http://silvaworld.org
SilvaWorld
e-ISSN: 2822-6127
https://prensip.gen.tr

REVIEW ARTICLE

The Role of Forest Fires in Plant Biodiversity: Ecological Responses and Succession

Nurcan Yiğit

Kastamonu University, Faculty of Forestry, Department of Forest Engineering, Kastamonu/Türkiye

ARTICLE INFO

Article History
Received: 05.08.2025
Accepted: 15.09.2025
First Published: 29.09.2025

Keywords
Floristic composition
Forest botany
Forest fire
Plant communities
Succession

ABSTRACT

Forest fires represent increasingly frequent disturbances in forested and semi-forested ecosystems, primarily driven by the interplay of natural processes and anthropogenic pressures. These events have reached alarming levels, significantly altering the structural, functional, ecological, and biological dynamics of forest ecosystems. Recognized as among the most destructive natural disturbances, forest fires exert direct and long-lasting effects on ecosystems that extend far beyond the mere burning of vegetation. This study aims to evaluate the ecological impacts of forest fires, with particular emphasis on their effects on floristic composition, the ecological responses of plant species, and the post-fire succession processes. Following fire events, substantial shifts in species diversity, dominance, and community structure are observed. The interplay between fire-resistant and fire-sensitive species plays a decisive role in shaping the trajectory of ecological succession. Moreover, the rapid proliferation of invasive species—often gaining a competitive edge in disturbed habitats—poses a serious threat to native plant diversity and overall ecosystem integrity. In this context, floristic monitoring studies are vital for informed conservation planning. Supporting natural succession, promoting the *in situ* conservation of native species, and implementing ecosystem-based management strategies emerge as critical tools for sustaining post-fire ecosystem resilience. This article adopts an interdisciplinary perspective to examine fire–flora interactions, synthesizing insights from the current literature and offering region-specific recommendations, particularly for forested ecosystems in Türkiye.

Please cite this paper as follows:

Yiğit, N. (2025). The role of forest fires in plant biodiversity: Ecological responses and succession. *SilvaWorld*, *4*(2), 81-87. https://doi.org/10.61326/silvaworld.v4i2.391

1. Introduction

Forest fires are among the most important natural processes affecting the structure and functions of ecosystems. They are among the environmental threats becoming increasingly frequent and severe due to increased human activities and climate change (Turner, 1989). While fires serve as a natural succession mechanism in some ecosystems, uncontrolled and frequently occurring fires, in particular, can have irreversible effects on floristic structure and biodiversity. They cause dramatic effects on plant composition, habitat fragmentation, destruction of ecological corridors, deterioration in soil structure and quality, and decreased biodiversity (Certini, 2005; Pausas & Keeley, 2009; Turner et al., 1997).

The ecological impacts of fires are not limited to tree burning or carbon release; they also profoundly affect plant communities' structural and functional properties. These effects are particularly evident in more sensitive components such as understory flora and ground cover plants. The responses of plant species to fire vary depending on species-specific adaptations, such as the fire resistance of root systems, seasonal seed set, and resprouting capacity.

Corresponding author
E-mail address: nyigit@kastamonu.edu.tr

Floristic composition describes the number and distribution of plant species within an ecosystem and is an important indicator of ecosystem health. Fires affect this composition directly (species elimination) and indirectly (changes in competitive relationships, transformation of soil properties). For example, some species can rapidly become dominant during the post-fire succession process, while others can disappear entirely from the ecosystem.

While distinctions are sometimes made between fire-adapted and non-fire-adapted ecosystems, fires occur with varying frequency and severity in nearly all terrestrial biomes worldwide (Archibald et al., 2018; He et al., 2019; Keeley et al., 2011; McWethy et al., 2013). The flammability of a particular ecosystem is greatly influenced by the composition, structure and species composition of the community, climatic conditions or seasonality of conditions suitable for fire spread, and the frequency of ignition sources (Gill & Zylstra, 2005; Pausas & Keeley, 2009; Pausas et al., 2017).

Species' responses to fire vary depending on their ecological traits and the characteristics of the fire regime, particularly its frequency, intensity, seasonality, and the size of the burned area (He et al., 2019). Fire influences both the abundance and structure of plant communities, creating a dynamic and often complex ecological relationship—especially critical in the context of exotic plant invasions. Post-fire ecological succession refers to the temporal changes in community structure and species composition following a fire event. During this process, species that are fire-resistant or capable of rapid regeneration often become dominant, while slower-growing or fire-sensitive species may decline or disappear entirely. Consequently, the floristic composition can differ significantly between pre- and post-fire conditions. Furthermore, the expansion of invasive plant species into fire-cleared areas can exert competitive pressure on native flora, destabilizing the ecosystem and undermining biodiversity (Daskalakou & Thanos, 1996; Mandle et al., 2011).

This article critically evaluates the ecological consequences of wildfires on plant diversity, with a specific focus on post-fire succession dynamics. By integrating global and Türkiye-based case studies, it aims to highlight patterns, gaps, and practical implications for sustainable forest management.

2. The Relationship between Fire Regimes and Floristic Structure

A fire regime encompasses the full range of fire-related characteristics within an ecosystem, including frequency, intensity, seasonality, duration, and spatial extent. These parameters collectively play a critical role in shaping the floristic composition and ecological dynamics of each ecosystem. The effects of fire on biotic communities are not determined solely by the occurrence of fire itself but are strongly influenced by the specific attributes of the fire regime. In particular, the frequency, intensity, and timing of fires are key factors in determining plant species' survival and regeneration capacity (Gill & Zylstra, 2005; Keeley et al., 2011; Pausas & Keeley, 2009).

2.1. Fire Frequency and Intensity

In forest ecosystems where fires occur frequently, a new fire may occur before the natural succession process is complete. This causes slow-growing, late-succession species to be replaced by fast-growing, fire-resistant species. Excessive fire pressure can reduce floristic diversity, homogenize species diversity, and weaken ecosystem services. These effects have been observed, particularly in the Turkish red pine (*Pinus brutia* Ten.) forests of the Mediterranean and Aegean regions, where frequent fires occur (Akkemik et al., 2023; Bond & Wilgen, 1996; Kavgacı & Tavşanoğlu, 2010).

Fire intensity is related to soil surface temperature, burning depth, and the level of organic matter destruction. Low-severity fires affect only the surface shrub and herbaceous layer; High-intensity fires can destroy the seed bank, damage root systems, and disrupt soil structure, negatively impacting regeneration (DeBano et al., 1998). This leads to species losses and structural disruptions, particularly in the understory flora (Pausas et al., 2008).

2.2. Seasonality

The season in which a fire occurs can increase or decrease its impact depending on the phenological status of the plants. For example, a fire in spring can be fatal to plants that have not yet flowered and produced seeds, while late-summer fires may be less destructive because they occur after some species have dispersed their seeds. Furthermore, the season of the fire affects which species will benefit during succession (Daskalakou & Thanos, 1996).

2.3. Effects of Fires on Floristic Structure

Fire regimes can affect floristic composition in the short term (extinction of existing species or shift in dominant species) and in the long term (direction of succession, species persistence). In ecosystems frequently exposed to fire, fire-adapted species (e.g., resprouter shrubs, thick-barked trees, serotinous conifers) become prominent, while sensitive species face the threat of extinction. This can weaken the ecosystem's functional diversity and balance mechanisms (Keeley et al., 2011; Pausas & Verdú, 2005).

Fire regimes observed in Turkish forests are gradually changing due to climate change and anthropogenic impacts. Increased fire risk, particularly after long dry periods, triggers permanent transformations in the Mediterranean and flora, suppressing native species and causing floristic degeneration in some regions.

3. Plant Types Responding to Fire

Forest fires represent one of the most significant ecological disturbances, impacting flora, fauna, biodiversity, and landscape structure across fire-prone ecosystems worldwide. In Mediterranean regions in particular, fires act as powerful ecological forces, substantially altering species composition and disrupting ecological balance (Bond & Keeley, 2005; Pausas & Keeley, 2009). The extent to which plant species and communities respond to fire is shaped by various functional traits, physiological tolerances, and reproductive strategies that have evolved under recurrent fire regimes (Keeley et al., 2011).

Plant species exhibit capacities to persist in fire-affected areas (Kavgacı & Tavşanoğlu, 2010). Mediterranean vegetation, in particular, displays high fire adaptability due to both vegetative and generative traits (Kazanis & Arianoutsou, 2004; Paula et al., 2009; Tavşanoğlu & Gürkan, 2004). These adaptations are the result of long-term evolutionary processes (Pausas et al., 2004; Trabaud, 1994). Fire- adapted plant species are typically categorized into functional groups based on their mechanisms of persistence, regeneration strategies, and post-fire establishment potential. Many such species survive fire events by resprouting from dormant buds or underground organs such as tubers, lignotubers, or rhizomes. Fire-adapted species, which withstand fire damage due to their structural or chemical properties, are also prevalent in fire-prone regions (Clarke et al., 2013; Lamont et al., 2019). Mediterranean-type ecosystems are often dominated by maquis vegetation, characterized by species capable of regenerating both vegetatively and from seeds (Lavorel, 1999).

Understanding the distribution and ecological roles of fire-sensitive plant species is emerging as a critical research priority, particularly in the context of intensifying climate change. Global climate models predict a marked increase in the frequency and severity of wildfires in the coming decades (Bowman et al., 2020; Flannigan et al., 2009). Such changes are expected not only to amplify biomass loss but also to drive long-term shifts in vegetation composition, successional dynamics, and ecosystem functions (Ertürk et al., 2024a, 2024b; Özcan et al., 2024).

Fire-adapted plant species have evolved a range of survival strategies, including vegetative resprouting, fire-stimulated seed germination, the development of thick bark, and the production of protective chemicals (Keeley et al., 2011; Pausas & Keeley, 2009). For instance, some species maintain persistent soil seed banks, where seeds remain dormant and viable for many years. When fire occurs, the heat or chemical cues from smoke break dormancy, promoting synchronized germination. This adaptation, known as fire-induced germination, is crucial for the persistence of many woody and herbaceous species in ecosystems where crown fires are common (Ergan, 2017; Moreira et al., 2010; Tavşanoğlu et al., 2017).

However, the extent to which these strategies are effective under different fire regimes remains to be clarified in regional contexts. Accurately modeling the distribution patterns of plant groups responding to fires is crucial for post-fire ecosystem renewal, biodiversity conservation, and sustainability.

In this context, accurately predicting the impacts of changing fire regimes on plant communities and determining appropriate strategies not only contributes to ecological resilience and durability but also forms the scientific basis for climate-adapted land management and conservation strategies (Clarke et al., 2013; Pausas & Bradstock, 2007). Furthermore, changes in fire regimes caused by anthropogenic land use changes and invasive species are increasingly altering the selective pressures on plant communities, potentially disrupting long-standing evolutionary adaptations (Pausas & Bradstock, 2007).

4. Post-Fire Successional Dynamics of Floristic Composition

Plant species in Mediterranean-type ecosystems can re-enter the area after a fire due to their adaptability (Kavgacı & Tavşanoğlu, 2010). The ecological impact of fires can lead to an ongoing reconstruction process in the form of post-fire recovery of ecosystems (Doussi & Thanos, 1994), but can also result in ecosystem degradation, often due to human-induced factors, and a departure from existing floristic structure and structural characteristics (Moreira & Vallejo, 2009).

Suppose the dominant tree species can re-establish and develop rapidly after a forest fire. In that case, pre-fire environmental conditions will occur earlier, and the vegetation will rapidly return to pre-fire conditions (Arnan et al., 2007). The emergence of open land conditions after a fire creates favorable conditions for specific species or groups of species that could not disperse or were present at low densities in old, closed forests. In this context, species called pioneer species germinate rapidly and cover the site in the first year after a fire. Legumes and rockrose are the most prominent species in this context (Figure 1). Legumes, in particular, are crucial for post-fire vegetation dynamics because they improve soil nutrient content and provide a high organic matter input. These fire monitors survive by germinating their seeds hidden in the soil after the fire (URL1, 2025).

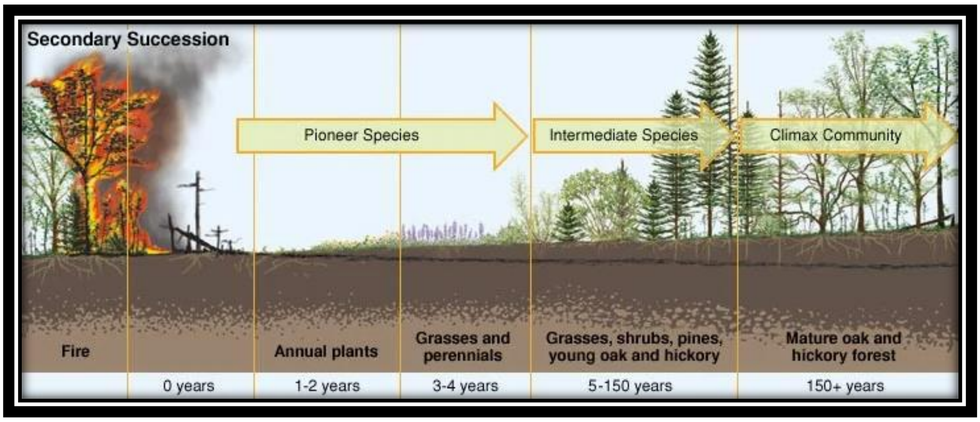

Figure 1. Stages of secondary succession (URL1, 2025).

5. Natural Succession and Floristic Regeneration Processes

Natural ecosystems are dynamic structures that undergo continuous change and development over time. Ecological succession, one of the processes underlying these changes, can be defined as reestablishing a specific order in habitats disrupted by significant events such as forest fires, floods, landslides, or anthropogenic activities (Begon et al., 2006). Plant communities begin with fast-growing and short-lived species in the early stages of natural succession and gradually give way to climax communities. Throughout this process, biodiversity, soil structure, microclimate, and interactions among species become increasingly complex (Prach & Pyšek, 2001). For example, herbaceous species become dominant after fires in the early succession stages and may eventually be overshadowed by shrubs and trees (Keeley et al., 2011). The succession process; It depends on the interaction of many environmental and biotic factors, such as fire, flood, and land abandonment, climate, soil properties (pH, moisture capacity, macro and micronutrients), and species diversity in the immediate environment (Mitchley, 2008).

The period immediately following fires is a critical one that must be carefully managed. During this period, the protection of forest soil and the prevention of alien species (e.g., *Ailanthus altissima, Robinia pseudoacacia, Acacia saligna*), which can rapidly colonize post-fire habitats and suppress native regeneration, are of great importance. Tropical and subtropical forests, including the Mediterranean Region, have evolved through fires. Minerals, organic materials, and seeds found in the soil of burned areas are sources of forest renewal. However, because these areas are completely open, they are also prone to loss through erosion, and great care must be taken to protect soil, a vital resource, in situ. Intensive land clearing, drainage, and restoration activities after fires can cause the loss of this valuable resource to wind and surface runoff. Therefore, forest regeneration can be significantly delayed (Kemer, 2022). Natural succession is important because it demonstrates the self-renewal capacity of ecosystems (Rey Benayas et al., 2009). Furthermore, the recovery of ecosystem services such as biodiversity, habitat quality, and carbon storage is directly related to successional processes.

6. Post-Fire Floristic Change and the Role of Invasive Species

Forest fires are powerful ecological disturbances that not only cause immediate damage to ecosystems but also drive long-term changes in floristic composition. Recent studies have demonstrated that fires lead to both temporal and structural alterations in plant diversity (Kavgacı & Tavşanoğlu, 2010; Kemer, 2022). However, the increasing frequency and intensity of forest fires—exacerbated by climate change and anthropogenic pressures—have been shown to negatively affect the composition and stability of native plant communities over time. In Türkiye, this trend poses a growing threat to the structural integrity of vegetation and has the potential to result in species losses and ecological imbalance (Akkemik et al., 2023).

In this context, invasive plant species emerge as a critical concern. These species often capitalize on the ecological vacancies created by fire, rapidly colonizing disturbed areas and outcompeting native flora (Richburg et al., 2004). Their proliferation can alter successional pathways, inhibit the regeneration of indigenous vegetation, and contribute to a decline in biodiversity. In addition, fire suppression policies—which interrupt natural fire regimes—can further disrupt floristic balance and exacerbate the ecological impacts of subsequent fire events (McLauchlan et al., 2020).

Thus, the ecological consequences of forest fires extend far beyond the immediate post-disturbance phase. The interplay between fire-driven habitat change and the spread of invasive species gives rise to complex and persistent ecological challenges, ultimately threatening ecosystem stability and biodiversity. Monitoring post-fire vegetation dynamics, evaluating the expansion of invasive species, and implementing proactive strategies to conserve native flora are therefore essential for maintaining the resilience and ecological integrity of fire-adapted forest ecosystems.

7. Conclusion and Recommendations

The forest fires, which have become more frequent and intense due to climate change and human pressure, have and will continue to impact natural plant species composition over time negatively. In areas affected by fires, herbaceous plant species diversity initially increases significantly, but then declines as woody species re-dominate. Studies have shown that a significant increase in species diversity occurs in the first few years after a fire, stabilizing after 20 years. The increased species diversity after the fire is reduced in areas subject to deep and mechanized tillage due to the inability of deeply buried herbaceous seeds to germinate. While removing hard-leaved woody species in these areas benefits the planted species, it can negatively impact shrub diversity and density. This negative impact on plant diversity caused by mechanization can be mitigated by conducting strip and zoned rather than full-scale operations. However, it is important to avoid mechanization as much as possible in areas that are home to rare and endemic species whose populations are expected to increase after fires (Akkemik et al., 2023).

All restoration efforts should be conducted within the framework of biodiversity principles, aiming to restore the natural forest ecosystem (Kemer, 2022). Natural succession and floristic regeneration processes are crucial for understanding the long-term recovery dynamics of degraded ecosystems and developing conservation strategies. Careful monitoring and guidance of these processes provide the scientific basis for sustainable habitat management and restoration practices.

Conflict of Interest

The author declares that there is no conflict of interest.

References

Akkemik., Ü., Kavgacı, A., & Akarsu, F. (2023). Orman yangınlarının bitki çeşitliliği üzerindeki etkileri. In A. Kavgacı, & M. Başaran, (Eds.), *Orman yangınları* (pp. 326-342). Türkiye Ormancılar Derneği Yayını. (In Turkish)

Archibald, S., Lehmann, C. E., Belcher, C. M., Bond, W. J., Bradstock, R. A., Daniau, A. -L., Dexter, K. G., Forrestel, E. J., Greve, M., & He, T. (2018). Biological and geophysical feedbacks with fire in the Earth system. *Environmental Research Letters*, *13*(3), 033003. https://doi.org/10.1088/1748-9326/aa9ead

Arnan, X., Rodrigo, A., & Retana, J. (2007). Post-fire regeneration of Mediterranean plant communities at a regional scale is dependent on vegetation type and dryness. *Journal of Vegetation Science*, *18*(1), 111-122. https://doi.org/10.1111/j.1654-1103.2007.tb02521.x

Begon, M., Townsend, C. R., & Harper, J. L. (2006). *Ecology: From individuals to ecosystems*. Blackwell Publishing.

Bond, W. J., & Keeley, J. E. (2005). Fire as a global 'herbivore': The ecology and evolution of flammable ecosystems. *Trends in Ecology & Evolution*, *20*(7), 387-394. https://doi.org/10.1016/j.tree.2005.04.025

Bond, W. J., & Wilgen, B. W. (1996). *Fire and plants: Population and community biology series*. Springer. https://doi.org/10.1007/978-94-009-1499-5

Bowman, D. M., Kolden, C. A., Abatzoglou, J. T., Johnston, F. H., van der Werf, G. R., & Flannigan, M. (2020). Vegetation fires in the Anthropocene. *Nature Reviews Earth & Environment*, *1*(10), 500-515. https://doi.org/10.1038/s43017-020-0085-3

Certini, G. (2005). Effects of fire on properties of forest soils: A review. *Oecologia*, *143*, 1-10. https://doi.org/10.1007/s00442-004-1788-8

Clarke, P. J., Knox, K. J. E., Bradstock, R. A., & Munoz-Robles, C. (2013). Post-fire recovery of woody plants in eastern Australian forests: The role of fire severity, interval and resprouting. *Journal of Vegetation Science*, *24*(4), 724-733.

Daskalakou, E. N., & Thanos, C. A. (1996). Aleppo pine (*Pinus halepensis*) post-fire regeneration: The role of canopy and soil seed banks. *International Journal of Wildland Fire*, *6*(2), 59-66. https://doi.org/10.1071/WF9960059

DeBano, L. F., Neary, D. G., & Ffolliott, P. F. (1998). *Fire's effects on ecosystems*. John Wiley & Sons.

Doussi, M. A., & Thanos, C. A. (1994). *Post-fire regeneration of hardseeded plants: Ecophysology of seed germination*. 2nd International Conference of Forest-Fire Research. Coimbra.

Ergan, G. (2017). *Akdeniz bitkilerinin yangınla olan ilişkisinin incelenmesi ve yangın efemerallerinin tespiti* (Master's thesis, Hacettepe University). (In Turkish)

Ertürk, N., Arıcak, B., Şevik, H., & Yiğit, N. (2024b). Possible change in distribution areas of *Abies* in Kastamonu due to global climate change. *Kastamonu University Journal of Forestry Faculty*, *24*(1), 81-91. https://doi.org/10.17475/kastorman.1460616

Ertürk, N., Arıcak, B., Yiğit, N., & Sevik, H. (2024a). Potential changes in the suitable distribution areas of *Fagus orientalis* lipsky in Kastamonu due to global climate change. *Forestist*, *74*, 159-165. https://doi.org/10.5152/forestist.2024.23024

Flannigan, M., Stocks, B., Turetsky, M., & Wotton, M. (2009). Impacts of climate change on fire activity and fire management in the circumboreal forest. *Global Change Biology*, *15*(3), 549-560. https://doi.org/10.1111/j.1365-2486.2008.01660.x

Gill, A. M., & Zylstra, P. (2005). Flammability of Australian forest fuels. *Forest Ecology and Management*, *68*(2), 87-93. https://doi.org/10.1080/00049158.2005.10674951

He, T., Lamont, B. B., & Pausas, J. G. (2019). Fire as a key driver of Earth's biodiversity. *Biological Reviews*, *94*(6), 1983-2010. https://doi.org/10.1111/brv.12544.

Kavgacı, A., & Tavşanoğlu, Ç. (2010). Akdeniz tipi ekosistemlerde yangın sonrası vejetasyon dinamiği. *Süleyman Demirel Üniversitesi Orman Fakültesi Dergisi*, *A*(2), 149-166. (In Turkish)

Kazanis, D., & Arianoutsou, M. (2004). Long-term post-fire vegetation dynamics in *Pinus halepensis* forests of Central Greece: A functional approach. *Plant Ecology*, *171*, 101-121. https://ddoi.org/10.1023/B:VEGE.0000029376.15741.b4

Keeley, J. E., Pausas, J. G., Rundel, P. W., Bond, W. J., & Bradstock, R. A. (2011). Fire as an evolutionary pressure shaping plant traits. *Trends in Plant Science*, *16*(8), 406-411. https://doi.org/10.1016/j.tplants.2011.04.002

Kemer, N. (2022). Orman yangınları ve sonrası: Orman ekosistem restorasyonu. *Avrupa Bilim ve Teknoloji Dergisi*, (33), 373-381. https://doi.org/10.31590/ejosat.1054290 (In Turkish)

Lamont, B. B., He, T., & Pausas, J. G. (2019). Fire as a selective agent for both serotiny and nonserotiny over space and time. *Critical Reviews in Plant Sciences*, *39*(2), 140-172. https://doi.org/10.1080/07352689.2020.1768465

Lavorel, S. (1999). Ecological diversity and resilience of Mediterranean vegetation to disturbance. *Diversity and Distributions*, *5*(1-2), 3-13. https://doi.org/10.1046/j.1472-4642.1999.00033.x

Mandle, L., Bufford, J. L., Schmidt, I. B., & Daehler, C. C. (2011). Woody exotic plant invasions and fire: Reciprocal impacts and consequences for native ecosystems. *Biological Invasions*, *13*, 1815-1827. https://doi.org/10.1007/s10530-011-0001-3

McLauchlan, K. K., Higuera, P. E., Miesel, J., Rogers, B. M., Schweitzer, J., Shuman, J. K., Tepley, A. J., Varner, J. M., Veblen, T. T., & Adalsteinsson, S. A. (2020). Fire as a fundamental ecological process: Research advances and frontiers. *Journal of Ecology*, *108*(5), 2047-2069. https://doi.org/10.1111/1365-2745.13403

McWethy, D., Higuera, P., Whitlock, C., Veblen, T., Bowman, D., Cary, G., Haberle, S., Keane, R., Maxwell, B., & McGlone, M. (2013). A conceptual framework for predicting temperate ecosystem sensitivity to human impacts on fire regimes. *Global Ecology and Biogeography*, *22*(8), 900-912. https://doi.org/10.1111/geb.12038

Mitchley, J. (2008). Old Fields. Dynamics and restoration of abandoned farmland, Edited by Viki A. Cramer and Richard J. Hobbs, ix + 334 pp., 23 × 15 × 1.5 cm, ISBN 978 1 59726 075 6 paperback, GB£ 26.50, London, UK: Island Press. *Environmental Conservation*, *35*(2), 191-192. https://doi.org/10.1017/S0376892908004815

Moreira, B., Tormo, J., Estrelles, E., & Pausas, J. G. (2010). Disentangling the role of heat and smoke as germination cues in Mediterranean Basin flora. *Annals of Botany*, *105*(4), 627-635. https://doi.org/10.1093/aob/mcq017

Moreira, F., & Vallejo, R. (2009). What to do after fire? Post-fire restoration. In Y. Birot, (Ed.), *Living with wildfires: What science can tell us: A contribution to the science – policy dialogue* (pp. 53-58). European Forest Institute.

Özcan, A. U., Gülçin, D., Tuttu, G., Velázquez, J., Ayan, S., Stephan, J., Tuttu, U., Varlı, A., & Çiçek, K. (2024). The future possible distribution of Kasnak oak (*Quercus vulcanica* Boiss. & Heldr. ex Kotschy) in Anatolia under climate change scenarios. *Forests*, *15*(9), 1551. https://doi.org/10.3390/f15091551

Paula, S., Arianoutsou, M., Kazanis, D., Tavsanoglu, Ç., Lloret, F., Buhk, C., Ojeda, F., Luna, B., Moreno, J. M., Rodrigo, A., Espelta, J. M., Palacio, S., Fernández-Santos, B., Fernandes, P. M., & Pausas, J. G. (2009). Fire-related traits for plant species of the Mediterranean Basin. *Ecology*, *90*(5), 1420. https://doi.org/10.1890/08-1309.1

Pausas, J. G., & Bradstock, R. A. (2007). Fire persistence traits of plants along a productivity and disturbance gradient in mediterranean shrublands of south-east Australia. *Global Ecology and Biogeography*, *16*(3), 330-340. https://doi.org/10.1111/j.1466-8238.2006.00283.x

Pausas, J. G., & Keeley, J. E. (2009). A burning story: The role of fire in the History of life. *BioScience*, *59*(7), 593-601. https://doi.org/10.1525/bio.2009.59.7.10.

Pausas, J. G., & Verdú, M. (2005). Plant persistence traits in fire-prone ecosystems of the Mediterranean Basin: A phylogenetic approach. *Oikos*, *109*(1), 196-202. https://doi.org/10.1111/j.0030-1299.2005.13596.x

Pausas, J. G., Keeley, J. E., & Schwilk, D. W. (2017). Flammability as an ecological and evolutionary driver. *Journal of Ecology*, *105*(2), 289-297. https://doi.org/10.1111/1365-2745.12691

Pausas, J. G., Llovet, J., Rodrigo, A., & Vallejo, R. (2008). Are wildfires a disaster in the Mediterranean basin? – A review. *International Journal of Wildland Fire*, *17*, 713-723. https://doi.org/10.1071/WF07151

Pausas, J. G., Ribeiro, E., & Vallejo, R. (2004). Post-fire regeneration variability of Pinus halepensis in the eastern Iberian Peninsula. *Forest Ecology and Management*, *203*(1-3), 251-259. https://doi.org/10.1016/j.foreco.2004.07.061

Prach, K., & Pyšek, P. (2001). Using spontaneous succession for restoration of human-disturbed habitats: Experience from Central Europe. *Ecological Engineering*, *17*(1), 55-62. https://doi.org/10.1016/S0925-8574(00)00132-4

Rey Benayas, J. M., Newton, A. C., Diaz, A., & Bullock, J. M. (2009). Enhancement of biodiversity and ecosystem services by ecological restoration: A meta-analysis. *Science*, *325*(5944), 1121-1124. https://doi.org/10.1126/science.1172460

Richburg, J., Patterson III, W., & Ohman, M. (2004). *Fire management options for controlling woody invasive plants in the northeastern and mid-Atlantic US*. Retrieved 01 Aug, 2025, from https://www.umass.edu/nebarrensfuels/publications/pdfs/Richburg_Ohman-Invasives_Fire_final_report.pdf

Tavşanoğlu, Ç., & Gürkan, B. (2004). Akdeniz havzasında bitkilerin kuraklık ve yangına uyumları. *Ot Sistematik Botanik Dergisi*, *11*(1), 119-132. (In Turkish)

Tavşanoğlu, Ç., Ergan, G., Çatav, Ş. S., Zare, G., Küçükakyüz, K., & Özüdoğru, B. (2017). Multiple fire-related cues stimulate germination in Chaenorhinum rubrifolium (Plantaginaceae), a rare annual in the Mediterranean Basin. *Seed Science Research*, *27*(1), 26-38. https://doi.org/10.1017/S0960258516000283

Trabaud, L. (1994). Postfire plant community dynamics in the Mediterranean Basin. In J. M. Moreno & W. C. Oechel (Eds.), *The role of fire in the Mediterranean-type ecosystems* (pp. 1-15). Springer. https://doi.org/10.1007/978-1-4613-8395-6_1

Turner, M. G. (1989). Landscape ecology: The effect of pattern on process. *Annual Review of Ecology and Systematics*, *20*, 171-197. https://doi.org/10.1146/annurev.es.20.110189.001131

Turner, M. G., Romme, W. H., Gardner, R. H., & Hargrove, W. W. (1997). Effects of fire size and pattern on early succession in Yellowstone National Park. *Ecological Monographs*, *67*(4), 411-433. https://doi.org/10.1890/0012-9615(1997)067[0411:EOFSAP]2.0.CO;2

URL1. (2025). *Secondary Succession*. Retrieved Jul 28, 2025, from https://www.britannica.com/science/secondary-succession