially the removal of large trees has created large amounts of small diameter trees and woody debris. Coupled with drought, the public forests are experiencing catastrophic fires.

The federal agenda of promoting high levels of timber harvest caused another serious impact on forest management. With excessive logging and the prevention of fire, biodiversity in forested areas declined. Recent forest and environmental policies especially the Northwest Forest Management Plan and the Endangered Species Act have targeted the loss of species and habitats (USDA 1996). Fire, a primary restorative force, must be reintroduced into forest ecosystems in order to enhance specific habitats and the recovery of endangered species. Pyne (1997) asserts that the more destructive fire management in the 1970s was not the high levels of prevention and suppression but the reduction in the use of controlled burns for ecosystem management.

Fire, in this scenario, is enlisted by forest managers as the tool it once was. Prescribed burning is now an important part of forest treatment. These fires are set in periods of high humidity and under controlled situations. Optimally, a prescribed fire burns slowly at low temperatures along the ground. The result is a naturally cleared lower story within a

complex of trees and shrubs. A fire will also promote the growth of specific species and thin stressed trees from the gene pool. Since 1990, catastrophic fires have destroyed millions of hectares, structures, and caused loss of human life. The fires also burn at relatively high temperatures to destroy soil nutrients and seed. The fires have been at a high cost to forest ecosystems and human systems (USGAO 2000).

This general and compressed review of American ideas about wildland fire has highlighted changing beliefs and actions associated with wildlands, and the use and suppression of fire. Historical changes in perception, management, use, and proximity to forests has had a direct impact on the role of fire in the landscape.

Wildfire Risk

Foresters and other federal land managers became aware of the increasing risk of wildfire on public wildlands in the 1980s. The eighty-year policy of total fire suppression had allowed huge volumes of woody debris and slash to build up in the forests. In 1910, more than 500000 hectares burned. This number dropped dramatically and reached a plateau of 80000 per year until 1980 (USGAO 1998). The rise in the number of hectares burned since 1980 is almost equal to the decline in fires after 1925. It is estimated that the annual area consumed by wildfires dropped from 16 to 20 million hectares a year in the early 1930s to two million hectares in the 1970s. Between 1984 and 1995, the number of fires and the number of hectares burned has risen dramatically (USGAO 1999).

Ninety six percent of the hectares burned are located in the interior West. A map of lands at medium and high risk of catastrophic fire indicates that the mountainous regions of the west are at the most risk. These areas are primarily public lands administered by the USFS. Smaller trees and woody brush normally destroyed by low intensity fires had accumulated to a point that fires were becoming much hotter and causing significant damage to soil, water, wildlife, timber, and USFS infrastructure. In addition to declining forest health, invasive grass species such as cheat grass had spread through much of the wildlands. These grasses increased the fuel load on public and private lands.

The fuel situation must also be placed in the context of the increasing popularity of residential building on the edges of national forests and wildlands. The population growth along the margins of public forests has increased dramatically. A map based on US Census data indicated that nearly all counties in Nevada, California, and Arizona have experienced more that twenty five percent growth rates since the 1980s. Many of these counties include national forest and other public wildlands.

To meet changing social values, population growth, forest ecology, and the risk of fire, the United States government, acting through agencies, has constructed policy statements. Federal, regional, and local personnel theoretically implement policy statements on the ground. It is to the current policies we will now turn.

Fire Policies

The American policy of total fire suppression for eighty years created a tinderbox only waiting for combustion. In 1988, a series of thunderstorms ignited the lodgepole pine forests in and around Yellowstone National Park, a preserved area located in the northern Rocky Mountains. Given the natural park and wilderness status of the area, the first fires of the summer were monitored. But by July 21st, several large fires were burning. Within a week the fires consumed 40000 hectares and by in a month winds had pushed the fires across 60000 hectares. The park was closed to visitors and a major firefighting effort including 25000 firefighters was undertaken. By September a total of 0.5 million hectares were burned including approximately thirty six percent of Yellowstone National Park.

The federal government engaged in a massive effort to 1) access the impacts of the fires; 2) assess changes in policy in order to prevent such extensive losses of property and ecosystems; and 3) clarify needs and reconstruction of the Yellowstone ecosystems and facilities. Fire policies of the past were identified as one of the major contributions to the extensive 1988 fires. Prior to 1972, all fires in national parks were stopped as a way of preserving the area and its appeal as a natural place. As research and experience on the need for fires to promote natural settings increased, some fires were allowed to burn in national parks. After the 1988 fires, prescribed burning became a major element in park and fire management.

On July 6, 1994 a series of wildfires erupted in southern Colorado near Glenwood Springs. The combination of lightening and a drought stressed forest resulted in a cluster of fires on the White Mountain National Forest. The fire cluster quickly reached the status of a "complex fire," a situation that moves fire management into a critical level of suppression response (USDA 1998). Firefighting equipment and personnel from national, tribal, and local resources were called to Glenwood Springs to assist in the firefighting effort. A specialized crew of firefighters, known as "hotshots," as sent from the Ochoco National Forest in Prineville, Oregon to assist in the effort.

A small lightening fire had been reported in South Canyon not far from Glenwood Springs. The Prineville Hotshots, along with three other firefighters from other units, were sent to contain what became known as the South Canyon Fire (also known as the Storm King Fire). The Hotshots started up the steep and rugged slopes of South Canyon. Their information about the fire was that it was small and could be contained without much effort. By the time the hotshots located the exact fire location, an un-reported wind began to push the fire up the slopes of the canyon. The expanding fire rapidly engulfed the firefighters, whose only option was to try and out-run the fire. By the end of the day, fourteen firefighters died in South Canyon (USDA 1998).

The South Canyon Fire and the deaths of fourteen young firefighters set in motion a series of investigative reports about the causes of loss of life. Ultimately, a new cadre of federal policies designed to prevent the loss of life and property due to catastrophic fire were implemented. The policies emphasize the increasing risk of fire in poorly managed forests and wildland settings, and the need to establish cooperative management

guidelines for the prevention and management of wildland fire. An entirely new approach to wildland fire has been created since the South Canyon Fire critical fire event.

Immediately following the disaster in South Canyon, representatives of US land management agencies and the Bureau of Indian Affairs conducted an extensive review of firefighting policies, ecosystem status, agency coordination ability, and funding levels. The result of their analysis was the first comprehensive national fire policy known as the Federal Wildland Fire Management Policy and Program review report. Issued in 1995, the federal policy establishes a series of guiding principles and details operating procedures for all federal firefighting efforts. The guiding principles and policies include:

1. Firefighter and public safety is the first priority in every fire management activity.
2. Wildland fire is an essential natural process that will be incorporated in management planning.
3. Fire management plans will support other planning efforts.
4. Risk management will be incorporated in all other management plans.
5. Fire management costs will be included in other management costs and objectives.
6. Fire management will be based on the best available science.
7. Fire management will incorporate public health and environmental quality considerations.
8. Federal, state, tribal, and local agencies will work collaboratively.
9. Policies and procedures among federal agencies will be standardized.

This list and accompanying background information was further defined in the 1995 plan. Collectively, the plan and accompanying report is the primary US National Fire Plan. Governmental agencies at all levels are guided by the document. Additional reports and up-dates to the plan occur on a regular basis. The most important of reports and planning initiatives are included in this discussion.

In the wake of the South Canyon Fire and the National Fire Plan, several investigations into the increasing risk of catastrophic fire were conducted. The US General Accounting Office (GAO) was directed by Congress to assess wildfire threat to resources. In a 1998 report entitled “Western national Forests: Catastrophic Wildfires Threaten Resources and Communities,” the GAO summarized the risk of fire due to extensive and serious forest health problems, the status of US Forest Service response to forest health, and the agency’s attempts to address the problems (USGAO 1998). The primary forest health problem was the extreme amount of fuels (woody debris) that had accumulated in the forests. This accumulation was due to the historic policy of total fire suppression and extensive timber harvesting administered by the USFS. Further, the USFS had inadequate data to develop a strategy to remove the fuels. Prescribed burns were gradually being implemented but at the additional risk of turning into catastrophic fires as well. The 1998 GAO report was followed in 1999 by a GAO strategy report. This report again cited the USFS’s inability to act without better scientific data on the role of and utilization of fire in reducing fuels. Fire risk at the forest-urban interface was especially noted (USGAO 1999).

In the spring of 2000 National Park Service personnel set a prescribed burn on the Bandelier National Monument, a National Park Service facility. The fire rapidly grew into an intense fire that moved rapidly through the monument and on to adjacent public and private land. Ultimately, the fire burned 19000 hectares, forced 18000 people to be evacuated, required 1000 firefighters and equipment to reach containment, and caused an estimated one billion dollars in damages. The fire, known as the Cerro Grande fire event seriously damaged a large area of northwestern New Mexico especially the community and research facilities at Los Alamos (USS 2000).

The cause of the Cerro Grand fire was investigated in a number of reports. In a statement prepared by the GAO for Congress, the use and setting of prescribed fires by monument personnel was identified the primary cause of the fire. The report recommended changes in the use prescribed fire management by all federal agencies to include a peer-review process; development of contingency plans, and coordination across all agencies to effectively address prescribed burns that accelerate into wildfires.

The 2000 fire season was, at the time, the worst recorded in US history. By September more than 2.6 million hectares – more than two times the ten-year national average – had burned. This extraordinarily combustion was due to severe drought and summer lightening storms. Combating the fires required huge amounts of personnel and equipment. More than 29000 fire fighters, including foreign firefighters, were required. The firefighters extinguished 75000 fires, 95 percent of them before they became large fires. President Clinton requested a report on the status of fires and the impacts of wildfires on communities and the environment. The research found that the risk of catastrophic fires was primarily due to the previous century's fire suppression policies, the large build up of fuels, and a lack of knowledge about the impact of fire on local communities (USGAO 2000).

Based on the research, the report recommended that all necessary firefighting resources be made available for the protection of life and property. Secondly, the report recommended the restoration of landscapes and the rebuilding of communities affected by the 2000 fires. Third, federal agencies should assist local communities in reducing the risk of fire. Community participation, local capacity to develop volunteer firefighters, and public education were listed fourth. Finally, the report recommended an Executive Cabinet level coordinating team be put in place to monitor firefighting efforts. The report also reviewed funding levels and recommended that the budget for Fiscal Year 2001 be expanded to 2.8 billion dollars (USGAO 2000).

The Western Governors' Association led the effort to improve community involvement portion of fire risk reduction. The Association brought together agency leaders at all levels of government, Tribal and state leaders, and local citizens. This group developed a collaborative effort to reduce fire risk at the community level. A 10-Year Comprehensive Strategy was identified in August of 2001 (WGA 2001) and an Implementation Plan was issued in May of 2002 (WGA 2002). The implementation plan set goals and guiding principles for the 10-Year Strategy. The goals and principles reinforce firefighter safety, long-term investments, collaborative decision-making, accountability measures, and a

focus on local social conditions. In addition, the plan set out guidelines for managing fires in the urban-interface including private stewardship education. Prescribed burning was identified as the primary tool for reducing fuels and fire risk in the urban interface zone (WGA 2002).

The most current policy statement of wildland fire risk and management is contained in President Bush's Healthy Forests initiative dated August 22, 2003 (OP 2003). The initiative is based on the 2001 fire season that exceeded 2000 in terms of hectares burned and communities affected by wildland fire. Adversely affected were communities in the urban interface zone. Fuels build-up was again identified as the primary cause of catastrophic fire. The initiative focuses on implementing the 1995 National Fire Plan (SA&ID 1995) by expanding the coordination efforts between agencies, reducing overlapping environmental policies, developing guidance for weighing short term risk and long term benefits of fuels treatments, and developing a model environmental assessment reporting process to streamline National Environmental Policy requirements.

The Healthy Forests initiative (OP 2003) also advocates expanding the role of private contractors in reducing the volume of fuels. Volunteer firefighters and an expansion of the Student Conservation Association internship program will provide additional personnel to document risk and assist in firefighting. Local landowners are also notified that they are responsible for preventing and fighting fire in the urban interface zone. Finally, the initiative seeks to reinforce the selective harvesting of timber to decrease fire risk as laid out in the 1994 Northwest Forest Plan (USDA 1996). Selected harvesting would reduce fuels as well as provide jobs in local communities.

United States wildfire management is documented by a series of reports, initiatives, and policy statements. These documents establish goals and provide guidance at the federal, state, tribal and local levels of government for managing wildfire on US public lands and in those areas were state and private lands are susceptible to catastrophic fire especially the urban-forest interface. Ultimately, the documents reveal the public will for managing forest and range resources.

United States wildland fire policies have developed over a period of time when fires were increasingly catastrophic. The high risk is the result of a century of total fire suppression that allowed large volumes of fuels to accumulate in forests. The USFS attempted to address the fuels problem but did not have adequate data. The lack of preparedness and poor administration of previous harvesting practices were overshadowed by a severe drought in the American West and the advent of disastrous fires that claimed lives and destroyed property. Since 1994, a series of increasing specific reports and initiatives have recommended protection and safety for firefighters, a reduction in fuels especially with the use of prescribed burns, increased research and collaboration between land management agencies and all other levels of government, and an expanded role of private contractors and homeowners in firefighting.

The US policy history indicates a growing awareness of risk. However, several factors become apparent and indicate that policy has been set in response to the development of

catastrophic fire. It is only after disastrous fire events such as the South Canyon Fire and the Cerro Grande Fire that major policy changes were instituted. The response to current fire conditions is linked to a greater role of agency collaboration, research and the application of science, an expanded role of private contracting and homeowner participation, and the development of a volunteer firefighting force in urban-forest interface zones. These current policies are primarily focused on a response to past forest management practices and changing demographics.

The protection of lives and property as the number one goal of firefighting efforts cannot be avoided. There is a large amount of literature dedicated to the explanation of American forest and forest fire policy. This literature covers a wide range of topics including native and natural landscapes, changes in forest land uses, technology and improved detection of fires and fire fighting, and analyzes of fire policy fire policies set the context of the current US wildland fire situation.

The re-establishment of fire as a part of the natural ecosystem is addressed with a policy to increase prescriptive burning. The prescribed burns reduce the current fuel loads and, theoretically, should pave the way for less intense fires in the future. Ecosystem managers are now included in the planning of prescribed burns and in fire fighting overhead teams. Whether a "natural" cycle of wildfire will ever return to the American West is yet to be determined. Given the current fire and forest conditions it would appear that fires will be carefully managed in the future (WGA 2003). In this context, fire returns to its status as the primary tool of wildland management, and deflates the idea that lands and fire are "wild."

V. Comparative Analysis of Greek and American Wildfire

A comparison of Greek and American physical geographies, environmental histories, wildfire risk, and wildfire policies reveal similar patterns of natural and anthropogenic wildfire over a long history of human habitation. It is in this comparison that large-scale commonalties and locally significant difference become evident. The comparative approach sheds light of the diffusion of knowledge, scales of significance, and patterns of social constructions of natural environments and processes.

While North American and southern Europe would appear to be physically dissimilar, large areas of both continents share Mediterranean climate zones and associated ecosystems. Both continents also have extensive volcanic and faulted mountainous areas. Vegetation changes in these mountainous areas along a transverse known as altitudinal zonation. For example, lower elevations are characterized by temperate deciduous forests which are replaced by temperate evergreen forests, sub-alpine pine forests, and finally, treeless tundra and alpine conditions at the highest elevations. Wildfire occurs in Mediterranean grass and shrub zones, and in temperate and sub-alpine evergreen and pine forests in both locations. The vegetation in these zones are pre-adapted to fire, in other words, species are dependent upon fire for regeneration. Lightening was the primary source of fire prior to human occupation.

Human occupation of both continental locations included the introduction of fire as a method of encouraging specific ecosystems components, primarily grasses for the pasturage of wild and domestic animals. In the United States, indigenous peoples used fire to open forest areas and enhance wild animals that were taken in hunting. Human occupants of Greece used fire to clear land for agriculture. The use of fire for land clearing and agriculture was greatly expanded in the United States with European occupation. The Americans continued to use fire to clear land. Fire was part of a matrix of land management tools and was used by local people who were knowledgeable of its capabilities.

American interests in land management and forest protection were expanded to a national level by the twentieth century. Greece, on the other hand, was a loose set of regions often administered by foreign entities that were not so interested or able to manage land. The large expanses of publicly managed lands in the United States were administered by a strong federal organization that relied on scientific forestry to guide forest uses. Wildfire was transformed from a tool of management to an enemy that required total suppression. As a result, the forests became fire deficient. By the end of the century, massive, catastrophic fires were occurring because of a fire-less environment.

Greek forestry policies were very slow to develop. Fire management was not available or affordable during the twentieth century. Other land management strategies at the local level encouraged the use of fire. The "natural" environment of Greece maintained a fire-inclusive regime that was managed by local people.

These conditions changed when Greece joined the EU. EU policies encouraged more global and outward looking land management strategies. At the same time, severe drought became a major component of the environment. As a result, fire became a catastrophic event beyond local control. Major fire fighting efforts have been in place in Greece since the late 1990s. European, national, and local efforts are focused on the complete suppression of fire.

Both countries are now dependent on major fire fighting organizations outside of forest management agencies. Fire control has been elevated to a status within the federal governments. While the federal governments are attempting to suppress fire with major expenditures on equipment and fuels reduction, the balk of fire fighting is being placed on volunteer fire fighters. This strategy may be effective in Greece where numerous local volunteer organizations have formed since the late 1990s. However, volunteer fire fighting at the local level in the United States, while a major component of federal planning for wildfire, it is yet to be tested.

Both countries are investing in fire prevention and predictive modeling. Scientific research and technical applications are making it possible to increase the level of fire prediction. Much of this work is done within the context of global climate warming. The opportunity to share knowledge and exchange technologies is expanding wildfire work to a global level of knowledge, exchange and implications. Eventually, work between

Europe and America will result in global standards and harmonization for forest management and wildfire prevention and control. Fire fighting has already become an international activity.

Sharing wildfire knowledge and management technologies across international borders expands the spatial context of socially constructed natures. Forests, the "nature" of this research, will eventually become more similar and less diverse over time as consistent management guidelines are applied in both countries on the two continents. The future of wildland fire management will hopefully move from catastrophic to predictable and manageable levels of risk.

VI. Conclusion

The regional comparison of the two countries' experience with wildfire reveals a common thread of experience and management regimes. Efforts to control the risk of fire damage over time have created an equal level of crisis and management tools. A comparison of environmental histories, wildland events, and management goals indicate that the two countries, while seemingly un-comparable, have much in common. On a grander scale, this research indicates that catastrophic world wildfire events may be evaluated across spatial and temporal systems.

A common pattern of the loss of traditional fire practices has been replaced by Germanic inspired forestry and total fire suppression. The United States is now in the process of re-defining these policies based on recent catastrophic fires while Greece continues to suppress fire despite recent fires. The global loss of traditional fire practices and the increasing efforts to manage fire are establishing new social boundaries of catastrophic fire.

VII. References

Alexandrian, D., and F. Esnault, 1999. Public policies affecting forest fires in the Mediterranean basin. In Proceedings Meeting on Public Policies Affecting Forest Fires. Rome (Italy). 28-23 Oct. 1998. FAO. Pp. 39-58.

Fabbri, K., 2003. Southern Europe in flames. Automated Fire and Flood Hazard Protection System Newsletter, University of the Aegean, Department of Geography, December 2003(2):1,3.

Kalabokidis, K.D., 1996. Wildland fire safety in residential areas. In Proceedings International Fire Safety Conference, 24-25 May 1996, Santorini, Greece. Department of Civil Engineering, Aristotelian University of Thessaloniki, Greece. Pp. 267-278.

Kalabokidis, K.D., 2001. Forest fire prevention, problems and strategies. In Proceedings of the 2001 AGROTICA Symposium on Forest Development and Protection, 1 Feb. 2001, Thessaloniki, Ministry of Agriculture & NAGREF. Pp. 13-19 [in Greek].

Kalabokidis, K.D., and N. Stamou, 1996. Analysis and planning for forest fire management in the Aegean. In Proceedings 7th National Forestry Conference, 11-13 October 1995, Karditsa, Greece. Hellenic Forestry Society, Thessaloniki, Greece. Pp. 558-567 [in Greek].

Kalabokidis, K.D., S. Gatzojannis, and S. Galatsidas, 2002. Introducing wildfire into forest management planning: towards a conceptual approach. Forest Ecology and Management 158(1-3):41-50.

Kalabokidis, K.D., C. Karavitis, and C. Vasilakos, 2004. Automated fire and flood danger assessment system. In Proceedings of the International Workshop on Forest Fires in the Wildland-Urban Interface and Rural Areas in Europe, 15-16 May 2003, Athens. Ed. Gavriil Xanthopoulos, MAICH, Crete, Greece. Pp. 143-153.

Konstantinidis, P., 2003. Learning to live with Forest Fires. Thessaloniki: Xristodoulidis. [in Greek].

Marmaras, Em., 1991. The apartment building of the Inter-War Athens: The beginning of intensive speculation on urban land. Athens: Cultural and Technological Foundation of Greek Bank of Industrial Development. [in Greek]

Morehouse, B.J., 2000. The implications of La Nina and El Nino for fire management. Workshop Proceedings. A CLIMAS publication, University of Arizona, Tucson, USA.

Office of the President, August 22, 2003. Healthy Forests: An Initiative for Wildfire Prevention and Stronger Communities.

Pyne, S.J., 1997. Fire in America. Seattle: University of Washington Press.

Secretaries of Agriculture and Interior Departments, December 18, 1995. Federal Wildland Fire Management Policy and Program Report.

Stamou, N., K.D. Kalabokidis, P. Konstantinidis, S. Fotiou, A. Christodoulou, V. Blioumis, P. Prastacos, M. Diamantakis, and G. Kochilakis, 1998. Improving the efficiency of the wildland fire prevention and suppression system in Greece. In Proceedings 3rd International Conference on Forest Fire Research and 14th Conference on Fire and Forest Meteorology, 16-20 November 1998, Luso-Coimbra, Portugal. Published by ADAI, University of Coimbra, Portugal. Pp. 203-221.

Tsiourlis, G.M., P. Kasapidis, and P. Konstantinidis, 2001. The role of grazing on the maintenance and degradation of Mediterranean Ecosystems in Central Crete, Greece. In Proceedings of the Int. Conf. Forest Research. Radoglou, K. (Ed.): a challenge for an integrated European approach. Volume II. August 27-1 September 2001. Pp. 715-721.

US Department of Agriculture, Office of Forestry and Economic Assistance, December 1996. The Northwest Forest Plan: A Report to the President and Congress.

US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Research Paper RMRS-RP-9, September 1998. Fire Behavior Associated with the 1994 South Canyon Fire on Strom King Mountain, Colorado.

US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, MT, June 2003.Thoughts on the Wildland-Urban Interface Fire Problem, Jack Cohen, Research Physical Scientist.

US General Accounting Office, Testimony before House of Representatives, September 1998. GAO/T-RCED-98-273. Western National Forests: Catastrophic Wildfires Threaten Resources and Communities.

US General Accounting Office, Testimony before House of Representatives, April 1999. GAO/RCED-99-65. Western National Forests: A Cohesive Strategy is Needed to Address Catastrophic Wildfire Threats.

US General Accounting Office, September 8, 2000. Managing the Impact of Wildfires on Communities and the Environment: A Report to the President in Response to the Wildfires of 2000.

US Senate, July 20, 2000. GAO/T-RCED-00-257. Fire Management: Lessons Learned From the Cerro Grande (Los Alamos) Fire, Testimony before the Committee on Energy and Natural Resources.

Western Governor's Association, August 2001. A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy.

Western Governor's Association, May 2002. A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan.

Western Governor's Association, July 19, 2003. Forest Health Summit Consensus Recommendations.

Williams, M., 1989. Americans and their Forests. New York: Cambridge Press.

Xanthopoulos, G., P. Balatsos, F. Theodorou, D. Alexandris, O. Kakaliagou, and K. Kalabokidis, 2003. A cool fire season for Greece. Automated Fire and Flood Hazard Protection System Newsletter, University of the Aegean, Department of Geography, December 2003(2):2-3.