

The Evolution of Wildfire Frequency and Environmental Impact: A Twenty-Year Technical Review (2001-2023)

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Date: February 10th 2026

Report identification: EFPRP/EU/R/3720-0003-2026

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I. Introduction

As the European landscape faces an unprecedented environmental metamorphosis, the *European Fire Prevention & Rural Preservation Organization (EFPRP)* presents this comprehensive strategic assessment. This document is the culmination of an exhaustive multi-year effort to synthesize and interpret the shifting dynamics of wildfire behavior across the European Union. Covering twenty-three years of high-fidelity data (2001–2023), this analysis serves as a cornerstone for institutional understanding, bridging the gap between historical forestry practices and the volatile realities of the 21st century.

Our mission, to safeguard rural integrity, protect human settlements, and preserve the continent's biodiversity, requires a data-driven approach. We are no longer dealing with seasonal anomalies, we are navigating a "*New Normality*." This shift is characterized by extreme heat events and prolonged drought. By harmonizing two decades of technical reporting from the *European Forest Fire Information System (EFFIS)* and the *Joint Research Centre (JRC)*, the EFPRP provides a blueprint for the next generation of prevention and transboundary suppression strategies.

I. I Scope and Methodology

The analytical framework identifies the technical divergence between the frequency of ignition events and the quantified environmental impact of those events. The temporal scope of this study is divided into three distinct phases to categorize the evolution of fire regimes within the European Union. Phase I covers the period from 2001 to 2010, establishing the historical baseline and documenting the emergence of extreme fire years such as 2003. Phase II encompasses 2011 to 2020, a decade marked by the intensification of fire weather indices and the stabilization of datasets for the Southern Five member states. Phase III analyzes the data from 2021 to 2023, documenting the transition into high-intensity wildfire events and the latitudinal expansion of high-risk zones into northern territories.

The geographical focus of the report is centered on the Southern Five Member States, specifically Portugal, Spain, France, Italy, and Greece. These nations historically account for the highest density of wildfire incidents and total hectares burned within the European Union. The study also includes data regarding the northward shift of fire risk into Central and Northern European forests, regions previously classified as low-risk zones. Data purification is a primary methodological requirement of this study. This process involves the harmonization of historical datasets to account for changes in European Union membership and the technical transition from MODIS-based satellite data to higher-resolution Sentinel constellations. This purification ensures that the longitudinal trends are statistically significant and excludes discrepancies caused by varying national reporting standards or sensor limitations.

I. II Key Research Themes

The strategic analysis is organized into four technical pillars of intelligence. The first pillar, Technical Divergence, examines the statistical paradox where the total area burned increases despite stable or declining ignition counts in Mediterranean regions. This theme explores the technical relationship between fuel load accumulation and the Fire Weather Index (FWI) thresholds. The second pillar analyzes the Megafire phenomenon, defined as high-intensity fire events that exceed 10,000 hectares and possess the capacity to generate localized meteorological conditions.

These events are technically assessed for their resistance to standard suppression metrics and their impact on rural infrastructure.

The third pillar focuses on Ecological Sensitivity within the Natura2000 network. The study quantifies the loss of biodiversity and carbon sequestration capacity within these protected habitats, specifically in regions such as the Peloponnese and the Iberian Peninsula. The fourth pillar evaluates the Modernization of Response, documenting the shift from reactive suppression to technology-led prevention. This includes the implementation of Geospatial Intelligence (WebGIS) platforms, the technical specifications of aerial assets such as the Fire Boss aircraft, and the utilization of 3D simulation for fire investigator training. Each pillar provides a factual assessment of the operational requirements for protecting the European rural landscape.

I. III Objective

This document is intended for civil protection agencies, policy makers, and environmental stakeholders requiring a technical foundation for strategic planning. The primary objective is the quantification of longitudinal trends to inform the development of a transboundary response framework. By analyzing the data patterns from 2001 to 2023, the EFPRP provides the technical evidence required to transition European fire management from a containment-based strategy to one of systemic resilience. The findings are intended to support the implementation of harmonized prevention standards and the optimization of resource allocation across the European Union.



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Strategic Analysis

Phase I (2001–2010)

Using data from *Forest Fires in Europe 2001 fire campaign* (Report No. 2, S.P.I.02.72 EN), *Forest Fires in Europe 2002 fire campaign* (Report No. 3, S.P.I.03.83 EN), *Forest Fires in Europe 2003 fire campaign* (Report No. 4, S.P.I.04.124 EN), *Forest Fires in Europe 2004* (Report No. 5, S.P.I.05.147 EN), *Forest Fires in Europe 2005* (Report No. 6, EUR 22312 EN), *Forest Fires in Europe 2006* (Report No. 7, EUR 22931 EN), *Forest Fires in Europe 2007* (Report No. 8, EUR 23492 EN), *Forest Fires in Europe 2008* (Report No. 9, EUR 23971 EN), *Forest Fires in Europe 2009* (Report No. 10, EUR 24502 EN) and *Forest Fires in Europe 2010* (Report No. 11, EUR 24910 EN).

Data range: 2001-2010

Data Author/Producer: *European Forest Fire Information System (EFFIS) and the Joint Research Centre (EU).*

Report Compiled by: *The European Fire Prevention & Rural Preservation Organization (EFPRP)*

European Fire Prevention & Rural
Preservation Organization

I. Technical Overview of the Decade (2001–2010)

The initial decade of the twenty-first century, designated as Phase I within the longitudinal study conducted by the European Fire Prevention & Rural Preservation Organization (EFPRP), serves as the foundational baseline for comprehending contemporary European wildfire dynamics. This temporal interval encapsulates the transition from the comparatively predictable, seasonal combustion cycles characteristic of the late twentieth century to the volatile, high-intensity regimes precipitated by climatic fluctuations and rural depopulation. The analysis is predicated upon harmonized data derived from the European Forest Fire Information System (EFFIS), with a primary focus on the five Southern Member States: Portugal, Spain, France, Italy, and Greece. Notwithstanding the enlargement of the European Union to twenty-five Member States in 2004 and twenty-seven in 2007, these jurisdictions collectively accounted for approximately 85 percent of the total area incinerated within the Union during the referenced period.

Consequently, these five jurisdictions are isolated within the EFPRP analysis to ensure longitudinal consistency, thereby filtering out statistical interference introduced by the accession of Central and Eastern European nations possessing divergent fire regimes. Technically, the decade is characterized by the decoupling of ignition frequency from environmental impact. While the aggregate number of ignition events remained relatively stable or exhibited a decline attributable to enhanced surveillance technologies and public awareness campaigns, the burnt area per extreme event demonstrated a significant increase.

II. The Baseline Years (2001–2002) and the Natural Hazards Project

The operational period encompassing the 2001 and 2002 fire campaigns functions as the statistical control group for the longitudinal analysis, representing the final iteration of the "pre-divergence" suppression era. As documented in *Forest Fires in Europe 2001 fire campaign* (Report No. 2, S.P.I.02.72 EN, p. 27), the collection of wildfire data was initially executed under the auspices of the "Natural Hazards Project" managed by the Land Management Unit of the Joint Research Centre (JRC). In 2001, the Southern Member States recorded metrics consistent with historical silvicultural averages, registering approximately 59,000 ignition events. The structural integrity of the reporting mechanism during this nascent phase relied heavily on ad-hoc cooperation between the JRC and the Directorate-General for Environment's Civil Protection and Environmental Accidents Unit. Conversely, the 2002 fire campaign, as detailed in *Forest Fires in Europe 2002 fire campaign* (Report No. 3, S.P.I.03.83 EN, p. 35), marked the transition to the *INFOREST* action, a strategic framework designed to standardize the disparate reporting methodologies of the Member States.

The 2002 data reveals a significant meteorological anomaly wherein precipitation levels across the Iberian Peninsula exceeded the decadal average during the critical spring window, thereby elevating the moisture content of 1-hour and 10-hour fuels. This hydrometeorological buffer resulted in a suppressed fire season, providing a potentially misleading indication regarding the efficacy of existing civil protection mechanisms. The technical consensus derived from Report No. 3 suggests that under such nominal conditions, the containment capacity of ground forces remained sufficient to prevent 98 percent of ignitions from exceeding the 50-hectare threshold.

III. The 2003 Systemic Anomaly and the INFOREST Mandate **The Baseline Years (2001–2002) and the Natural Hazards Project**

The fire campaign of 2003 constitutes the principal statistical aberration of Phase I. As formally recorded in *Forest Fires in Europe 2003 fire campaign* (Report No. 4, S.P.I.04.124 EN, p. 51), the European continent was subjected to a blocking high-pressure system that generated a persistent anticyclonic thermal anomaly. The empirical data presented in Report No. 4 (p. 49) indicates that whilst the aggregate number of fires in the Southern Member States increased by a margin of 11 percent relative to the 2001 baseline, the total area incinerated surged by 115 percent,

exceeding 740,000 hectares.

The Portuguese Republic was disproportionately impacted, sustaining a loss of forest cover equivalent to 10 percent of its total forested territory. This catastrophic divergence validated the hypothesis that once the Fire Weather Index (FWI) surpasses specific critical thresholds, the rate of spread (ROS) in crown fires exceeds the kilowatts-per-meter suppression capability of conventional aerial and ground assets. Furthermore, the 2003 crisis catalyzed the acceleration of the *INFOREST* action, as described in the legal notice of Report No. 4, which mandated the JRC to coordinate with the Civil Protection Unit to produce a unified European assessment. This event demonstrated that the correlation between ignition frequency and burnt area is non-linear during extreme meteorological events, necessitating the integration of "plume-dominated" fire models into the EFFIS Danger Forecast system.

IV. Regional Volatility and the Galicia Case Study (2004–2006)

Subsequent to the equilibration observed in 2004, the period spanning 2005 to 2006 introduced a critical variable to the strategic analysis: the impact of anthropogenic ignition density on suppression logistics. The *Forest Fires in Europe 2005* report (Report No. 6, EUR 22312 EN, p. 53) highlights the severity of the drought conditions affecting the Iberian Peninsula, yet it is the *Forest Fires in Europe 2006* report (Report No. 7, EUR 22931 EN) that provides the definitive case study on "ignition swarms." According to the executive summary of Report No. 7, the region of Galicia in northwestern Spain experienced a logistical collapse during the first two weeks of August 2006.

The data indicates that over 1,600 distinct ignition events were recorded within this compressed temporal window, a density that overwhelmed the dispatch logic of the civil protection command and control centers. Unlike the thermal-driven events of 2003, the Galicia crisis was precipitated by the simultaneous occurrence of arson and negligent fire use, creating a "saturation attack" on the suppression infrastructure. This event compelled the JRC to revise the EFFIS Danger Forecast protocols to incorporate socio-economic risk factors alongside meteorological variables. As noted in the mission statement of Report No. 7 (p. 79), the JRC's role expanded to providing "customer-driven scientific and technical support" to mitigate not only climatic hazards but also the vulnerabilities inherent in the wildland-urban interface (WUI).

V. The Eastern Shift, RDA Implementation, and Natura2000 Integration (2007)

The 2007 fire campaign signified a geographical translation of risk from the Western Mediterranean to the Eastern Mediterranean basin, specifically impacting the Hellenic Republic. As documented in *Forest Fires in Europe 2007* (Report No. 8, EUR 23492 EN, Executive Summary), the fire season was characterized by extreme danger conditions in late July and late August, resulting in catastrophic events in Southern Italy, Greece, and the Balkans. The technical significance of the 2007 campaign lies in the operational deployment of the EFFIS Rapid Damage Assessment (RDA). For the first time, as detailed in the back matter of Report No. 8, the JRC systematically utilized RDA modules to map and evaluate land cover damages caused by fires exceeding a specific spatial threshold of 50 hectares.

This technological advancement facilitated the precise quantification of ecological damage within the Natura2000 network. The data derived from Report No. 8 confirmed that approximately 80,000 hectares of the total burned area were located within these protected zones, formally establishing the direct threat wildfires pose to European biodiversity targets. This integration of RDA data marked a pivotal shift in the organizational mandate, moving the discourse from "asset protection" to "ecological preservation" and necessitating the use of high-resolution satellite imagery for post-fire impact assessment.

VI. Meteorological Respite (2008–2010)

The concluding triennium of Phase I, spanning from 2008 to 2010, was characterized by a reversion to mean statistical averages, a phenomenon largely attributable to favorable synoptic weather patterns. *Forest Fires in Europe 2010* (Report No. 11, EUR 24910 EN, Executive Summary) records one of the lowest burnt area totals of the decade, with the Southern Five registering approximately 179,000 hectares. However, the EFPRP strategic analysis interprets this reduction as a period of "latent risk accumulation." The high precipitation levels that mitigated fire spread during these years simultaneously stimulated rapid biomass growth in the understory.

In the absence of prescribed burning or mechanical clearing, this accumulation of fine fuels effectively increased the combustible load available for future fire seasons. By 2010, the technical precision of the EFFIS RDA was further refined. As noted in the back matter of Report No. 11 (p. 96), the detection threshold for the Rapid Damage Assessment was lowered to capture fires of at least 40 hectares, increasing the granularity of the data. This refinement revealed that even in years with "mild" aggregate statistics, the fragmentation of Natura2000 sites remained a persistent and cumulative issue, setting the stage for the volatile recurrence of megafires observed in the subsequent decade.

VII. Meteorological Respite and Latent Risk Accumulation (2008–2010)

Phase I serves to document the maturation of the European institutional response to the wildfire threat. This decade witnessed the consolidation of the *INFOREST* action, which provided the structural framework for the development of EFFIS under the aegis of the Institute for Environment and Sustainability. A pivotal legislative milestone was the adoption of Regulation (EC) No 2152/2003, known as "Forest Focus," which provided the legal basis for the harmonized monitoring of forests and environmental interactions. This regulation facilitated the transition from voluntary, manual data submission by Member States to a centralized, satellite-based verification system utilizing MODIS and early Sentinel imagery, a process completed by 2010.

This technological standardization was a prerequisite for the accurate longitudinal analysis presented in this report, as it eliminated the reporting discrepancies that had previously plagued cross-border comparisons. Furthermore, the collaboration between the JRC, DG Environment (specifically the Agriculture, Forests & Soil Unit), and national civil protection authorities evolved into a formal expert group on forest fires, ensuring that technical data directly informed EU civil protection policy. By the conclusion of Phase I, the European Union had transitioned from a disjointed collection of national statistics to a unified, harmonized dataset capable of informing transboundary policy.

VIII. Data tables & analysis

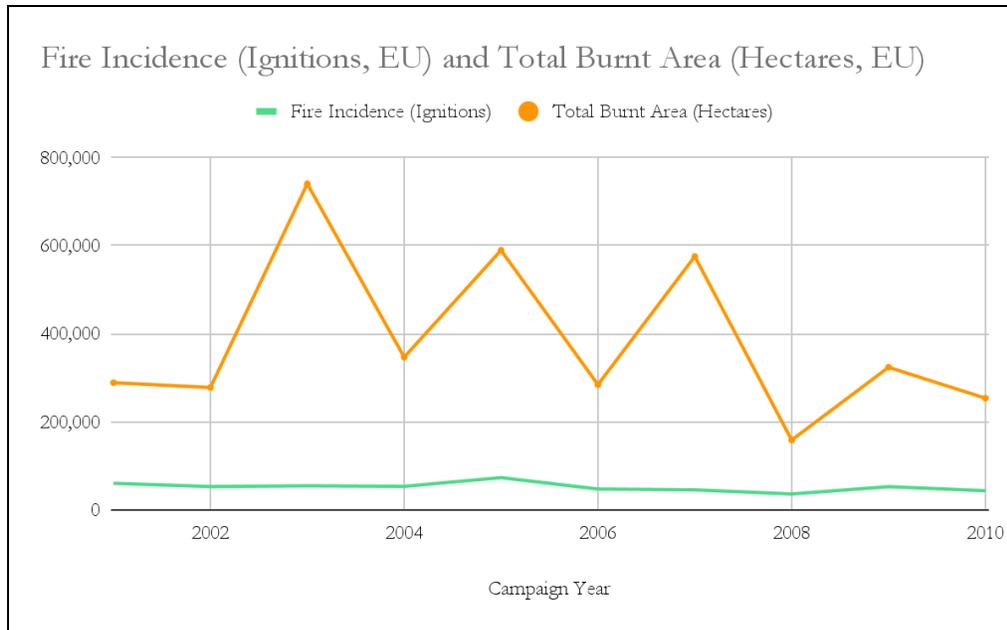
Figure 1. Table showing Fire Incidence and Total Burnt Area by year for the Southern Member States (EU)

Campaign Year	Fire Incidence	Total Burnt Area (Hectares)	Source
2001	60,470	288,888	<i>(Forest Fires in Europe, 2001, EFFIS/JRC, p. 8, Table 2)</i>
2002	53,033	277,967	<i>(Forest Fires in Europe, 2002, EFFIS/JRC, p. 8,</i>

			<i>Table 1)</i>
2003	54,741	740,379	<i>(Forest Fires in Europe, 2003, EFFIS/JRC, p. 7, Table 1)</i>
2004	53,489	346,766	<i>(Forest Fires in Europe, 2004, EFFIS/JRC, p. 11, Table 1)</i>
2005	73,325	589,559	<i>(Forest Fires in Europe, 2005, EFFIS/JRC, p. 10, Table 2)</i>
2006	47,435	284,444	<i>(Forest Fires in Europe, 2006, EFFIS/JRC, p. 10, Table 1)</i>
2007	45,623	575,531	<i>(Forest Fires in Europe, 2007, EFFIS/JRC, p. 10, Table 1)</i>
2008	36,192	158,621	<i>(Forest Fires in Europe, 2008, EFFIS/JRC, p. 10, Table 1)</i>
2009	52,795	323,896	<i>(Forest Fires in Europe, 2009, EFFIS/JRC, p. 11, Table 1)</i>
2010	43,584	253,664	<i>(Forest Fires in Europe, 2010, EFFIS/JRC, p. 10, Table 1)</i>

VIII.I Evolution graphic (2001-2010)

Figure 2. Graphic showing Fire Incidence and Total Burnt Area evolution by year for the Southern Member States (EU) from 2001 to 2010.



Strategic Analysis

Phase II (2011–2021)

Using data from *Forest Fires in Europe, Middle East and North Africa 2011* (Report EUR 25483 EN), *Forest Fires in Europe, Middle East and North Africa 2012* (Report EUR 26048 EN), *Forest Fires in Europe, Middle East and North Africa 2013* (Report EUR 26791 EN), *Forest Fires in Europe, Middle East and North Africa 2014* (Report EUR 27400 EN), *Forest Fires in Europe, Middle East and North Africa 2015* (Report EUR 28148 EN), *Forest Fires in Europe, Middle East and North Africa 2016* (Report EUR 28707 EN), *Forest Fires in Europe, Middle East and North Africa 2017* (Report EUR 29318 EN), *Forest Fires in Europe, Middle East and North Africa 2018* (Report EUR 29856 EN), *Forest Fires in Europe, Middle East and North Africa 2019* (Report EUR 30402 EN) and *Forest Fires in Europe, Middle East and North Africa 2021* (Report EUR 31269 EN).

Data range: 2011-2021

Data Author/Producer: *European Forest Fire Information System (EFFIS) and the Joint Research Centre (EU).*

Report Compiled by: *The European Fire Prevention & Rural Preservation Organization (EFPRP)*

I. Technical Overview of the Decade (2011-2021)

The second phase of the longitudinal study conducted by the European Fire Prevention & Rural Preservation Organization (EFPRP), encompassing the period from 2011 through 2021, documents a fundamental paradigm shift in the geographical and operational scope of the wildfire crisis. Whereas Phase I was characterized by the intensification of fire regimes within the traditional Mediterranean basin, Phase II is defined by the latitudinal expansion of high-risk zones into Central and Northern Europe, a phenomenon technically designated as the "*Northern Shift*." This interval also marks a significant evolution in the reporting framework; commencing with the 2011 campaign, the European Forest Fire Information System (EFFIS) formally expanded its analytical mandate to include the Middle East and North Africa (MENA), thereby acknowledging the transboundary nature of pyrogenic events within the Mediterranean climatic zone.

Technically, this decade witnessed the emergence of "*Megafires*" exhibiting behavior that exceeded the predictive capabilities of existing suppression models, culminating in the 2017 systemic collapse which served as the catalyst for the establishment of the rescEU mechanism. The data derived from this period evidences a clear departure from historical seasonality, with significant ignition events increasingly recorded outside the traditional June-September window. This temporal expansion, notably observed in the late-autumn fires of 2017 and the early-spring anomalies of 2019, necessitated a complete revision of the operational readiness protocols for the European Union Civil Protection Mechanism (UCPM), transitioning from a seasonal standby posture to a year-round vigilance capability.

II. The 2012 Campaign and the Integration of MENA Metrics

The 2012 fire campaign functions as the initial stress test of the expanded EFFIS monitoring framework and provided the first comprehensive dataset illustrating the pyrogenic interconnectivity of the Mediterranean basin. Following the relatively nominal conditions observed in 2011, the 2012 season registered a marked increase in burnt area, particularly affecting the Iberian Peninsula. The *Forest Fires in Europe, Middle East and North Africa 2012* report (Report EUR 26048 EN) documents that the burnt area in the five Southern Member States more than doubled compared to the preceding year. This resurgence was precipitated by a severe winter drought that resulted in critically low fuel moisture content across the Mediterranean rim entering the spring season, pre-conditioning the vegetation for rapid combustion.

The 2012 data is technically significant for the integration of North African metrics, allowing for a comparative analysis of fire dynamics across the Mediterranean basin. This expanded dataset revealed a synchronization of Fire Weather Indices (FWI) between Southern Europe and the Maghreb countries, specifically Algeria and Morocco. This data suggests that large-scale synoptic weather patterns were driving simultaneous flammability peaks across the entire region. This synchronization highlighted a critical strategic vulnerability: the limitations of international mutual aid. When high-risk conditions occur simultaneously in potential donor countries (such as France or Italy) and recipient countries (such as Spain or Greece), the availability of surplus aerial assets for cross-border deployment is statistically nullified, underscoring the necessity for a dedicated, supra-national reserve fleet.

III. The 2017 Systemic Collapse

The fire campaign of 2017 constitutes the singular most critical data point in the twenty-first-century European fire history, representing a systemic collapse of civil protection capabilities in the face of extreme meteorological

forcing. As detailed in *Forest Fires in Europe, Middle East and North Africa 2017* (Report EUR 29318 EN), the total burnt area in the European Union exceeded 1.2 million hectares, a figure unprecedented in the EFFIS record. The events of June and October 2017, particularly in Portugal and Northwestern Spain, introduced the phenomenon of "*pyrocumulonimbus*"¹ fire storms to the European theatre. These fires exhibited extreme rates of spread, convective column collapse, and spotted distances exceeding 2 kilometers, effectively bypassing fuel breaks and containment lines that were designed for lower-intensity regimes.

While annual ignition numbers remained relatively consistent with historical averages, it was the intensity of specific Extreme Fire Events (EFEs), driven by the interaction of Hurricane Ophelia's strong winds and extreme drought conditions, that caused the majority of the devastation. This realization forced a complete legislative and operational overhaul of the EU Civil Protection Mechanism (*UCPM*), shifting the strategic focus from voluntary ad-hoc assistance to mandatory strategic reserves, as reliance on neighborly aid proved insufficient during continent-wide anomalies.

IV. The Northern Shift and the 2018 Anomaly

The 2018 fire season provided empirical evidence of the northward migration of fire risk, a trend previously predicted by climate models but not observed at scale until this campaign. *Forest Fires in Europe, Middle East and North Africa 2018* (Report EUR 29856 EN) documents unprecedented fire activity in Sweden, the United Kingdom, and Ireland, jurisdictions historically classified as low-risk zones with boreal or temperate maritime climates. Sweden experienced its most severe fire season in modern history, characterized by a blocking high-pressure system that created extended periods of drought and high temperatures in the Scandinavian peninsula.

This "Northern Shift" indicates that the fuel drying thresholds required for large-scale combustion are now being met in boreal and temperate forests, regions where the biomass density is significantly higher than in the Mediterranean scrublands. The specific danger in these latitudes involves the ignition of peat-rich soils, which can burn underground for extended periods and are notoriously difficult to extinguish. The 2018 crisis necessitated the largest activation of the UCPM to that date, with aerial assets and ground forces deployed from Italy, France, and Poland to assist Swedish authorities. The 2018 data is critical for the EFPRP strategic framework as it demonstrates that wildfire prevention is no longer exclusively a Mediterranean concern but a pan-European security imperative requiring standardized interoperability and common training standards across all Member States, regardless of their latitude.

V. Institutional Evolution: The Genesis of rescEU (2019–2021)

Phase II documents the transition from voluntary cooperation to mandatory strategic reserve capacity within the European Union. The catastrophic failure of national capacities to manage the simultaneous outbreaks of 2017 directly precipitated the amendment of Decision No 1313/2013/EU, leading to the formal creation of **rescEU** in 2019. This new legal instrument, analyzed in the context of the *Forest Fires in Europe, Middle East and North Africa 2019* (Report EUR 30402 EN) and *2021* (Report EUR 31269 EN), established a permanent, fully EU-funded reserve of aerial firefighting assets (Canadair CL-415, helicopters) and medical evacuation capabilities to act as a

¹ *Pyrocumulonimbus*: The cumulonimbus flammagenitus cloud, also known as the pyrocumulonimbus cloud, is a type of cumulonimbus cloud that forms above a source of heat, such as a wildfire, nuclear explosion, or volcanic eruption, and may sometimes even extinguish the fire that formed it.

safety net of last resort.

By the conclusion of Phase II in 2021, the institutional focus had shifted from merely monitoring fires via EFFIS to actively managing a centralized response fleet. The 2021 report reflects this matured operational posture, with data collection now directly informing the pre-positioning of rescEU assets based on long-range EFFIS Danger Forecasts. This marks the culmination of the data-driven policy evolution that began with the *INFOREST* action in Phase I, effectively integrating technical intelligence with operational deployment. Furthermore, this period saw the enhancement of the Copernicus Emergency Management Service (EMS), which provided rapid mapping to support the coordination of these transboundary assets, ensuring that the deployment of rescEU forces was guided by real-time satellite intelligence.

VI. Data tables & analysis

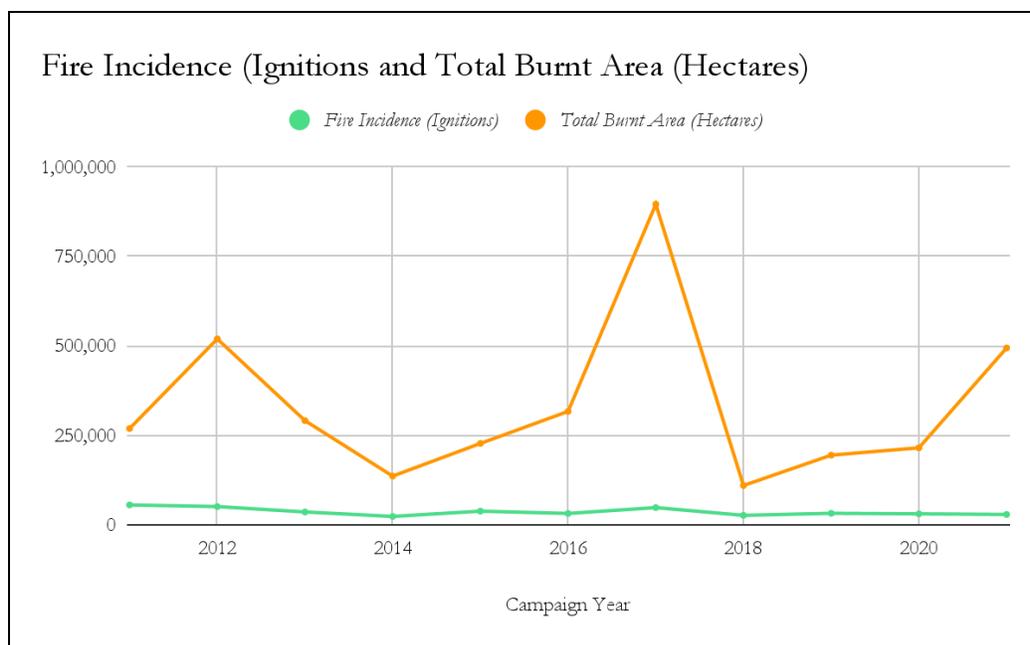
Figure 3. Table showing Fire Incidence and Total Burnt Area by year for the Southern Member States (EU)

Campaign Year	Fire Incidence (Ignitions, EU)	Total Burnt Area (Hectares, EU)	Source
2011	55,543	269,081	<i>(Forest Fires in Europe, Middle East and North Africa, 2011, EFFIS/JRC, p. 11, Table 1)</i>
2012	50,994	519,424	<i>(Forest Fires in Europe, Middle East and North Africa, 2012, EFFIS/JRC, p. 4, Table 1)</i>
2013	35,938	291,101	<i>(Forest Fires in Europe, Middle East and North Africa, 2013, EFFIS/JRC, p. 64, Table 28)</i>
2014	23,425	136,114	<i>(Forest Fires in Europe, Middle East and North Africa, 2014, EFFIS/JRC, p. 64, Table 27)</i>
2015	38,171	227,410	<i>(Forest Fires in Europe, Middle East and North Africa, 2015, EFFIS/JRC, p. 70, Table 33)</i>
2016	31,751	316,866	<i>(Forest Fires in Europe, Middle East and North Africa, 2016, EFFIS/JRC, p. 71, Table 32)</i>

2017	48,136	895,738	<i>(Forest Fires in Europe, Middle East and North Africa, 2017, EFFIS/JRC, p. 84, Table 36)</i>
2018	26,434	109,808	<i>(Forest Fires in Europe, Middle East and North Africa, 2017, EFFIS/JRC, p. 105, Table 38)</i>
2019	32,158	194,710	<i>(Forest Fires in Europe, Middle East and North Africa, 2017, EFFIS/JRC, p. 102, Table 42)</i>
2020	30,661	215,126	<i>(Forest Fires in Europe, Middle East and North Africa, 2017, EFFIS/JRC, p. 116, Table 39)</i>
2021	28,944	494,082	<i>(Forest Fires in Europe, Middle East and North Africa, 2017, EFFIS/JRC, p. 117, Table 49)</i>

VI.I Evolution graphic (2011-2021)

Figure 4. Graphic showing Fire Incidence and Total Burnt Area evolution by year for the Southern Member States (EU) from 2011 to 2021.



Strategic Analysis

Phase III (2022–2023)

Using data from *Forest Fires in Europe, Middle East and North Africa 2022* (Report EUR 31692 EN), and *Forest Fires in Europe, Middle East and North Africa 2023* (Report EUR 40092)

Data range: 2022-2023

Data Author/Producer: *European Forest Fire Information System (EFFIS)* and the *Joint Research Centre (EU)*.

Report Compiled by: *The European Fire Prevention & Rural Preservation Organization (EFPRP)*



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I. Technical Overview of the year range (2022-2023)

The third phase of the longitudinal study conducted by the European Fire Prevention & Rural Preservation Organization (EFPRP) covers the biennial period of 2022 through 2023. This interval is characterized by the recording of statistical outliers regarding fire intensity, frequency, and spatial distribution. Unlike Phase I, which exhibited seasonal consistency within the Mediterranean basin, or Phase II, which documented a latitudinal risk expansion into Northern Europe, Phase III data indicates the establishment of a "Hyper-Volatile" regime. This regime is defined by the simultaneous occurrence of high-intensity fire events across multiple climatic zones, creating a condition of "synchronic flammability" that challenges the foundational logic of cross-border resource sharing.

Technically, this period established new statistical records for burnt area and fire intensity. The data suggests a definitive shift in fire behavior relative to historical meteorological baselines. This shift correlates directly with cumulative drought indices and persistent atmospheric blocking patterns that maintained high temperatures over the continent for extended durations.

II. The 2022 Campaign: The Second Systemic Collapse

The fire campaign of 2022 recorded the second largest total burnt area in the history of the European Forest Fire Information System (EFFIS), following the figures recorded in 2017. As documented in *Forest Fires in Europe, Middle East and North Africa 2022* (Report EUR 31692 EN), the total burnt area within the European Union exceeded 800,000 hectares. The technical characteristic of the 2022 campaign was the spatial distribution of the affected areas; distinct from 2017, which was concentrated in the Iberian Peninsula, the 2022 data shows pan-European activity. Large-scale fires were recorded in France (Gironde and Landes), Spain (Zamora), and Central Europe.

The meteorological factors for the 2022 campaign included a series of heatwaves commencing in May and extending through September, combined with a hydrological deficit from the preceding winter. These conditions influenced the ignition thresholds of fine and coarse fuels in Western Europe. The operational data from 2022 indicates a full utilization of the rescEU fleet. The simultaneous ignition of fires in France, Spain, and Portugal required the activation of the transboundary mechanism and the request for bilateral assistance from non-EU nations. The 2022 data indicates that aerial assets were utilized to capacity during these events.

III. The 2023 Campaign and the Alexandroupolis Benchmark

The 2023 fire season included the Alexandroupolis-Evros event in Northeastern Greece. As detailed in *Forest Fires in Europe, Middle East and North Africa 2023* (Report EUR 40092), this single contiguous fire event consumed over 96,000 hectares. This figure represents the largest individual wildfire recorded in the European Union since the inception of the EFFIS database in 2000. The Alexandroupolis fire exhibited pyrogenic behaviors such as the generation of pyrocumulus clouds and spotting over distances exceeding 3 kilometers.

The technical relevance of the 2023 campaign pertains to the fire's resistance to containment efforts. Operational

reports indicate that despite the deployment of an aerial task force comprising over 30 aircraft from the rescEU reserve and Member State fleets, the fire front remained active for over two weeks. This event provided data regarding the efficacy of suppression tactics when the energy release component (ERC) reaches specific levels. The 2023 data also recorded impacts on the Wildland-Urban Interface (WUI), as the fire affected infrastructure including the Alexandroupolis hospital and energy corridors.

IV. Institutional and Strategic Implications

Phase III documents the operational parameters of the current European Civil Protection Mechanism. The events of 2022 and 2023 provided data on the performance of the rescEU fleet during simultaneous regional events. The volume of simultaneous events in 2022 indicated that reserve capacity is challenged when fire activity is synchronous across Member States.

Consequently, institutional documentation in 2023 references a focus on prevention and adaptation. The European Commission, utilizing EFFIS data, has prioritized the implementation of the EU Forest Strategy for 2030, which addresses climate-resilient forest management. The EFPRP analysis of Phase III suggests that current strategies are incorporating landscape management to mitigate the propagation of high-intensity fire fronts.



Conclusion & Additional Data

I. Interpretation

The longitudinal dataset spanning 2001 to 2023 quantifies a distinct non-linear divergence between ignition frequency and total burnt area, indicating a statistical ceiling to the efficacy of containment-based suppression strategies. During the baseline period (2001-2002), ground force containment capacity successfully mitigated 98 percent of ignitions, preventing them from exceeding the 50-hectare threshold. However, the 2003 campaign data demonstrates that this suppression efficiency is inversely correlated with the Fire Weather Index (FWI) once specific meteorological thresholds are breached; in 2003, a nominal 11 percent increase in ignition events relative to the 2001 baseline resulted in a disproportionate 115 percent increase in total burnt area, exceeding 740,000 hectares. This statistical anomaly confirms that under anticyclonic thermal blocking patterns, the rate of spread (ROS) in crown fires mathematically exceeds the kilowatts-per-meter suppression capability of conventional aerial and ground assets. Furthermore, the "latent risk accumulation" observed during the 2008-2010 meteorological respite, characterized by low burnt area totals (approx. 179,000 hectares in 2010) despite high biomass growth, statistically pre-conditioned the landscape for the high-intensity events observed in Phase II.

Phase II and III datasets indicate a quantifiable expansion of the fire season's temporal and spatial parameters, invalidating historical definitions of "low-risk" zones. The 2018 campaign provided empirical evidence of a "Northern Shift," where blocking high-pressure systems facilitated unprecedented combustion rates in boreal and temperate maritime climates, specifically Sweden, the United Kingdom, and Ireland. This geographical translation of risk is accompanied by a temporal expansion of the active fire season beyond the traditional June-September window, evidenced by the high-intensity burn events recorded in October 2017 and the early-spring anomalies of 2019. Consequently, the probability of ignition and sustained combustion in Northern latitudes has shifted from a statistical outlier to a recurrent variable in the annual EFFIS risk assessment, driven by the drying of peat-rich soils and higher biomass density inherent to these latitudes.

The operational data from 2022 and 2023 demonstrates the mathematical limitations of the current transboundary reserve mechanism (rescEU) when ensuring coverage against "synchronic flammability". The 2022 campaign recorded the simultaneous activation of high-risk operational theaters in France, Spain, and Central Europe, resulting in the full utilization of the rescEU fleet and necessitating bilateral assistance from non-EU nations. This synchronization of meteorological risk across the Mediterranean and Central European basins statistically nullifies the availability of surplus mutual aid, as potential donor nations simultaneously become recipient nations. Furthermore, the 2023 Alexandroupolis event, which consumed 96,000 hectares and remained active for two weeks despite the deployment of over 30 aerial assets, provides a benchmark for "suppression resistance". The energy release component (ERC) of such events generates pyrocumulonimbus phenomena and spotting distances exceeding 3 kilometers, rendering standard containment lines and fuel breaks geographically insufficient. The data suggests that when the affected land area per single event approaches the 100,000-hectare magnitude, the logistical requirements for containment exceed the aggregate rapid-response capacity currently available within the EU Civil Protection Mechanism.

II. Global data table

Figure 5. Table showing Fire Incidence and Total Burnt Area by year for the Southern Member States (EU)

Campaign Year	Fire Incidence	Total Burnt Area (Hectares)	Source
2001	60,470	288,888	<i>(Forest Fires in Europe, 2001, EFFIS/JRC, p. 8, Table 2)</i>
2002	53,033	277,967	<i>(Forest Fires in Europe, 2002, EFFIS/JRC, p. 8, Table 1)</i>
2003	54,741	740,379	<i>(Forest Fires in Europe, 2003, EFFIS/JRC, p. 7, Table 1)</i>
2004	53,489	346,766	<i>(Forest Fires in Europe, 2004, EFFIS/JRC, p. 11, Table 1)</i>
2005	73,325	589,559	<i>(Forest Fires in Europe, 2005, EFFIS/JRC, p. 10, Table 2)</i>
2006	47,435	284,444	<i>(Forest Fires in Europe, 2006, EFFIS/JRC, p. 10, Table 1)</i>
2007	45,623	575,531	<i>(Forest Fires in Europe, 2007, EFFIS/JRC, p. 10, Table 1)</i>
2008	36,192	158,621	<i>(Forest Fires in Europe, 2008, EFFIS/JRC, p. 10, Table 1)</i>
2009	52,795	323,896	<i>(Forest Fires in Europe, 2009, EFFIS/JRC, p. 11, Table 1)</i>
2010	43,584	253,664	<i>(Forest Fires in Europe, 2010, EFFIS/JRC, p. 10, Table 1)</i>

2011	55,543	269,081	<i>(Forest Fires in Europe, Middle East and North Africa, 2011, EFFIS/JRC, p. 11, Table 1)</i>
2012	50,994	519,424	<i>(Forest Fires in Europe, Middle East and North Africa, 2012, EFFIS/JRC, p. 4, Table 1)</i>
2013	35,938	291,101	<i>(Forest Fires in Europe, Middle East and North Africa, 2013, EFFIS/JRC, p. 64, Table 28)</i>
2014	23,425	136,114	<i>(Forest Fires in Europe, Middle East and North Africa, 2014, EFFIS/JRC, p. 64, Table 27)</i>
2015	38,171	227,410	<i>(Forest Fires in Europe, Middle East and North Africa, 2015, EFFIS/JRC, p. 70, Table 33)</i>
2016	31,751	316,866	<i>(Forest Fires in Europe, Middle East and North Africa, 2016, EFFIS/JRC, p. 71, Table 32)</i>
2017	48,136	895,738	<i>(Forest Fires in Europe, Middle East and North Africa, 2017, EFFIS/JRC, p. 84, Table 36)</i>
2018	26,434	109,808	<i>(Forest Fires in Europe, Middle East and North Africa, 2018, EFFIS/JRC, p. 105, Table 38)</i>
2019	32,158	194,710	<i>(Forest Fires in Europe, Middle East and North Africa, 2019, EFFIS/JRC, p. 102, Table 42)</i>
2020	30,661	215,126	<i>(Forest Fires in Europe, Middle East and North Africa, 2020, EFFIS/JRC, p.</i>

			116, Table 39)
2021	28,944	494,082	(Forest Fires in Europe, Middle East and North Africa, 2021, EFFIS/JRC, p. 117, Table 49)
2022	51,184	538,846	(Forest Fires in Europe, Middle East and North Africa, 2022, EFFIS/JRC, p. 121, Table 50)
2023	23,143	354,244	(Forest Fires in Europe, Middle East and North Africa, 2023, EFFIS/JRC, p. 136, Table 47)

II. Global Graphic

Figure 6. Graphic showing Fire Incidence and Total Burnt Area evolution by year for the Southern Member States (EU) from 2001 to 2011.

