



OPEN ACCESS

EDITED BY

Guillermo Emilio Defossé,
National Scientific and Technical Research
Council (CONICET), Argentina

REVIEWED BY

Anastasia Christopoulou,
National and Kapodistrian University of
Athens, Greece

*CORRESPONDENCE

Yuka Kotozaki
✉ kotoyuka@iwate-med.ac.jp

RECEIVED 12 March 2025

ACCEPTED 05 May 2025

PUBLISHED 27 May 2025

CITATION

Kotozaki Y (2025) The increase of wildfires and
their impact: the importance of prevention
and measures through the example of
Ofunato. *Front. For. Glob. Change* 8:1589796.
doi: 10.3389/ffgc.2025.1589796

COPYRIGHT

© 2025 Kotozaki. This is an open-access
article distributed under the terms of the
[Creative Commons Attribution License \(CC
BY\)](#). The use, distribution or reproduction in
other forums is permitted, provided the
original author(s) and the copyright owner(s)
are credited and that the original publication
in this journal is cited, in accordance with
accepted academic practice. No use,
distribution or reproduction is permitted
which does not comply with these terms.

The increase of wildfires and their impact: the importance of prevention and measures through the example of Ofunato

Yuka Kotozaki*

Iwate Medical University, Morioka, Japan

KEYWORDS

wildfire, human impact, mental health, prevention, social support

Introduction

Wildfires are natural disturbances that play an essential role in ecosystem dynamics. However, in some forest ecosystems, wildfire plays a natural role in ecosystem regeneration. Rather than insisting on preventing wildfires altogether, it is important to consider ways to minimize wildfire damage while allowing natural fire cycles to function where appropriate. This perspective allows for a more balanced discussion of wildfire management strategies. When they occur in wildland–urban interface (WUI) areas or threaten human lives and infrastructure, they may have disastrous consequences (Omi, 2005; Pyne, 2010; Kalogiannidis et al., 2023). While there is evidence of increasing wildfire frequency or severity in certain regions (e.g the Mediterranean), satellite data suggest that the global burned area has actually declined by ~25% over the past two decades (Andela et al., 2017). Therefore, global trends are heterogeneous and influenced by both natural and anthropogenic drivers. Once wildfires start to cause damage may result in long-term or irreversible environmental damage, including biodiversity loss, degradation of soil fertility, and destruction of mature forest ecosystems (Diaz, 2014). Although wildfires are caused by a variety of factors, from natural to man-made, they can be prevented by taking appropriate countermeasures.

This article examines the wildfires and their environmental and social impacts, and proposes multifaceted preventive measures and countermeasures through the case of Ofunato City. Ofunato, located in Iwate Prefecture, Japan, experienced a significant wildfire in February 2025 that affected forested areas and nearby communities. This case serves as a timely and locally relevant example of how climate conditions, land use, and preparedness intersect in determining wildfire risk and response in regional Japan.

Current situation and background of wildfires

Wildfires are particularly prone to occur in dry seasons and regions. Recent years have seen an increase in the frequency and severity of wildfires (Wasserman and Mueller, 2023). Rising temperatures and extreme weather events caused by global warming are widely believed to be contributing factors (Diffenbaugh et al., 2017; Coumou and Rahmstorf, 2012; Toreti et al., 2013; Allan and Soden, 2008). In addition, prolonged drought conditions, which have become more frequent and intense in recent years, significantly increase the flammability of vegetation, making wildfires more likely and difficult to control (Halofsky et al., 2020; Jones et al., 2022). These wildfires cause more than just forest loss; they worsen air pollution, accelerate global warming, and cause social and economic disruption (Bolan et al., 2024).

In Japan, about 1,300 wildfires occur annually, destroying about 700 hectares of forest and costing about 240 million yen in damages. Four wildfires occur daily in Japan, burning about 2 hectares of forest and costing about 700,000 yen in damages (Forestry Agency, 2024). While wildfires are a year-round occurrence, their frequency and severity tend to increase during the dry period, from late spring to early autumn. During this time, lower precipitation and higher temperatures result in drier vegetation, making it more susceptible to ignition. This seasonal increase in fire risk is particularly concerning, as dry conditions significantly enhance the flammability of vegetation, leading to more frequent and intense wildfires. Ofunato City is located in the southern coastal area of Iwate Prefecture in the Tohoku region of Japan and is known for its beautiful rias coastline and rich forest resources. On February 19, 2025, a wildfire broke out in the Ryouritahama area of Sanriku-cho, Ofunato, Iwate Prefecture, and as of March 6, 1 week after the outbreak, the fire had not been extinguished. The area burned reached ~2,900 hectares, which is equivalent to about 9% of Ofunato City's total area (Iwate Prefecture, 2025). This fire is the largest wildfire in Japan since 1990 (Forestry Agency, 2024).

Ofunato City is one of the most mountainous and forested areas in Iwate Prefecture, and is particularly affected by winds due to its location on the coast. In this wildfire, the strong winds increased the intensity of the wildfire, and the fire spread to dozens of hectares in just a few hours. Fortunately, human casualties were minimal, but the smoke caused respiratory problems in some areas and raised concerns about health risks to residents. The wildfire damaged forested areas, mainly coniferous trees such as cedar and pine. These tree species are often found in areas planted for forestry purposes and are extremely vulnerable to fire due to their thin bark and high resin content (Van Wagner, 1977; Fonda, 2001; Mensah et al., 2023). In particular, the fire spread rapidly as it developed into a "crown fire" that spread to the leaves and branches of the trees (Van Wagner, 1977), and had a significant impact on the habitat of flora and fauna (Iwate Prefecture, 2025). As of March 8, 2025, the Japanese government is working to designate the large-scale wildfire in Ofunato City as a severe disaster.

The following are some examples of current wildfires in other countries. In the U.S. wildfires are particularly prevalent in California, Oregon, and Washington (U.S. Department of Agriculture, 2025); in 2020, California experienced the largest wildfire in its history, burning more than 2 million acres of forest (Frontline Wildfire Defense, 2025). Fire causes include dry weather, lightning, electrical equipment failure, and human activities such as arson, negligence, or infrastructure failures (UN Office for Disaster Risk Reduction, 2025). In California in particular, wildfires occur every year, and the size and frequency of fires are increasing each year. This has led to serious social and environmental problems, including the evacuation of residents, smoke impact on cities, and loss of habitat for plants and animals (Frontline Wildfire Defense, 2025).

Australia is one of the countries where wildfires are a serious problem. In particular, the massive "Black Summer" fires of 2019–2020 killed billions of animals and forced the evacuation of more than 800,000 people. The fires were considered one of the worst fire seasons on record, with warmer temperatures and drier weather contributing to the spread of the fires. In addition, the Australian

government and experts are calling for stronger countermeasures to deal with the prospect of more severe wildfires in the future as global warming continues to increase (Australian Public Service Commission, 2025).

Canada is another region where wildfires occur frequently (Hanes et al., 2019). Canada experienced its worst wildfire season in history in 2023, with fires burning 16.5 million hectares. This is more than double the previous record and almost seven times the historical average (NASA, 2025). Wildfires in Canada are becoming increasingly severe due to the combined effects of rising temperatures, drought, lightning, and even human-caused causes (Brulé, 2023).

In Greece, fires are particularly frequent during the summer months, and the effects of drought and high temperatures on summer fires have been reported (Turco et al., 2017). Recent study have shown that warmer and drier conditions in the Mediterranean region have led to more frequent and larger fires (Guion et al., 2022). The devastating 2018 Mati wildfire in Eastern Attica, Greece exemplifies the deadly combination of prolonged drought, extreme temperatures, and strong winds in the wildland-urban interface. This fire resulted in over 100 fatalities and extensive property loss, becoming one of the deadliest wildfires in European history (Christakis, 2021; Efthimiou et al., 2020; Arianoutsou et al., 2024). These studies highlight the urgent need for integrated fire risk management strategies in the face of a warming climate.

Multiple effects of wildfires

The effects of wildfires go beyond the environment and spill over into social and economic issues. First, the environmental effects are very serious. Forests are responsible for absorbing carbon dioxide, and the loss of that function can accelerate the progression of global warming. In particular, the carbon dioxide and methane gases released by burned trees can further exacerbate climate change as greenhouse gases released into the atmosphere (Vieira et al., 2023). However, unlike fossil fuel emissions, the carbon released during wildfires may be partially offset over time through carbon uptake by regrowing vegetation. This regrowth process can help restore part of the carbon storage capacity of the forest, although the extent and pace of recovery vary depending on post-fire conditions, forest type, and human intervention. In addition, fires increase the risk of landslides when soils are exposed. Since forest roots are responsible for holding the soil in place, heavy rains after a fire increase the risk of landslides (Rengers et al., 2020). Moreover, wildfires alter watershed hydrology by reducing soil infiltration capacity and increasing surface runoff, leading to higher peak flows during storms (Frontline Wildfire Defense, 2025). These compounded effects underscore the importance of integrated land and water management strategies in fire-prone regions.

The economic impact cannot be ignored. Forests provide not only tangible resources such as timber and medicinal plants, but also a wide range of ecosystem services, including carbon storage, water regulation, and recreational value. Recent reviews have highlighted how wildfires can disrupt these services, resulting in long-term economic and environmental consequences (Arshad et al., 2022; Moazeni and Cerda, 2024; Escobedo et al., 2024). The

loss of these resources will take a heavy toll on the local economy (Kalogiannidis et al., 2023). In addition, when a fire breaks out, the enormous costs associated with firefighting and restoration efforts place a heavy economic burden on the local community. In addition, the spread of smoke and toxic substances in the air from a fire can affect the health of people living in the surrounding area, resulting in increased medical costs (Scaccia, 2024).

Wildfires not only cause physical destruction but also have profound psychological effects on affected communities. Survivors often experience stress, anxiety, and post-traumatic stress disorder (PTSD) due to the loss of homes, livelihoods, and loved ones (To et al., 2021; Grant and Runkle, 2022). Additionally, prolonged exposure to wildfire smoke has been linked to cognitive and emotional disturbances (Do et al., 2025). Community displacement and social disruption further exacerbate mental health challenges, highlighting the need for psychological support and long-term recovery programs in wildfire-affected areas (Heanoy and Brown, 2024).

Prevention and countermeasures against wildfires

To prevent fires, advance preparation and early response are essential. First is the importance of forest management. Firebreaks set up in forests and proper vegetation management can prevent the spread of fires. In areas of high fire risk, advance fire restrictions and increased vigilance are required, especially during dry periods. For example, California has a system in place to issue early fire warnings and evacuation advisories based on weather conditions (California Governor's Office of Emergency Services, 2025). Such a response is critical to minimize damage.

In addition, surveillance systems must be strengthened for early detection. Fire monitoring systems using drones and satellites are very effective in quickly detecting fires, even from remote locations (Ramadan et al., 2024). If fires can be controlled in their early stages through the introduction of such technologies, it will be possible to prevent the spread of damage. Furthermore, international cooperation is also important. Since wildfires are not a problem that affects only a specific country or region, but have a global impact, the international community as a whole must

work on prevention and countermeasures through information sharing and the provision of technology. For example, by sharing the experiences of Australia and Canada with other countries, the risk of similar disasters can be reduced.

Author contributions

YK: Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Allan, R. P., and Soden, B. J. (2008). Atmospheric warming and the amplification of precipitation extremes. *Science* 321, 1481–1484. doi: 10.1126/science.1160787
- Andela, N., Morton, D. C., Giglio, L., Chen, Y., van der Werf, G. R., Kasibhatla, P. S., et al. (2017). A human-driven decline in global burned area. *Science* 356, 1356–1362. doi: 10.1126/science.aal4108
- Arianoutsou, M., Athanasakis, G., Kazanis, D., and Christopoulou, A. (2024). Attica: a Hot spot for forest fires in Greece. *Fire* 7:467. doi: 10.3390/fire7120467
- Arshad, A., Azhar, A. A., and Anjali, K. S. (2022). Impact of forest fire on forest ecosystem. *J. Agric. Technol.* 9, 18–29.
- Australian Public Service Commission (2025). "Black Summer." Available online at: <https://www.apsc.gov.au/state-service/state-service-report-2019-20/chapter-1-commitment-service/black-summer> (accessed March 6, 2025).
- Bolan, S., Padhye, L. P., Jasemizad, T., Govarthan, M., Karmegam, N., Wijesekara, H., et al. (2024). Impacts of climate change on the fate of contaminants through extreme weather events. *Sci. Total Environ.* 909:168388. doi: 10.1016/j.scitotenv.2023.168388
- Brulé, C. (2023). *FACT SHEET: Climate change and wildfires*. Climate Institute. Available online at: <https://climateinstitute.ca/news/fact-sheet-wildfires/> (accessed March 6, 2025).
- California Governor's Office of Emergency Services (2025). *California State Warning Center Alert and Warning Program*. Available at: <https://www.caloes.ca.gov/office-of-the-director/operations/response-operations/headquarters-response/california-state-warning-center/cswc-awp> (accessed March 6, 2025).
- Christakis, G. (2021). Attica wildfires: the intersection of governance failures and climate change. *HPHR* 31. doi: 10.54111/0001/EE14

- Coumou, D., and Rahmstorf, S. (2012). A decade of weather extremes. *Nat. Clim. Change* 2, 491–496. doi: 10.1038/nclimate1452
- Diaz, J. M. (2014). *Economic Impacts of Wildfire. Fire Adapted Communities Learning Network*. Available online at: https://fireadaptednetwork.org/wp-content/uploads/2014/03/economic_costs_of_wildfires.pdf (accessed March 6, 2025).
- Diffenbaugh, N. S., Singh, D., Mankin, J. S., Horton, D. E., Swain, D. L., Touma, D., et al. (2017). Quantifying the influence of global warming on unprecedented extreme climate events. *Proc. Natl. Acad. Sci. U.S.A.* 114, 4881–4886. doi: 10.1073/pnas.1618082114
- Do, V., McBrien, H., Teigen, K., Childs, M., Kioumourtzoglou, M., and Casey, J. (2025). A National study on the impact of wildfire smoke on cause-specific hospitalizations among medicare enrollees with Alzheimer's Disease and Related Dementias from 2006 to 2016. *Fire* 8:97. doi: 10.3390/fire8030097
- Eftimiou, N., Psomiadis, E., and Panagos, P., (2020). Fire severity and soil erosion susceptibility mapping using multi-temporal Earth Observation data: the case of Mati fatal wildfire in Eastern Attica, Greece. *Catena* 187:104320. doi: 10.1016/j.catena.2019.104320
- Escobedo, F. J., Yadav, K., Ossola, A., Klein, R., and Drury, S. (2024). Urban forest cover and ecosystem service response to fire varies across California communities. *Urban For. Urban Green.* 101:128547. doi: 10.1016/j.ufug.2024.128547
- Fonda, R. W. (2001). Burning Characteristics of needles from eight pine species. *For. Sci.* 47, 390–396. doi: 10.1093/forestscience/47.3.390
- Forestry Agency (2024). Available online at: https://www.rinya.maff.go.jp/j/hogo/yamakaji/con_1.htm (accessed March 6, 2025).
- Frontline Wildfire Defense (2025). *California Wildfire History & Statistics*. Available online at: <https://www.frontlinewildfire.com/wildfire-news-and-resources/california-wildfires-history-statistics/> (accessed March 6, 2025).
- Grant, E., and Runkle, J. D. (2022). Long-term health effects of wildfire exposure: a scoping review. *J. Clim. Change Health* 6:100110. doi: 10.1016/j.joclim.2021.100110
- Guion, A., Turquety, S., Polcher, J., Pennel, R., Bastin S., and Arsouze, T. (2022). Droughts and heatwaves in the Western Mediterranean: impact on vegetation and wildfires using the coupled WRF-ORCHIDEE regional model (RegIPSL). *Clim. Dyn.* 58, 2881–2903. doi: 10.1007/s00382-021-05938-y
- Halofsky, J. E., Peterson, D. L., and Harvey, B. J. (2020). Changing wildfire, changing forests: the effects of climate change on fire regimes and vegetation in the Pacific Northwest, USA. *Fire Ecol.* 16:4. doi: 10.1186/s42408-019-0062-8
- Hanes, C. C., Wang, X., Jain, P., Parisien, M.-A., Little, J. M., and Flannigan, M. D. (2019). Fire-regime changes in Canada over the last half century. *Can. J. For. Res.* 49, 256–269. doi: 10.1139/cjfr-2018-0293
- Heanoy, E. Z., and Brown, N. R. (2024). Impact of natural disasters on mental health: evidence and implications. *Healthcare* 12:1812. doi: 10.3390/healthcare12181812
- Iwate Prefecture (2025). *Status of response to the forest fire in Akasaki Town, Ofunato City (17th report)*. Available online at: <https://iwate-bousai.my.salesforce-sites.com/servlet/servlet.FileDownload?file=00PIU00002blcGC2AY> (accessed March 6, 2025).
- Jones, M. W., Abatzoglou, J. T., Veraverbeke, S., Andela, N., Lasslop, G., Forkel, M., et al. (2022). Global and regional trends and drivers of fire under climate change. *Rev. Geophys.* 60:e2020RG000726. doi: 10.1029/2020RG000726
- Kalogiannidis, S., Chatzitheodoridis, F., Kalfas, D., Patitsa, C., and Papagrigroriou, A. (2023). Socio-psychological, economic and environmental effects of forest fires. *Fire* 6:280. doi: 10.3390/fire6070280
- Mensah, R. A., Jiang, L., Renner, J. S., and Xu, Q. (2023). Characterisation of the fire behaviour of wood: From pyrolysis to fire retardant mechanisms. *J. Therm. Anal. Calorim.* 148, 1407–1422. doi: 10.1007/s10973-022-11442-0
- Moazeni, S., and Cerda, A. (2024). The impacts of forest fires on watershed hydrological response. A review. *Trees For. People* 100707. doi: 10.1016/j.tfp.2024.100707
- NASA (2025). *Tracking Canada's Extreme 2023 Fire Season*. Available online at: <https://earthobservatory.nasa.gov/images/151985/tracking-canadas-extreme-2023-fire-season> (accessed March 6, 2025).
- Omi, P. N. (2005). *Forest fires: a reference handbook*. Santa Barbara, CA: ABC-CLIO. doi: 10.5040/9798400653070
- Pyne, S. (2010). The Ecology of Fire. *Nature Educ. Knowl.* 3:30.
- Ramadan, M. N. A., Basmaji, T., Gad, A., Hamdan, H., Akgün, B. T., Ali, M. A. H., et al. (2024). Towards early forest fire detection and prevention using AI-powered drones and the IoT. *Internet Things* 27:101248. doi: 10.1016/j.iot.2024.101248
- Rengers, F. K., McGuire, L. A., Oakley, N. S., et al. (2020). Landslides after wildfire: initiation, magnitude, and mobility. *Landslides* 17, 2631–2641. doi: 10.1007/s10346-020-01506-3
- Scaccia, J. (2024). *The Complexity of Wildfires and Environmental Justice*. *This Week in Science News*. Available online at: <https://thisweekinsciencenews.com/2024/01/11/the-complexity-of-wildfires-and-environmental-justice> (accessed March 6, 2025).
- To, P., Eboreime, E., and Agyapong, V. I. O., (2021). The Impact of Wildfires on Mental Health: A Scoping Review. *Behav. Sci.* 11:126. doi: 10.3390/bs11090126
- Toreti, A., Naveau, P., Zampieri, M., et al. (2013). Projections of global changes in precipitation extremes from Coupled Model Intercomparison Project Phase 5 models. *Geophys. Res. Lett.* 40, 4887–4892. doi: 10.1002/grl.50940
- Turco, M., von Hardenberg, J., AghaKouchak, A., Llasat, M. C., Provenzale, A., and Trigo, R. M. (2017). On the key role of droughts in the dynamics of summer fires in Mediterranean Europe. *Sci. Rep.* 7:81. doi: 10.1038/s41598-017-00116-9
- U.S. Department of Agriculture (2025). *Climate Change and Wildfire in Idaho, Oregon, and Washington*. Available at: <https://www.climatehubs.usda.gov/hubs/northwest/topic/climate-change-and-wildfire-idaho-oregon-and-washington> (accessed March 6, 2025).
- UN Office for Disaster Risk Reduction (2025). *LA fires: Why fast wildfires and those started by human activities are more destructive and harder to contain*. Available online at: <https://www.preventionweb.net/news/la-fires-why-fast-wildfires-and-those-started-human-activities-are-more-destructive-and-harder> (accessed March 6, 2025).
- Van Wagner, C. E. (1977). Conditions for the start and spread of crown fire. *Can. J. For. Res.* 7, 23–34. doi: 10.1139/x77-004
- Vieira, D. C. S., Borrelli, P., Jahaniannfard, D., Benali, A., Scarpa, S., and Panagos, P. (2023). Wildfires in Europe: burned soils require attention. *Environ. Res.* 217:114936. doi: 10.1016/j.envres.2022.114936
- Wasserman, T. N., and Mueller, S. E. (2023). Climate influences on future fire severity: a synthesis of climate-fire interactions and impacts on fire regimes, high-severity fire, and forests in the western United States. *Fire Ecol.* 19:43. doi: 10.1186/s42408-023-00200-8