Wildfires and Tourism in the Mediterranean: Balancing Conservation and Economic Interests

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Wildfires have been a recurrent issue in the Mediterranean region due to its hot, dry summers and dense vegetation, exacerbated by human activities and climate change. This paper examines the complex relationship between wildfires and tourism in Southern Europe, focusing on their regional patterns, interactions, and socio-economic impacts. The study identifies key drivers of wildfire incidence, such as climatic conditions, vegetation type, human activity, and topography, and analyzes their implications for the tourism sector. Through a systematic review of the literature, the authors highlight the increased frequency and intensity of fires in the Mediterranean, which have caused significant ecological, economic, and social damage. The research also discusses the regional diversity of fire occurrences, revealing that most large fires are concentrated in Spain, Portugal, Greece, Italy, France, and Croatia, among the most popular tourist destinations. The impact of wildfires on tourism is multifaceted. At the same time, they decrease the attractiveness of affected areas, leading to reduced visitor numbers and economic losses. The paper suggests that effective fire management and prevention strategies, including public awareness, sustainable tourism practices, and international cooperation, are essential to mitigate the adverse effects of wildfires. It calls for integrating risk management into tourism development plans to enhance the resilience of Southern European destinations to future fire events.

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INTRODUCTION

Climate and nature have created ideal conditions for fires to occur in the Mediterranean since ancient times. Vegetation fires are frequent, especially during the summer season, when the climate is dry and hot (Ruffault *et al.* 2016). In addition to physical geography, the spread of fires in southern Europe is also facilitated by human activity (Ricotta *et al.* 2014). Growing population, urbanization, and changes in land management contributed to an increase in the number and intensity of fires in the 20th century (Aquilué *et al.* 2020; Sil *et al.* 2024). Forest fires in Mediterranean countries were often caused by human activities such as agriculture, land burning, negligence, or even intentional actions (Santín and Doerr 2016; Ascoli *et al.* 2021). In recent decades, fires have become more frequent and more destructive, mainly due to climate change (Turco *et al.* 2014). The forecasts for the coming years are not favorable for southern Europe. As climate changes continue, fires are expected to become an increasingly pressing issue

(Fréjaville and Curt 2015; Richards *et al.* 2023). Adaptation to new climate conditions, quality prevention, crisis management, and raising public awareness of the issue are key to reducing risks (Flannigan *et al.* 2006; Grünig *et al.* 2023).

Fires have significant ecological, economic, and social impacts in the Mediterranean. Forest fires destroy large areas of natural vegetation, leading to loss of biodiversity and long-term damage to ecosystems. The consequences of fires are devastating not only for natural ecosystems but also for the local economy and residents. Fire-related damage slows the growth of gross domestic product, increases social spending, and can sometimes lead to threats to the health and lives of residents. Among the most affected sectors of the national economy are tourism, agriculture, forestry, and fishing (Kalogiannidis *et al.* 2023). Tourism, which is crucial to the Mediterranean region, has suffered significant damage in recent years due to the cancellation of bookings and overnight stays in areas affected by the fires. Large wildfires also reduce the recreational value of land and natural parks. The decline in the attractiveness of tourist destinations negatively affects the income of businesses in the tourism industry and, by extension, regional economies (Otrachshenko and Nunes 2022). For the above reasons, it is essential to pay attention to research into the causes, progress, and effects of fires. At the political level, it is necessary to plan and implement measures to mitigate the impact of wildfires and protect the natural heritage in the region of Southern Europe (Bacciu *et al.* 2022).

In recent years, the growing interest of researchers and the professional public in wildfires can be seen. Despite a considerable number of published articles and literature reviews, there have been only a limited number of studies focusing on regional aspects of fires and tourism in Southern Europe. As far as the authors know, a systematic literature review on the given topic has not been published in recent decades. Previous research is mostly geographically limited case studies that examined the effects of forest fires on tourism in Portugal (Otrachshenko and Nunes 2022), the costs of wildfires in Spain (Perez-Mato *et al.* 2016), the influence of wildfires on tourist behaviors in Florida (Thapa *et al.* 2013), or the economic valuation of recreational activities in Spain (Molina *et al.* 2019). Panel studies of European countries that focus on the issue of fires include tourism only marginally (Fernandez-Anez *et al.* 2021; Meier *et al.* 2023).

The presented review aims to explore the mutual interactions between fires and tourism in the Mediterranean. Based on the analysis of published studies, the main topics and gaps in the scientific literature will be identified and possible directions for future research will be recommended. Specifically, the authors set the following sub-goals: (1) to evaluate the geographical aspects and specifics of fires in Southern European countries, (2) to analyze the regional-economic importance of tourism and interaction with fires, (3) to map approaches to risk prevention and building resilience systems of countries and destinations concerning fires and other natural disasters.

Geographically, this work includes an overview of the literature on the coastal countries of southern Europe (Croatia, France, Greece, Italy, Portugal and Spain). The countries listed were selected based on their importance in terms of fire and tourism. The majority of large fires in Europe occur in the six countries surveyed (Colantoni *et al.* 2020; San-Miguel-Ayanz *et al.* 2024). Fires are among the most dangerous natural disasters in the analyzed countries, and at the same time, the affected areas are the most attractive tourist destinations. According to World Trade Organization statistics, Southern Europe has long been the most visited tourism region worldwide (World Tourism Organization 2024).

MATERIALS AND METHODS

The review methodology was based on thematic analysis and synthesis of scientific literature. The goal was to extract scientific articles published in the last 20 years. Most articles were drawn from the Web of Science and Scopus databases. To refine the search results and ensure the relevance of the identified literature, the procedure was to define inclusion criteria. Several steps were taken to exclude certain articles for the following reasons: duplicate articles in international databases, inadequate targeting of titles, abstracts, and keywords, and unavailability of full texts of articles in databases. Subsequently, all of the articles' texts were screened in detail. Studies were excluded that did not meet the objectives of the review. The selection criteria also included a language parameter (only articles published in English were reviewed). Also analyzed were expert documents and statistical data from the European Commission, the European Forest Fire Information System, and EUROSTAT. The Interactive Map Generator (IMAGE) allows the user to create statistical maps at the European, national, and regional levels. The study included a spatial comparison of states and NUTS 2 regions according to the classification of the European Union.

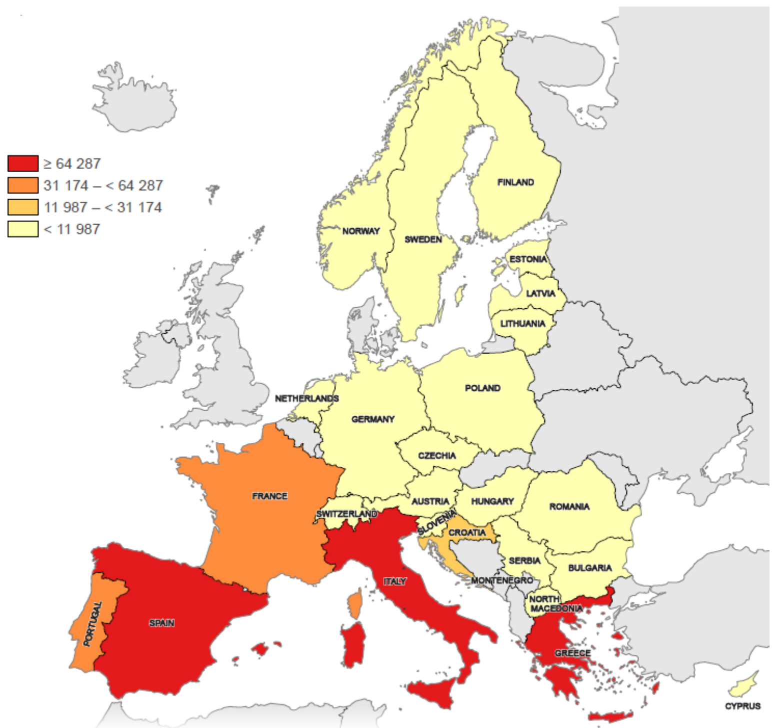
In the assessment of fire risks, a methodology that is based on existing studies and reflects the multifaceted impact of fires using weights of individual factors based on expert assessment was used. Through analyzing the direct and indirect relationships between the factors affecting fires, a matrix was created that provides a clear quantification of these relationships. To create the table of factors influencing wildfires, a comprehensive review of existing literature was conducted, focusing on both primary and secondary sources that examine the various contributors to wildfire risk. Studies were selected based on their relevance, scope, and methodological rigor, including quantitative analyses, case studies, and expert assessments. Each factor was identified, described, and evaluated for its contribution to wildfire risk, and the data were synthesized into a matrix. The weights assigned to each factor were determined by expert judgment. First, quantitative data from multiple studies were aggregated to assess the relative importance of each factor. Then, expert judgment was applied to adjust these weights, ensuring they accurately reflected the multifaceted nature of wildfire risk in various geographic and socio-economic contexts.

REGIONAL PATTERNS OF WILDFIRES IN THE MEDITERRANEAN

The regional diversity of fires in Europe is influenced by geographical, meteorological, topographic, and other specific conditions. The most threatened area is the Mediterranean (Colantoni *et al.* 2020). In the Mediterranean, fires destroy significantly larger forest areas than other natural hazards (tornadoes, parasites, insects, *etc.*). More than 60% of the total number of wildfires in Europe were concentrated in the six monitored countries of southern Europe (Spain, Portugal, Italy, Greece, France, and Croatia) in the last five years (San-Miguel-Ayanz *et al.* 2024). An even greater polarization of the six analyzed countries is indicated by the indicator of total burned areas in hectares. Although the statistics differ slightly according to meteorological conditions in individual years, the studied countries of southern Europe have long-term reached more than 85% of the total burned areas in Europe (San-Miguel-Ayanz *et al.* 2023). Regional differences between European countries according to the total number of burned areas over the last five years are illustrated in Map 1, from which it is evident that the largest extent of burned areas in

Europe was recorded in Spain, Italy, and Greece. It was followed by France, Portugal, and Croatia.

As shown in Table 1 and Fig. 1, fire activity showed increasing trends in the 1980s and 1990s. This was followed by a stable decade after 2000 and even a decline in 2010 to 2019. In the first four years of this decade (2020 to 2023), the number of large fires increased again. In all analyzed Southern European countries except Portugal, the average annual extent of burned areas increased compared to the last decade. The largest increase in burnt areas in hectares was recorded in France and Greece. In France, 45% of the total number of fires in the six monitored countries were detected in 2022, which is not usual in the long term. In past decades it was more typical for Spain or Portugal (San-Miguel-Ayanz *et al.* 2023; San-Miguel-Ayanz *et al.* 2024).



Map. 1. Burned areas (ha) in 25 European States (average 2019 to 2023); **Source:** San-Miguel-Ayanz *et al.* 2021, 2022, 2023, 2024

Table 1. Long-Term Development of Fires in Six Mediterranean Countries (1980 to 2023)

Burned Areas (ha)	**Croatia**	**France**	**Greece**	**Italy**	**Portugal**	**Spain**
Average 1980-1989	-	39157	52417	147150	73484	244788
Average 1990-1999	13040	22735	44108	118573	102203	161319
Average 2000-2009	15782	22363	49238	83878	160985	127229
Average 2010-2019	11241	12582	24220	63907	138084	94514
Average 2020-2023	14438	32935	78071	96636	62169	130734
Number of Fires	**Croatia**	**France**	**Greece**	**Italy**	**Portugal**	**Spain**
Average 1980-1989	-	4910	1264	11575	7381	9515
Average 1990-1999	490	5538	1748	11164	22250	18152
Average 2000-2009	669	4421	1695	7259	28774	18369
Average 2010-2019	471	3913	946	5420	19362	11860
Average 2020-2023	132	9043	862	4690	7283	7107

Source: San-Miguel-Ayanz *et al.* 2023, 2024

Developmental trends of the number of fires and total burned areas in the six countries studied over the past 44 years (1980 to 2023) can be traced from Table 1. The statistics are expressed as averages of individual decades to abstract data from seasonal weather variations. The data are drawn exclusively from the database of the European Forest Fire Information System (San-Miguel-Ayanz *et al.* 2023). Only fires over 30 ha are included to compare forty-year periods. In the statistics until 2018, smaller fires were not monitored, as current technological systems allow.

In the case of Greece, the most critical year was 2023, when the number of mapped fires did not increase, but their size was extreme. The total burnt area of 175,000 ha was a record because of the fires in the heavily forested Peloponnese peninsula in 2007 (Koutsias *et al.* 2012; Ferrara et *al.* 2018; San-Miguel-Ayanz *et al.* 2024). In July and August 2023, Greece was hit by large-scale forest fires that took place in several locations across the country, with the most affected areas including the islands of Rhodes, Euboea, and the Attica region. The fire on the island of Rhodes strongly affected the tourism industry. Some hotels and resorts were evacuated. Stays on the island were cancelled in the short term. In addition to extensive damage to forest stands in the regions of Eubia and Attica, the fires also caused reduced air quality in the Greek capital (Dosiou *et al.* 2024).

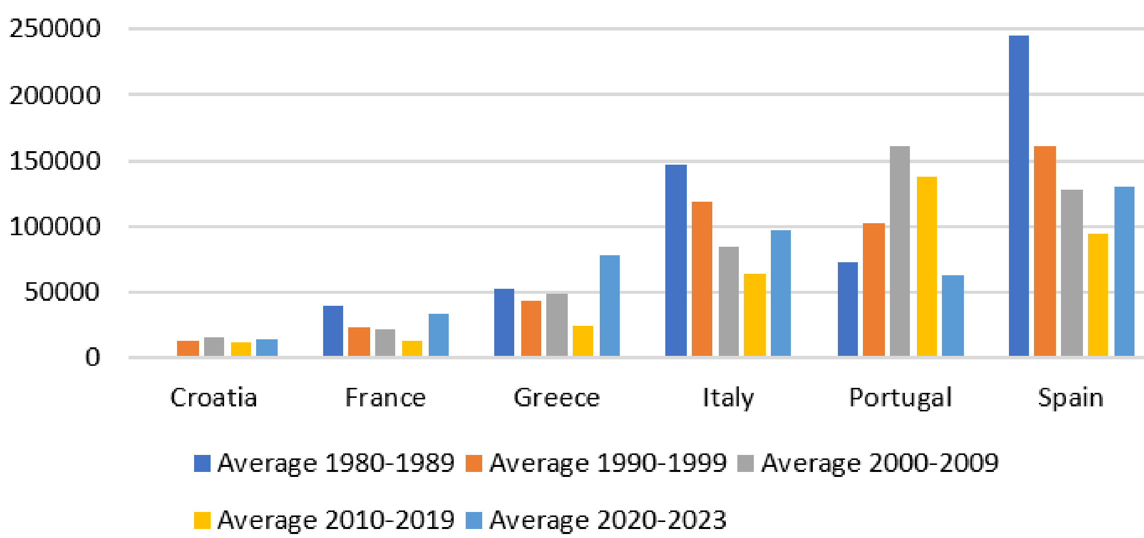
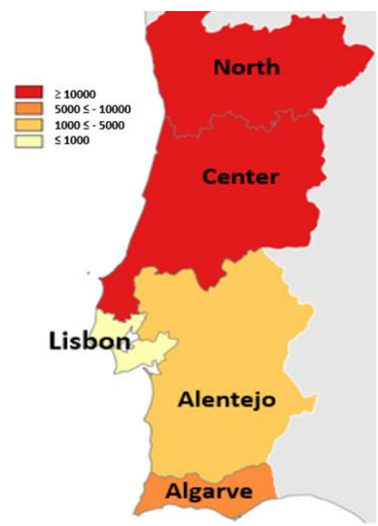


Fig. 1. Burned Areas (ha) in Mediterranean Countries (1980 to 2023); **Source:** San-Miguel-Ayanz *et al.* 2023, 2024

Meteorological conditions, topography, vegetation, and socio-economic conditions are not homogeneous in Southern Europe (Galizia *et al.* 2021; Doxa *et al.* 2022). Fire activity therefore differs according to countries and regions. In recent decades, the number of fires was highest in Spain, Portugal, and Italy. The incidence of fires in France, Greece, and Croatia was lower. In the last five years, Greece has approached the values of the countries of the Iberian Peninsula. The absolute numbers of fires in Croatia are underestimated by the smallest area of the territory and the lowest number of inhabitants of the monitored countries (Table 1).

Spain is one of the largest and most naturally diverse countries in Europe. Fires in Spain are promoted by the Mediterranean climate (Pausas and Fernández-Muñoz 2012) and anthropogenic factors. Most fires in Spain are caused by human activity. Changes in the settlement of rural areas and soil overgrowth are important factors (Chergui *et al.* 2018). Forest fire activities developed positively in the period 2010 to 2019 due to more effective response and monitoring (Turco *et al.* 2016; Fernandez-Anez *et al.* 2021). However, this trend has not continued in recent years. In 2022, more than 70 large fires were recorded. The extent of burned areas reached twenty-year highs. The geographic distribution of forest fires was highly dependent on large fires (San-Miguel-Ayanz *et al.* 2023). Map 2 shows the fire activities in the Spanish regions. In the current decade after 2000, the regions of northwestern Spain (Galicia, Asturias, and Castilla i Leon) suffered the greatest number of fires, as well as inland Extremadura at the border with Portugal and Andalusia on the Mediterranean coast.

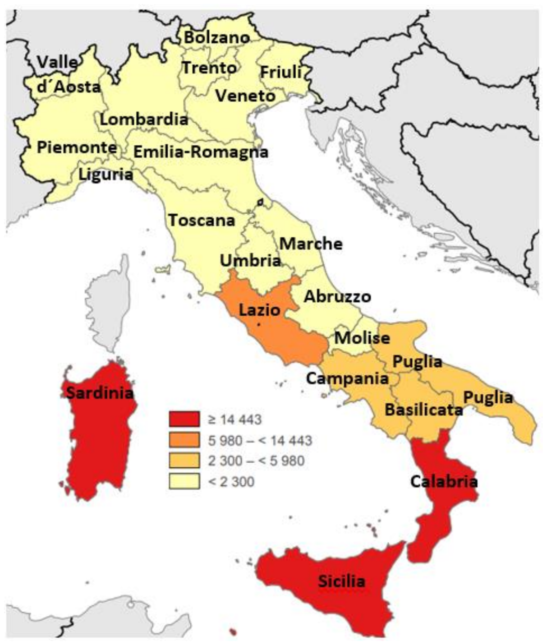
Map. 2. Regional differentiation of the number of large fires in Spain (average 2018 to 2022); **Source:** San-Miguel-Ayanz *et al.* 2021, 2022, 2023



Map. 3. Regional differentiation of burned areas (ha) in Portugal (average 2018 to 2022); **Source:** San-Miguel-Ayanz *et al.* 2019, 2020, 2021, 2022, 2023

Until the end of the last decade, Portugal had the highest number of fires per capita in the entire Mediterranean. The causes were hot and dry summers and large continuous areas of forests. In recent decades, the negative causes of fires also include anthropogenic influences and changes in socioeconomic behavior patterns (Nunes 2012; Oliveira *et al.* 2014; Parente *et al*. 2018). Socioeconomic factors that increase the risk of fires are increasing urbanization and rural abandonment, changes in land use, population density, and tourism. In the last decade, the highest fire activity is recorded in July, August, and September. From a regional point of view, the central and northern parts of Portugal were the most affected. Almost 75% of all fires in Portugal were concentrated in the regions Center and North (Map 3). In central Portugal, the heavily forested regions around the cities of Coimbra and Leiria were the most affected. In northern Portugal, these are the regions of Braga, Porto, and Viana do Castelo (Meira Castro *et al.* 2020; Bergonse *et al.* 2022). In recent years, fires in Madeira and the Algarve have also caused a decrease in arrivals and sales in tourism (Neger *et al.* 2024).

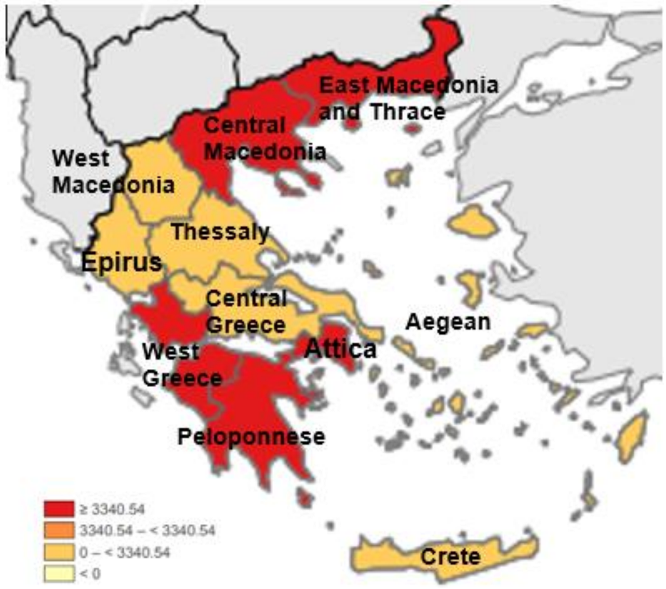
Similar to other Southern European countries, there has been a higher fire activity in Italy associated with the Mediterranean climate. The spread of fires is aided by deepening drought and fire-prone vegetation. However, many fires have been caused by intentional or unintentional human activities, such as hunting, pyromania, pasture restoration, and residue burning (San-Miguel-Ayanz *et al.* 2022). The geographical effects of fires differ from north to south in Italy (Telesca and Lasaponara 2010; Michetti and Pinar 2019). As shown in Map 4, a higher number of burned areas has been recorded on the islands (Sicily and Sardinia) and in the regions in the south of the Apennine Peninsula (Campania, Calabria, Puglia, Lazio, and Basilicata); Northern Italy is less threatened.



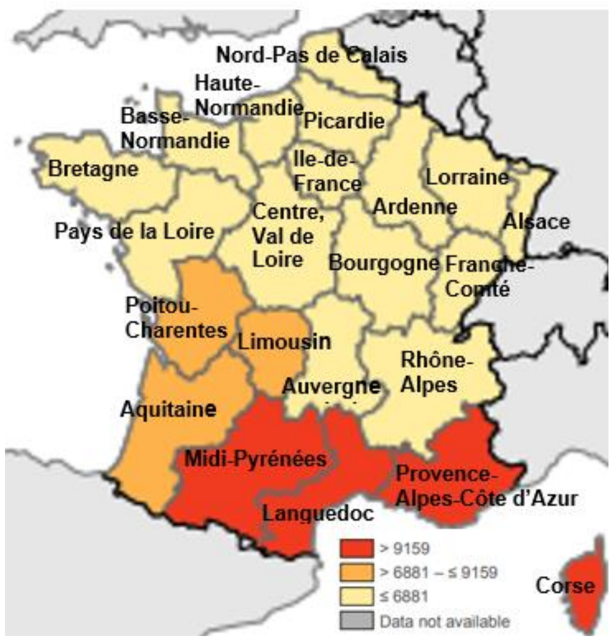
Map 4. Regional differentiation of burned areas (ha) in Italy (average 2018 to 2022); **Source:** San-Miguel-Ayanz *et al.* 2021, 2022, 2023

The climate in most of Greece is typically Mediterranean (Mitsopoulos *et al.* 2016). From Map 5, a relatively high risk of fires threatens most Greek regions. Areas in the south, north, west, east, and the capital city of Athens are affected. In the region of the capital city of Athens (Attica), fires are caused by a combination of dense population, forest areas, and a dry climate (Koutsias *et al.* 2012). Other threatened areas of Greece are the Peloponnese peninsula in the south of the country, the second largest Greek island of Euboia, the mountainous region of Thessaly, the western part of the largest Greek island of Crete, and the northern region of Macedonia and Thrace. Finally, the islands in the Aegean Sea

(Rhodes, Samos, and Kos) are also vulnerable. As mentioned in the previous text, the increase in fires and burned areas in recent years is alarming in Greece (Papavasileiou and Giannaros 2022; Dosiou *et al*. 2024).



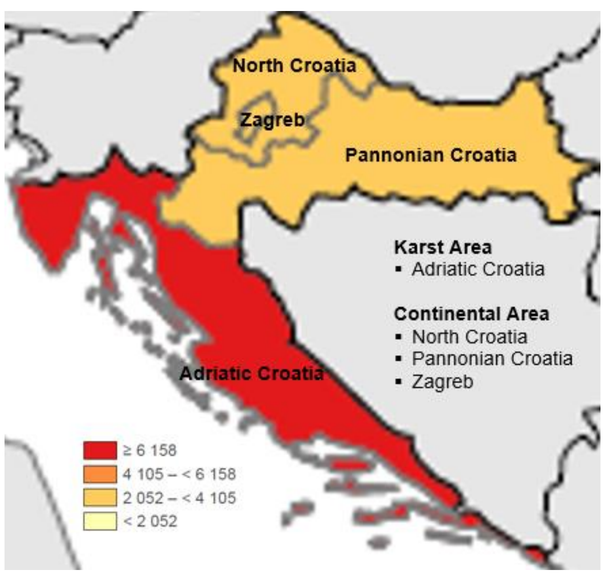
Map 5. Regional differentiation of burned areas (ha) in Greece (average 2018 to 2022); **Source:** San-Miguel-Ayanz *et al.* 2019, 2020, 2021, 2022, 2023



Map 6. Regional differentiation of burned areas (ha) in France (average 2018 to 2022); **Source:** San-Miguel-Ayanz *et al.* 2019, 2020, 2021, 2022, 2023

France is the country with the largest area in the European Union, diverse geography, and diverse climate. It is bordered to the west and north by the Atlantic Ocean (the Bay of Biscay and the English Channel), and to the south by the Mediterranean Sea. Different types of climate in the regions are important for the occurrence of fires. Most of western and northern France has an oceanic climate with mild summers. The central and eastern parts of the country are influenced by the continental climate. The mountain regions of the Alps, the Pyrenees, and the Massif Central are located in the colder zone (Terray and Boé 2013). The Mediterranean climate is typical for the regions of southwest and southeast France. The regions of the southwest with the Aquitaine massif and the southeast with Mediterranean forests (Auvergne-Rhône-Alpes, Corsica, Aquitaine , and Provence-Alpes-Côte d'Azur) are the most exposed to fires (Ganteaume and Jappiot 2013; Ganteaume and Long-Fournel 2015; Barbero *et al.* 2019). The Provence-Alpes-Côte d'Azur region, in particular, is often affected by fires. Provence-Alpes-Côte d'Azur is a popular tourist destination on the French Riviera, so fires are a closely watched topic in this region. Corsica is also a highly threatened region, where the dry climate and strong winds encourage the spread of fires. Map 6 illustrates how the regions of southern France significantly exceed other regions of continental France in terms of the number of fires and in particular the area of the burned area.

Croatia, especially its karst region, has been frequently affected by forest fires in recent years (Pavlek *et al.* 2017; Barčić *et al.* 2022; Posavec *et al.* 2023). The karst area includes coastal regions, such as Dalmatia, Istria, and part of Kvarner. These areas are prone to wildfires due to a combination of hot and dry summer weather, flammable vegetation, windy conditions, and difficult terrain. Bóra (dry, cold wind blowing from the interior) and jugo (moist southerly wind) can quickly spread fires over long distances (Šiljković and Mamut 2016). The rocky terrain of the karst area with deep canyons makes rescue processes difficult. Despite the mentioned natural factors, most of the fires in Croatia in recent decades had obvious human causes (Kisić and Bogunović 2016). Fires occur throughout the Croatian territory, although the most affected region is the central Adriatic coast and the islands. The most burned areas can be found in Dalmatia, which is covered by deciduous forests, scrub, garrigue, and thickets. This type of vegetation catches fire easily in the dry season (Pavlek *et al.* 2017). Map 7 shows the different occurrences of fires in the karst and continental areas of Croatia.



Map 7. Regional differentiation of burned areas (ha) in Croatia (average 2018 to 2022); **Source:** San-Miguel-Ayanz *et al.* 2019, 2020, 2021, 2022, 2023

CONDITIONS OF OCCURRENCE, PREVENTION, AND RESPONSE TO FIRES IN THE MEDITERRANEAN

The Mediterranean generally has a climate in the regime of mild and wet winters and dry and warm summer months. Dry summer weather has traditionally been a trigger for wildfires. However, in the past, natural causes of fires, such as lightning strikes, prevailed. Fire has been an important factor in changing the landscape here since the Miocene; thus, it has an effect on the composition of the Mediterranean flora (Lionello *et al.* 2014; Mitsopoulos *et al.* 2016). Anthropogenic activity has transformed the landscape in favor of the expansion of settlements and infrastructure. As a result of urbanization and intensive land use, there is a loss of biodiversity, soil degradation, and erosion. The loss of soil retention capacity, together with changes in the microclimate, leads to the susceptibility of the landscape to fires (Campo *et al.* 2006; Vieira *et al.* 2023).

Fires have historically represented some re-vegetation. Man has learned to use fires by intentionally setting them to eliminate unwanted vegetation (Molina *et al*. 2019; Fernandez-Anes *et al.* 2021). In some countries, prevention of the risk of large fires by establishing controlled burning is considered, which hurts the environment, but the economic and environmental benefits of this activity prevail (Khabarov *et al.* 2016; Bondur *et al.* 2017; Molina *et al*. 2019).

If one focuses on the most important fire risks across southern Europe, they are socio-economic causes, climate change, and the human factor. The anthropogenic factor affects more than 80% of the occurrence and spread of fires in Europe (San-Miguel-Ayanz *et al.* 2023). It is not only the use of machines and technology in the highly flammable forest environment but also intentional arson and irresponsible behavior. Human activities, such as careless handling of fire, illegal burning of vegetation, neglect of forest management and expansion of buildings into threatened areas can increase the risk of fires (Kolanek *et al.* 2021). Tourism (especially visits to inaccessible places and the behavior of tourists) also contributes to this spread of fires. Other socio-economic causes of fire activity can be found in the abandonment of the countryside and the ageing of the rural population. Then, there is a change in land use. Some rural areas become overgrown and unmaintained. The risk of fires is then higher (Oliveira *et al.* 2012; Fernandez-Anes *et al.* 2021).

Climate change has been creeping in southern Europe for several decades. Climate change can affect the number and intensity of fires, but also extend the period of their danger (Liu *et al.* 2010; Duane *et al.* 2021). Heat waves, massive dry spells, and windy events are not only responsible for the creation, but above all for the spread of fires. Frequent strong storms also come into play, although the risk of ignition by lightning is not high. The Mediterranean region is the most affected by heat waves. Extremes in this course of the Mediterranean climate are increasing. The summers are longer and warmer, and the drought is deepening. Winter precipitation has shown a decreasing trend. Massive storms with gusty winds and lots of lightning are common in the summer. According to some studies, the worst situation is in the Iberian Peninsula (Venäläinen *et al.* 2014; Khabarov *et al.* 2016; Heisig *et al.* 2022).

The state and type of vegetation depend on climate changes, not only trees and shrubs but also the herb layer. Vegetation species that require more water are disappearing or are in worse condition. The surface temperature of the Mediterranean Sea is higher than in the pre-industrial era. Droughts are more frequent and more intense. The sea level is rising. The number of days with high and very high temperatures has doubled compared to previous centuries. There are more intense storms with high lightning activity. Precipitation is distributed irregularly and decreases in the winter months. Thus, drought is most likely to be the most influential factor in vegetation conditions and fire susceptibility (Ruffault *et al.* 2016).

The Mediterranean hosts exceptional biodiversity in a unique environment. Recurrent fires can lead to degradation and changes in the species composition of ecosystems. The burnt area in the Natura 2000 system and other protected areas accounts for around 60% of the total destroyed area in Europe. In some parts of the Mediterranean, ecosystems have developed that have adapted to regular fires, for example, trees whose seeds are released after a fire. However, even such ecosystems do not benefit from an increase in the frequency and intensity of fires. Fires in the Mediterranean affect different types of vegetation. As in the rest of Europe, the largest part of the affected areas consists of deciduous, coniferous, and mixed forests, as well as agricultural land and other natural areas. The share of destroyed coniferous forests is lower in the six countries studied than in the northern parts of Europe. The only exception in southern Europe in this regard is Spain. In Italy and Greece, agricultural land is more affected. An above-average proportion compared to the rest of Europe is made up of evergreen sclerophyllous vegetation throughout the Mediterranean. Sclerophyllous forests, shrubs, and herbs are highly flammable and can support the spread of fires (Roszyk *et al.* 2020; San-Miguel-Ayanz *et al.* 2023).

In the following text, some endangered species of southern European trees and shrubs will be characterized. Aleppo pine (*Pinus halepensis*) is often found on dry slopes and soils. However, it is sensitive to fires, which can cause serious damage to seedlings and young trees. The cork oak (*Quercus suber*) is characteristic of the Mediterranean and its bark is used to make cork stoppers. Fires can cause serious damage to mature trees and thus affect the economic potential of this species. Juniper bushes (*Juniperus* spp.) are drought tolerant, but fires can degrade the vegetation and threaten the reproduction of these species. Rosemary bushes (*Rosmarinus officinalis*) are often flammable and fast-spreading shrubs. Fires can affect its population and habitat. *Arbutus unedo* is a characteristic species of the Mediterranean. Fires can affect its occurrence and threaten the fruits, which are important food for local animals. Myrtle bushes (*Myrtus* spp.) are often widespread in the Mediterranean and fires can affect this popular plant. *Cytisus* bushes (*Cytisus* spp.) are flammable and fires can affect the distribution of these bushes. *Cistus* bushes (*Cistus* spp.) are typical of dry Mediterranean environments and fires can affect the ecosystems in which they occur. Thistle bushes (*Calicotome* spp.) are often flammable and at risk of fires. Bush heather (*Erica* spp.) is common in the Mediterranean, and fires can affect its occurrence. Eucalyptus forests are highly susceptible to fires due to the high content of oils in the leaves. Eucalyptus forests are mainly found in Spain and Portugal (Vázquez *et al.* 2002; Médail 2022).

Fires have an advantage over other natural disasters, as they can be predicted to a certain extent, and monitored and thus their effects can be reduced. Although fire suppression plays a key role in protecting human life and property, the emphasis on preventive activities is pragmatic and economically beneficial in the long term (Moreira *et al.* 2020). In the entire Mediterranean region, it is necessary to improve spatial planning precisely from the point of view of fire resistance. Mapping, tracking, and monitoring of potentially dangerous areas is necessary for the effective management of field fires. Especially at the border between cities and settlements and wild landscapes, it is necessary to have a functioning and high-quality early warning system. It is necessary to have documents in the form of models and maps of the risk of fire spreading. During the season, it is necessary to have forecasts of potentially dangerous conditions. Finally, it is desirable to improve the state of ecosystems, support the diversity of species and thus increase the overall resilience of the landscape (Lasanta *et al.* 2018; Bacciu *et al*. 2021). Southern European countries should focus not only on their challenges but cooperate on implementing preventive and adaptive measures across the region. Coordinated cooperation is also supported within the policies and agencies of the European Union (Heisig *et al.* 2022; Meier *et al*. 2023).

Fire hazard prediction requires sophisticated approaches at the national and European levels. An important element is the use of satellite mapping (Loepfe *et al*. 2014). Areas after fires are monitored not only to assess the volume of emissions from fires but also in terms of the speed of landscape recovery (Bondur *et al.* 2017). A key tool for fire prediction is the modelling of fire occurrence using regression models, machine learning, and simulation methods. Technological progress in the fields of artificial intelligence and machine learning enables more accurate and efficient risk prediction, decision support during interventions, as well as ex-post analysis and strategic planning. Artificial intelligence can process and analyze data from camera systems, drones, and heat and smoke sensors. As in other fields, artificial intelligence can predict based on historical data and also simulate fire activities and situations (Oliveira *et al.* 2012; Salis *et al.* 2021; Cilli *et al.* 2022). Fighting fires requires technology and human resources. It is necessary to devote funds to modern technology and equipment to extinguish fires effectively and to prevent their spread. Strategies and procedures created for individual countries according to their geographical specificities appear to be necessary. Public involvement is important to prevent fires from starting and spreading. Increasing public awareness of fire risks and good behavior in nature is key to reducing fires started by humans (Kountouris and Remoundou 2011; Abt *et al.* 2015; Molina *et al.* 2019).

RISKS OF WILDFIRES IN THE MEDITERRANEAN

For better insight into the issue and clarity, a table of factors affecting forest fires was created, which is based on existing studies and reflects the multifaceted impact of fires using the weights of individual factors based on expert assessment (see Table 2). Through analyzing the direct and indirect relationships between the factors affecting fires, a matrix was created that provides a clear quantification of these relationships.

To create the table of factors influencing wildfires, a comprehensive review of existing literature was conducted, focusing on both primary and secondary sources that examine the various contributors to wildfire risk.

Climatic Conditions and Fire Regimes: Research by Ruffault *et al.* (2016) identified the critical role of climatic conditions, such as temperature and humidity, in driving large fire events in Mediterranean ecosystems. This study provided data on how different climatic variables interact to influence fire severity and frequency. Several studies identify heat waves and drought as the most dangerous manifestations of climate change (Santos *et al.* 2024). The occurrence of fires in these extreme situations is more frequent. Pausas and Keeley (2021) also mention more frequent and extreme climatic conditions suitable for the occurrence of fires.

Vegetation and Fuel Load: Studies by Ricotta and Di Vito (2014) modeled landscape drivers of fire recurrence in Sardinia, Italy, highlighting the importance of vegetation type and fuel load in fire spread. The analysis involved understanding the spatial distribution of vegetation and its contribution to fire propagation. The importance of the types and conditions of vegetation is mentioned by Arrogante-Funes *et al.* (2024). According to Ma *et al.* (2020), it is necessary to look into the type of vegetation, but also its condition, *i.e.* vitality, water content and other substances in the fire risk assessment wood. On the contrary, Guion *et al.* (2022) mention a higher risk of fires during heat wave periods, they mention the state of vegetation as less important.

Human Activity: Research by Kolanek *et al.* (2021) examined the impact of anthropogenic factors, such as agricultural activities, recreational practices, and urban expansion, on the density of forest fires in Poland. Their findings helped assign weights to human activity factors based on observed fire incidences and their correlation with human presence and activities. Similar conclusions were confirmed by several authors (Novo *et al.* 2020; El Mazi *et al*. 2024). Berčák *et al.* (2024) analyzed the influence of human activities on the frequency of fires in the Czech Republic. It was the human factor that caused a massive fire in Hřensko in 2022 when a large part of the protected area burned down. Amruth *et al.* (2022) mention fires caused by tourists in risk areas.

Topography: The influence of topography on wildfire behavior was detailed by Salis *et al.* (2021), who used simulation modeling to assess how elevation, slope, and aspect affect fire exposure and transmission in Sardinia, Italy. The study's findings were crucial in determining the weight of topographical factors in the matrix. Other studies mentioning topography of the terrain as an important factor for the occurrence of fires are the works of the authors Francos *et al.* (2021), which examines these effects in the Iberian Peninsula. Sakellariou *et al.* (2023) mentioned the availability of fireplaces for firefighting equipment.

Table 2. Table of Factors Influencing Wildfire

Factor	Description	Weight
Climatic Conditions	Include temperature, humidity, wind speed, and precipitation patterns that directly influence the likelihood and severity of wildfires.	0.25
Vegetation Type and Fuel Load	Refers to the type of vegetation and the amount of combustible material available, which affects fire spread and intensity.	0.20
Human Activity	Encompasses human actions, such as agricultural burning, recreational activities, and accidental or intentional ignition sources.	0.20
Topography	Includes elevation, slope, and aspect, which affect fire behavior by influencing wind patterns and fuel availability.	0.15
Socioeconomic Factors	Involve the impact of population density, land use patterns, and economic activities on fire risk.	0.10
Fire Prevention and Management	Covers measures, like firebreaks, controlled burns, and fire-fighting infrastructure, that reduce the likelihood or impact of wildfires.	0.10

Source: Own creation

Socioeconomic Factors: The role of socioeconomic elements, such as population density and land-use patterns, was explored by Chergui *et al.* (2018). This study assessed fire-regime variability in the Mediterranean Basin and linked socioeconomic factors to fire risk, which informed the weight assigned to these factors in the matrix. De Diego *et al.* (2023) indicate the high importance of socio-economic conditions in the territory of Spain. Parente *et al.* (2019) reached similar conclusions in Portugal.

Fire Prevention and Management: Bacciu *et al.* (2022) discussed a systemic approach to fire risk management, emphasizing the importance of preventive measures, such as controlled burns and firebreaks, in reducing fire risks. Their findings contributed to understanding the effectiveness of different management strategies and their corresponding weight in the matrix. Moreira *et al.* (2020) have the same conclusions, emphasizing the prevention of fires. Palaiologou *et al.* (2020) researched regions of Greece where fires have caused major damage in recent years.

Matrix of Factors Influencing Wildfires

The matrix below presents the interactions and combinations of different factors influencing wildfires, along with their respective weights. The matrix illustrates how each factor contributes not only individually, but also in combination with others, reflecting the complex dynamics of wildfire risk.

The matrix was created by synthesizing data from a systematic literature review, focusing on studies that examined the interactions between various factors contributing to wildfire risks. This approach involved analyzing both direct and indirect relationships between factors, using statistical models and expert assessments to quantify the strength of these interactions. Weights for each interaction were determined by expert judgment.

Table 6 represents a matrix of interactions among key factors influencing wildfire risk. The main factors listed are Climatic Conditions; Vegetation Type and Fuel Load; Human Activity; Topography; Socioeconomic Factors; and Fire Prevention and Management. The matrix illustrates how each factor interacts with others to influence wildfire risk. The diagonal values in the table represent the direct weight of each factor, indicating the independent influence of that factor on wildfire risk. For example, Climatic Conditions have a direct weight of 0.25, highlighting the strong impact of weather conditions (*e.g.*, high temperatures, low humidity, and wind) on the likelihood of wildfires.

Table 3. Matrix: Interactions of Factors Influencing Wildfire

Factors	Climatic Conditions	Vegetation Type and Fuel Load	Human Activity	Topography	Socioec. Factors	Fire Prevention and Management
Climatic Conditions	0.25	0.10	0.05	0.05	0.03	0.02
Vegetation Type and Fuel Load	0.10	0.20	0.08	0.06	0.04	0.02
Human Activity	0.05	0.08	0.20	0.07	0.05	0.03
Topography	0.05	0.06	0.07	0.15	0.04	0.03
Socioeconomic Factors	0.03	0.04	0.05	0.04	0.10	0.02
Fire Prevention and Management	0.02	0.02	0.03	0.03	0.02	0.10

Source: Own creation

The off-diagonal cells indicate the interaction weights between two factors, reflecting how their combination impacts wildfire occurrence and severity. For instance, the interaction between Climatic Conditions and Vegetation Type and Fuel Load is given a weight of 0.10, reflecting how dry conditions combined with dense vegetation significantly increase fire risk. Similarly, Human Activity interacts with Vegetation Type and Fuel Load (0.08) due to activities, such as farming or recreational activities in vegetated areas, which can easily lead to ignition under certain conditions.

Climatic Conditions (0.25). Climatic factors are critical in determining the dryness of vegetation and the ease with which fires can start and spread. According to Guion *et al.* (2022), climate change has been linked to more frequent and severe wildfire events, emphasizing the high weight of this factor.

Vegetation Type and Fuel Load (0.20). Dense vegetation and the availability of dry fuel are major determinants of wildfire severity. The impact of vegetation type on fire spread has been widely documented in studies, such as (Lin *et al.* 2024), which confirm that areas with high fuel loads are more prone to intense wildfires.

Human Activity (0.20). Human-induced factors like land use, agricultural burning, or accidental ignitions play a significant role in fire occurrences. Topography (0.15). The shape of the land influences how wildfires spread. For example, fires tend to move faster uphill due to heat rising and pre-heating the vegetation above (Pais *et al.* 2021). The weight of 0.15 reflects this relationship.

Socioeconomic Factors (0.05). These factors include population density, infrastructure, and economic conditions, indirectly affecting wildfire risk. Although they are not primary contributors, socioeconomic factors influence the resources available for prevention and response (Kala 2023).

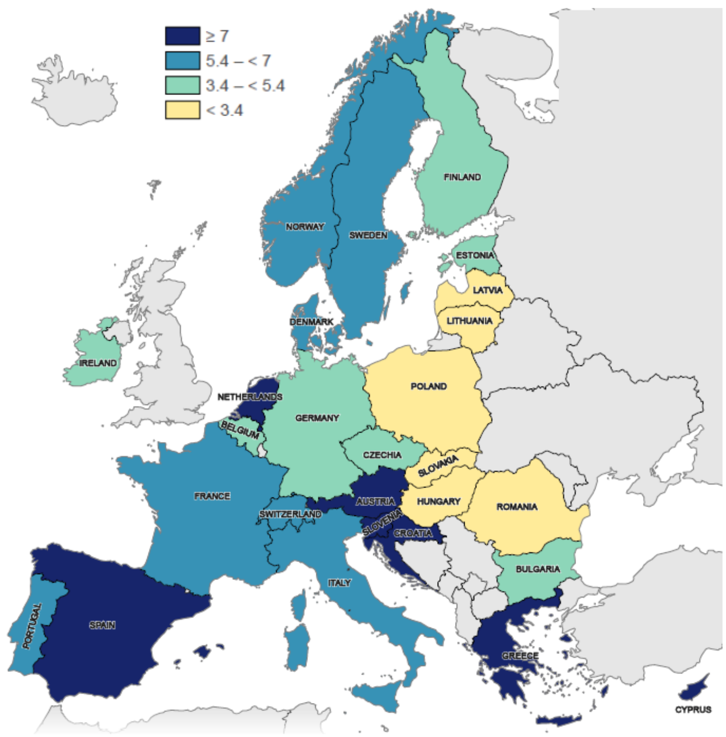
Fire Prevention and Management (0.10). The implementation of fire prevention measures, such as controlled burns and public awareness campaigns, can significantly mitigate wildfire risk. The weight of 0.10 emphasizes the importance of proactive management strategies (Carta *et al.* 2023).

TOURISM AND WILDFIRES

The Mediterranean region is a leading destination for international tourism. In 2023, more than 700 million visitors stayed in the six monitored countries. Roughly three-quarters of them stayed in traditional accommodation facilities (hotels, boarding houses, *etc.*), and one quarter were in capacities offered through sharing economy platforms (EUROSTAT 2024). France and Spain are the most visited countries in the world. Italy has long been in the world's top five, and Greece is in the world's top ten in terms of the number of international arrivals (World Tourism Organization 2024). Visitors to the Mediterranean are primarily looking for a favorable climate, beautiful nature, and rich history. In addition to seaside recreation, the region also offers cultural monuments, exceptional cuisine, and other attractions (Amelung and Viner 2006).

In the analyzed Southern European countries, tourism is an important sector of the national economy with a high share of GDP, employment, and export of services. The tourism industry in Southern Europe is related to other economic sectors, such as transport, fishing, agriculture, energy, exchange services, or construction (Mejjad *et al.* 2022). In 2023, the share of the tourism economy, including related industries, was 9.2% of global GDP. By contrast, in Croatia it was 26.3% GDP in the same year, in Greece 19.2%, in Portugal 15.8%, in Spain 14.6%, in Italy 10.5%, and in France 9% (World Travel and Tourism Council 2024). In Croatia and Greece, tourism is a pillar of the national and regional economy. As can be seen from Map 8, the intensity of tourism in Southern European countries is higher than in Northern, Central, and Eastern Europe. The intensity of tourism is expressed as a proportion of the number of overnight stays in mass accommodation facilities to the number of inhabitants of a given country. It is therefore an indicator of the relative importance of tourism for a given country.

Tourism is often concentrated in regions with high fire activity. Among the tourist attractive regions with a relatively high fire risk are Andalusia, Galicia, Castilla and Leon in Spain; Provence-Alpes-Côte d'Azur, Aquitaine and Corsica in France; Adriatic Croatia, North and Algarve region in Portugal, Lazio, Sicily, Sardinia, Campania, Calabria, and Puglia and the Greek islands (Crete, Rhodes, Samos, and Kos). Specifically, Lazio is the most visited region in Italy. Adriatic Croatia and Greek islands (considering all islands in total) ranks among the top five most visited regions in Europe. The Provence-Alpes-Côte d'Azur region is the second most attractive French destination after Pari. Andalusia has the highest number of overnight stays in tourist facilities in continental Spain. The Algarve tourist region has the highest number of arrivals in Portugal (EUROSTAT, 2024).



Map 8. Number of overnight stays in EU countries in relative terms per inhabitant (2023);
Source: EUROSTAT (2024)

The scientific literature on fires and tourism in the Mediterranean is not very extensive. For this reason, the following discussion primarily includes studies of southern European countries, but also other relevant research on the topic from other regions of the world. The relationship between fires and tourism can be examined from different points of view. Economically oriented studies usually estimate how fires affect the tourism industry and the regional development of the affected areas. Meier *et al.* (2023) quantified the impacts of an average 2011 to 2018 fire season in Italy, Spain, Portugal, and Greece on aggregate GDP output losses of 13 to 21 billion EUR. They link the decline in GDP and employment mainly to the retail and tourism sectors. Otrachshenko and Nunes (2022) presented a long-term forecast of the annual costs of fires for the Portuguese economy for the years 2030 and 2050. They estimate the impacts on domestic tourism to be between 17 and 24 million EUR, and inbound tourism between 18 and 38 million EUR. The authors of this study estimate the cost by 2050 to more than quadruple. Lam-González *et al.* (2022) set the possible losses of island tourism in Portugal due to fires at more than 250 EUR per person. Neger *et al.* (2024) identified almost all of Spain and Portugal, Italy (especially Sicily), several regions of Southern France and the Greek region of Thessaly as areas with a high fire danger index within the six countries evaluated.

Another perspective on the interaction between fires and tourism is offered by studies of consumption behavior. Most research has found different visitor responses to fires (Bauman *et al.* 2020). Tourism losses can be derived from the intensity and area of the fire, but also from the attractiveness of the destination. Fires over large areas generally have a greater effect on the frequency of recreational visits. The socio-demographic characteristics of the visitors also play a significant role. Some groups according to age, gender, and education may differ according to risk aversion (Kovačić *et al.* 2020). Visitors' reactions often change over time. In the short term, the fires will strongly affect tourism demand. In the long term, the effect is minimal (Hystad and Keller 2008). Thapa *et al.* (2023) identified tourist response to wildfires as a minority issue. They expect significant impacts on consumption behavior only if visitors consider the risks of fires to be very high.

Fires are a worldwide social and economic problem that also has an environmental impact. Destinations that are affected by wildfires may experience a decrease in tourist numbers also due to damage to natural attractions (Leung and Catts 2013). Forest fires have significant and often devastating impacts on the biosphere in the Mediterranean. This region is one of the richest in biodiversity in Europe, but it is also one of the most threatened due to frequent fires and climate change. Forest areas serve not only as market resources but also as space for leisure and recreation. The value of forests is often valued using the travel cost method (Prochazka and Abrham 2024). Large wildfires reduce the recreational value of the area (Gellman *et al.* 2022). Endangered areas are less attractive to tourists, resulting in a negative impact on businesses such as hotels, restaurants, transport services, and museums (Otrachshenko and Nunes 2022). In the case of a stay, fires can lead to restrictions on tourist activities such as nature trips, outdoor sports, *etc.* The impact of fires on natural resources and the related consequences of non-market losses are difficult to estimate. Tourism demand is related to the intensity of the heat and the location of burned areas (Hesseln *et al.* 2003). Sometimes, on the other hand, one encounters "fire tourism", where visitors purposefully go to a location that has been destroyed by fires just to see this disaster up close. This practice tends to be dangerous and against the interest of the natural recovery of the landscape after a fire (Bacciu *et al.* 2021; Otrachshenko and Nunes 2022).

DISCUSSION, LIMITATION AND FUTURE RESEARCH

Overall, the literature review confirmed growing research interest in wildfires. The number of studies in the Google Scholar database has increased over the last decades. Most of the analyzed articles were registered in the international databases Web of Science and Scopus. Published studies focused primarily on the causes and consequences of fires. This research included climatic, natural, and anthropogenic factors. A significant share of articles was also recorded on the prediction, prevention, and crisis management of wildfires. From the point of view of tourism, the effects of fires on the economy and consumer behavior were evaluated in particular. This study provides evidence that wildfires and tourism have an interconnected relationship. Both phenomena interact bilaterally. As a result, fires harm the frequency of recreational visits. The drop in demand is due to concerns about the safety and quality of the stay. There is also a risk of damage to tourism infrastructure and deterioration of the destination's media image (Molina *et al.* 2019). Sometimes, however, a disaster can increase awareness of a given area and, over time, stimulate arrivals. Paradoxically, this can lead to a positive relationship between fires and tourism (Rosselló *et al.* 2020). In contrast, tourism itself can increase the risk of fires due to overcrowding and careless behavior.

Accessing the interaction of fires and tourism continues to provide opportunities for future research. At the regional, national and European level, there is a need to improve the documentation of the effects of fires on tourism to be able to statistically quantify and evaluate these events. Previous studies are limited to estimates and predictions of the effects of fires on tourism. In the literature, there is a complete lack of comprehensive impact studies of a larger number of countries in Europe and the world. The available statistical data on fires are not uniform at the regional level, which was also a limitation in our analysis of Mediterranean countries. The country reported data for regional units of varying sizes. Unlike the other countries (Greece, Italy, France and Croatia), data were available for Spain only in the case of the number of fires. Data on the total burnt area could only be obtained for larger regions.

The present literature review includes several studies focused on preventing and dealing with the effects of fires (Bacciu *et al*. 2021; Meier *et al*. 2023). However, there is still a gap in the scientific literature in the research of crisis management at the level of destinations and tourism policies. Given the increasing risks of forest fires, destinations should incorporate risk management into their strategies. Research may include studying the conditions governing access to certain areas during high fire risk, creating emergency plans, and developing sustainable tourism practices. Crises should be accompanied by appropriate measures to ensure the long-term sustainability of business in the tourism industry. Future research should identify and propose crisis scenarios for the entire course of the crisis and the subsequent revival of tourism (specifically focused on ongoing prevention, the course of the crisis and post-crisis revitalization). The presented literature review also indicates a need to further research the role of the media and the mechanisms of public opinion formation. Published studies confirm the influence of the media on the behavior of tourists during fires (Thapa *et al.* 2013; Otrachshenko and Nunes 2022). Comprehensive research on the issue is, however, quite limited. At the same time, classic and new media play an increasingly important role in providing relevant information that determines the consumption behavior of visitors.

CONCLUSIONS

1. The rise in wildfires in Southern Europe is largely due to a combination of climate change, increased human activity, and socio-economic factors, which have created conditions conducive to more frequent and intense fire events.
2. Wildfires cause extensive ecological damage, including biodiversity loss and habitat destruction, and have significant economic and social impacts, particularly in tourism-dependent regions.

3. The relationship between wildfires and tourism is complex; while fires reduce the attractiveness of affected areas and decrease visitor numbers, they may also lead to increased awareness and interest in those areas, sometimes resulting in disaster tourism.
4. Effective fire management and prevention strategies, such as public awareness, sustainable tourism practices, and international cooperation, are crucial to mitigating the negative effects of wildfires and enhancing resilience.
5. There is a need to integrate fire risk management into tourism development plans to safeguard the economic viability of tourism in Southern Europe and protect its natural and cultural heritage.
6. Continued research and monitoring of fire trends, impacts, and management practices are essential to developing adaptive strategies that address both the immediate and long-term challenges posed by wildfires in this region.

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