fEs2023

2nd International Congress on
Fire in the Earth System: Humans and Nature

Granada, July 4-8, 2023

Department of Agriculture
HELLENIC MEDITERRANEAN UNIVERSITY

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fEs2023

2nd International Congress on Fire in the Earth System: Humans and Nature

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Editors

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The Mission of fEs2023

Fire is a key component of the Earth System and humans used as hunters and farmers. In the 21st century, fire is in the forefront of the environmental management and there is a need to find the role fire must play in our landscape. To achieve success, scientists, citizens and practitioners must interact and networking. **fEs2023** propose a hybrid conference with scientists, citizens and practitioners to share information, ideas and goals to use fire as a tool to achieve sustainability.

We invite participants with backgrounds such as fire dynamics, fire risk management, fire effects on vegetation, fauna, soil and water, and socio-economic, historical, geographical, political perception and land management approaches. We wish to connect the scientific communities from different regions of the world with the practitioners and citizens that will contribute to see different experiences and will boost the emergence of new approaches to fire research.

fEs2023 will power synergistic collaborations between research groups, citizens and stakeholders. **fEs2023** will help to synthesise the existing knowledge, to create fire-resilient landscapes based on integrated approach that include from biological, biochemical and physical research approaches, but also socio-economic, historical, geographical, sociological, perception and policy constraints.

fEs2023 will contribute to prepare society, practitioners and scientists to the intensification and geographical spreading of wildfires under the impact of Climate and Land Use Change. Global Change and fire will be two key actors for the fate of the humankind, and they will be discussed in **fEs2023**.

The president of the fEs2023 Organizing Committee,

Artemi Cerdà

Professor
University of Valencia

Scientific Committee

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2. Elena María Marcos Porras, Dpto. Biodiversidad y Gestión Ambiental, Fac. Ciencias Biológicas y Ambientales, Universidad de León
3. Saskia Keesstra, Senior researcher, Wageningen Environmental Research, Netherlands, Conjoint Associate Professor, University of Newcastle, Australia
4. Jesús Barrena González, University of Extremadura
5. Marco Turco, University of Murcia
6. Alexander Leverkus, University of Granada
7. Filipa Esteves, University of Porto
8. José Damián, Ruiz Sinoga University of Málaga
9. Stefan Doerr, University of Swansea
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2. JESÚS RODRIGO COMINO, Junior Researcher, Soil Erosion and Degradation Research Group, Department of Geography, University of Valencia, University of Trier
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Conference Program

II FIRE IN THE EARTH SYSTEM

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FACULTAD DE FILOSOFÍA Y LETRAS

Contact number and emails (organizers)
1. Jesús Rodrigo Comino (geo.jrc@gmail.com and 0034 637937558)

2. Artemi Cerdà (artemiocerda@gmail.com and 0034 696320315)

3. Ioannis Daliakopoulos (daliakopoulos@hydromech.gr → virtual conference)

DAY 1---04/07/2023

Preconference day. Guided visit of Granada city by a professor of Human Geography Department (University of Granada) and La Alhambra.
We will start here at 9:30: https://goo.gl/maps/LjfyTwQdqAdtznQE8

DAY 2-3---05-06/07/2023

In situ conference with keynotes, oral and poster presentations with sponsor tables and coffee breaks at the Faculty of Philosophy and Letters at the University of Granada. First floor, Aula García Lorca (ROOM).

LINK GOOGLE MEET: https://meet.google.com/ynh-kuog-njz

Instructions for online presentations: https://firecongress.eu/wp-content/uploads/2021/10/RECORDING-Guide_Poster-presentation.pdf

DAY 4--- 07/07/2023

Postconference fieldtrip I to the Baetic Experimental Plot (www.egemap.eu) and Valle de Lecrín/Sierra Nevada forest fire site.

We will depart at 7:30 from here: https://goo.gl/maps/QExSPtDRFRsyH4oH6

DAY 5---08/07/2023

Postconference fieldtrip II to Los Guájares forest fire site.

We will depart at 7:30 from here:
https://goo.gl/maps/QExSPtDRFRsyH4oH6

PRELIMINARY AGENDA (PENDING ON LAST MINUTE CORRECTIONS) 05/07/2023

9:15	Dean and Junta de Andalucía, organizers welcome		
9:30-9:45	**Keynote speaker 1**	**Marco Turco**	
9:45-10:00	**Keynote speaker 2**	**Marta Yebra**	
	Artificial Intelligence and Machine Learning for Wildfires	**Jesús RC**	
10:10	Automated mapping of U.K. upland burning using Sentinel 2 imagery and Deep Neural Networks	Mr	Shewring
10:20	Capabilities of unmanned aerial vehicles for the classification of forest fuels in Mediterranean environments using machine learning techniques	Mr	Hoffrén
	Climate-driven changes to wildfires	**Marco Turco**	
10:30	The influence of teleconnection patterns on wildland fire	Mr	Qu
10:40	Likely future changes in the conducive conditions to the extreme wildfire events in Europe.	Dr	Moghli
10:50	Assessing the role of climate change in the rate of spread of wildfires in the Iberian Peninsula	Mr	Senande-Rivera
11:00	Feedbacks on weather via fire-generated aerosols over Greece	Mr	Rovithakis
	Data-Driven Wildfire Research: From Forests to Health Impacts	**Filipa Esteves**	
11:10	Protecting Wildland Firefighters' Health: saving the lives of those who fight to save us	Ms	Esteves
Coffee break	11:30-12:00		
	Fire and soil hydrology	**Jesús FG**	
12:00	Monitoring the evolution of fire affected forest and agricultural land after the Los Guajares wildfire September 2022	Dr	Seeger
12:10	Hydrological impacts of wildfires on diverse climatic regions	Prof	Voulgarakis
	Fire ecology: flora and fauna	**A. Leverkus**	
12:20	Post-fire regeneration across climate gradients	Mr	Zomer
12:30	Fire intensity effects on soil microbiota in shrub encroached subalpine grasslands	Mr	Alfaro
12:40	Fire-prone animals: adaptive responses in lizards	Mr	Álvarez-Ruiz
	Fires at the Wildland-Urban-Interface	**N. Fernández**	
12:50	Field observation sheets to identify resilience to forest fires in Chilean Mediterranean landscapes	Dr	Ojeda
13:00	Ecosystem Vulnerability analysis to Barcelona wildland-urban interface fires WUICOM – BCN	Ms	Núñez

13:10	Characterisation of forest fires in the wildland-urban interface area in Galicia in the year 2022: Fires with an operational situation of risk for the populations.	Mr	Rodríguez Jiménez
	Geospatial maps/products/services in the various phases of wildfire management and decision-makers	**Marta Yebra**	
13:20	WildFireSat: The Canadian Operational Mission	Dr	de Jong
13:30	Creation and implementation of a decision-making tool focused on the automation, scaling, updating and dissemination of information related to variables that affect the risk and behaviour of fire.	Dr	Sánchez-García
13:45	Optimizing Fire Severity Mapping using the Image Compositing Technique: An Assessment of the Effects of the Compositing Period and the Reducing Statistical Method on Fire Severity Signal.	Ms	Quintero
13:55	Wildfire hazard and social vulnerability on evacuation decision: Methodological proposal applied to municipalities of Central Portugal	Mr	Pinto
14:05	Modelling the linkages between structural fire risk and fire impacts in forest areas: the case of Águeda catchment	Ms	Parente
14:15	Assessing the social and biophysical conditions that define pyroregions in mainland Portugal.	Mr	Barbosa
Lunch	14:30-15:45		
16:00	**Keynote speaker 3**	**Alexander Leverkus**	
	Fire regime and forest management	**Elena Marcos**	
16:15	Impact of Fire Frequency and Severity on Post-Fire Recovery and Growth of Mediterranean Serotinous Pines	Ms	Marcos
16:25	Fire and predation shape postfire regeneration of Pinus halepensis populations	Ms	Guiote
	Human & Social Dimensions of Wildfire	**Manuel Seeger**	
16:35	Quantifying land fragmentation impacts on fire at global, biome and population scale	Mr	Bowring
16:45	Community-Based Fire Management in East and Southern Africa\'s Savanna-Protected Areas	Ms	Croker
16:55	What message do we want to convey? An analysis of the media treatment of largest fires in Spain	Dr	Vázquez Varela
17:05	Evacuation priority in the municipality of Alvaiázere: Comparing evacuation models in emergency situations	Ms	Gonçalves
17:15	Between peatlands and fires: livelihoods of peatland communities in Southeast Asia	Dr	Dermawan

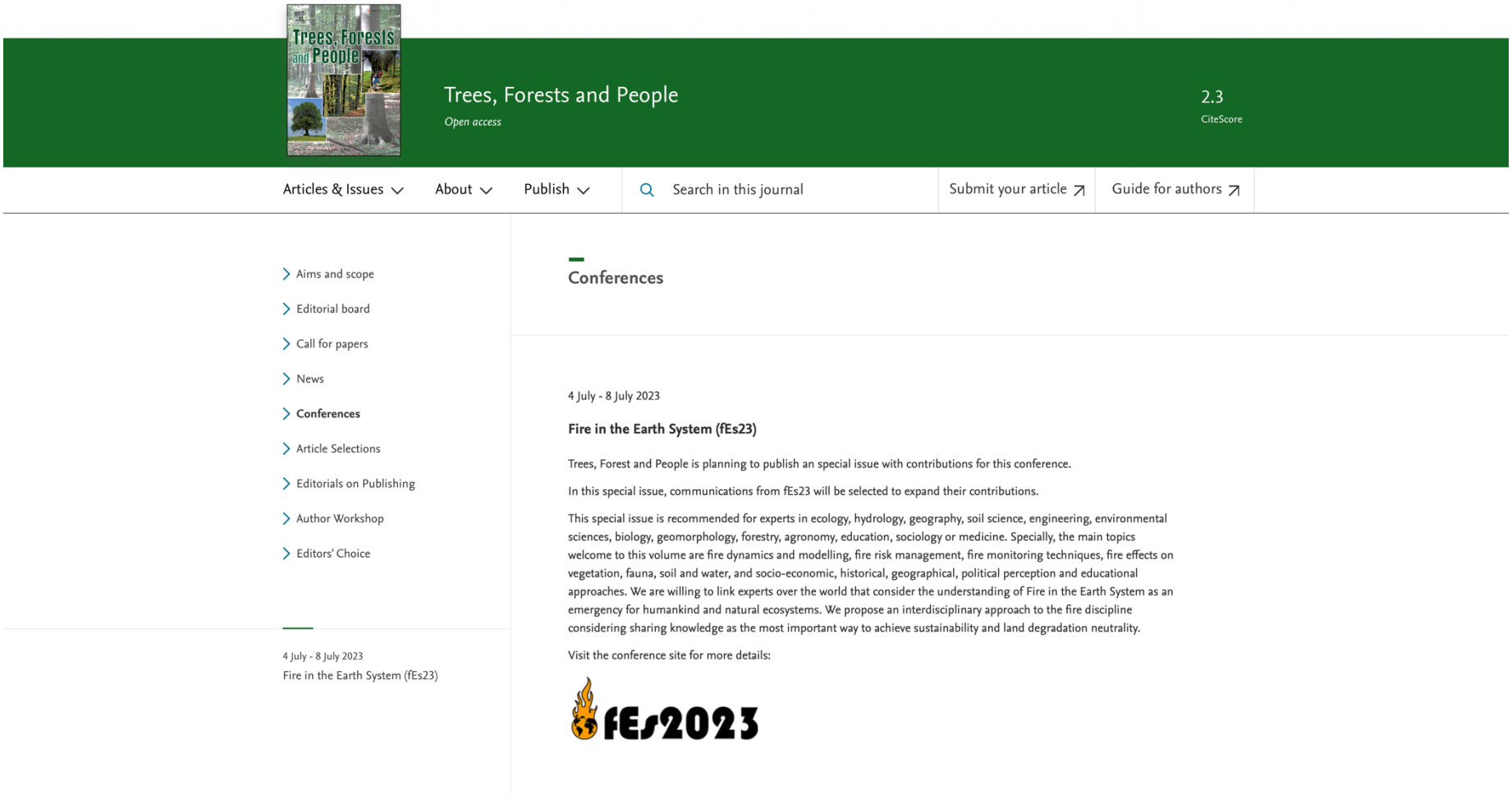
POSTER SESSION *17:30-19:00*

	06/07/2023		
9:00	**Keynote speaker 4: Saskia Keestra**		
9:10	**Keynote speaker 5: Ito Kyoko**		
	Landscapes, fire and human perception	**Andrés C.**	
9:25	Wooden construction, supply difficulties due to the loss of forest mass due to forest fires, among other causes	Mr	Garay
9:35	Human perceptions of fire expressed through the arts: a science centre's journey (so far) of the art-science interface	Dr	Ford
	Post-fire management and restoration in Mediterranean Europe	**J.L. Serrano**	
9:45	FRISCO: Assessing and managing post-fire risk of water quality contamination	Ms	Parente
9:55	Post-fire forest recovery in the framework of precision restoration: what to do and what not to do.	Prof	Castro
	Pyric Herbivore and Mixed Animal Grazing for Mitigating Threats From Wildfire	**Brad Wilcox**	
10:05	Pyric herbivory: Developing a landscape level application of the fire-grazing interaction	Prof	Fuhlendorf
10:15	The Prairie Project: Restoring Grasslands in the Great Plains with Fire and Grazing	Dr	Wilcox
10:25	Pyric herbivory for mountain habitat restoration in SW Europe: learning for the challenges and the trade-offs of different regional contexts	Dr	Canals
10:35	An integrated education-extension approach for developing agents of change and innovations to affect cultural change - Promoting adoption and public support of pyric herbivory and multi-species grazing	Prof	Wu
10:45	Developing Learning Experiences to Increase Student Understanding of Rangeland Ecosystem Services and the Essential Role of Fire and Herbivory	Mr	Yockers
10:55	Open2preserve, SUMHAL, Pyriclab and COMPAS: four pyric herbivory projects in South Spain.	Mr	Ramos
Coffee Break	11:00-11:45		
	Rural Challenges, Social Communication and Fire Risk	**E. Castelló I. Ottollini**	
11:45	Towards a Resilient Role Reporting: Farmers, the Rural and Wildfires' Journalistic Narratives in Spain	Prof	Castelló
11:55	Wine producers as landscape wildfire stewards against wildfire	Mrs	Darnay
12:05	Going beyond communicating about risk: Learning from community-led wildfire initiatives	Mrs	Ottolini
12:15	The impact of wildfire experience in the adoption of preparedness measures to reduce future losses in industries	Mr	Correia
	Wildfires today: A scientific and societal challenge	**Artemi Cerdà**	
12:25	Looking for "fire" and "forest fire" concepts in the Spanish Primary School curricula.	Prof	Cerdà
12:35	Multitemporal analysis of land-use changes in the 2022 forest fire that occurred in the Guájares comarca (Granada, Spain)	Ms	Gómez

12:45	Effectiveness of the dehesa system to prevent and fight against wildfires	Dr	Pulido
12:55	A Bibliometric Analysis of Forest Fires	Mrs	Bahçeci
	Wildfires, environmental risks, and the role of management	**A. Leverkus**	
13:00	Investigating the Vulnerability of water reservoirs to post-fire water contamination in Portugal.	Mr	Nitzsche
13:10	Identification of potential areas to introduce agroforestry systems as a practice to mitigate wildfires risk in Europe	Mr	Barrena
13:20	Restoring the sustainability and fire resilience of a forest – a landscape planning approach	Mrs	Müller
13:30	A review on the driver of fires and associated biodiversity impacts in Southeast Asia	Ms	Silviana
13:40	Tourism carrying capacity of Mediterranean natural protected areas based on wildfire safety	Ms	Ortega
Lunch	14:00-15:45		
	Keynote speaker 6: Filipa Esteves		
	Increasing the Resilience to fire and climate change in Europe	**M. Pulido**	
16:15	Reducing forest carbon vulnerability to forest wildfires through climate-smart management	Ms	Piazza
16:30	Envisioning a new rural landscape for Centre Region, Portugal	Mr	Franco
16:45	Holistic and Integrated Wildfire Risk Management in Slovakia - Introduction of Slovak Pilot Study	Ms	Majlingova

POSTER SESSION *17:00-18:30*

SPECIAL ISSUE 1 (Jesús Rodrigo-Comino, Saskia D. Keesstra and Nieves Fernández)
https://www.sciencedirect.com/journal/trees-forests-and-people/about/conferences



SPECIAL ISSUE 2 (Andrés Caballero, Stefan Doerr, Paulo Fernandes and Jesús Rodrigo-Comino)
https://revistaseug.ugr.es/index.php/cuadgeo/announcement/view/151

Fire in the Earth System: a key topic from human to natural ecosystems.Granada (03-07 July, 2023). Call for Papers.

2022-07-04

Call for Papers (PDF)
Special Issue, 2024

Submissions and Guidelines for authors:

Conference tours

DAY 1: 04/07/2023

Preconference day. Guided visit of Granada city by a professor of Human Geography Department (University of Granada) and La Alhambra (https://www.alhambra-patronato.es/en).

DAY 4: 07/07/2023

Postconference fieldtrip II to the Baetic Experimental Plot (www.egemap.eu) and Valle de Lecrín/Sierra Nevada forest fire site.

DAY 5: 08/07/2023

Postconference fieldtrip I to Los Guájares forest fire site.

Abstracts

Fire in the Earth System Abstracts
Vol. 2 FES-185
Granada, Spain, 4-8 July, 2023

The effect of tree leaf traits and earthworm on burnability of forest floor based on manipulation experiment.

Martinovská Aneta and Frouz Jan

Charles University, Faculty of Science, Institute for Environmental Studies, Benátská 2 Praha, 12800, Czechia

Abstract

Accumulation of plant litter in a forest floor and its quality is one of the key factors affecting flammability of forest floor and hence fire occurrence. Foliage properties may substantially affect rate of litter decomposition and consequently its accumulation in forest floor. Beside litter quality decomposition is affected also by many other factors such as soil properties or climatic conditions. The effect of soil biota, namely soil fauna, is however usually neglected in this regard despite the fact that globally more than half annual litter fall is consumed by soil fauna. Here we used laboratory manipulation experiment to test effect of litter quality and earthworms activity on flammability of forest floor.

In metal boxes we reconstructed forest floor of plantation of four tree species *Alnus glutinosa*, *Quercus robur*, *Picea omorica* and *Pinus nigra* growing on post mining sites near Sokolov. Two plantation ages were reconstructed here. Young plantation where litter of respective species was placed directly on overburden and 40 years old plantation where litter was placed on developing Oe and A layers sampled form these plantations. These mesocosms were then inoculated by earthworms and incubated for 4,5 months. Then forest floor in boxes was ignited and burning and smoldering duration, flame height, fire path and soil temperature were recorded. In both types of mesocosms (mimicking young and developed soil) the tree species significantly affect most of the measured fire properties with pine being more flammable then other species. At the same time there were significant differences between young and developed soil in most of fire parameters. In young soil the presence of earthworms has significant effect on most fire properties (generally speaking suppers flammability), but this effect of earthworm presence disappears in developed soil. However previous research on the same sites show that earthworms in large extend determine formation of topsoil layer and co determine differences in topsoil among tree species. So, we can conclude that earthworms have strong immediate effect on litter accumulation in forest floor in young soils, at the same time they in long run contribute to diversification of forest floor properties under tree species with different litter quality, which enhance effect of tree species on flammability in older plantation. At the same time in older sites, where soil become more developed, immediate effect of earthworms presence on flammability become less important.

Keywords: fire, litter, earthworms

References

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Acknowledgments: Supported by AV 21 and DivLand projects

Fire in the Earth System Abstracts
Vol. 2 FES-213
Granada, Spain, 4-8 July, 2023

Post-fire regeneration across climate gradients

Zomer, A. Maya, Moreira, Bruno and Pausas, G. Juli

Centro de Investigaciones sobre Desertificación (CIDE-CSIC)

Abstract

In flammable Mediterranean shrublands, plant species have evolved to persist with recurrent fire disturbance by germinating profusely after fire from long-lived seedbanks or resprouting from surviving dormant buds. The success of these strategies depends on how they cope with both fire and climate. Thus, we studied intraspecific variability in key post-fire regeneration mechanisms of five species, including heat-released physical seed dormancy and resprouting ability, along environmental gradients of summer temperatures and aridity in Eastern Spain. Our results demonstrate considerable among-population variability in both traits. Seeder populations growing under warmer summers require more heat to release seed dormancy, in order to maintain the soil seedbank during the inter-fire period. However, variability in resprouting ability was determined by a combination of factors that define individual plant history, and only secondarily by differences in water availability. Climate projections for the Mediterranean Basin predict rising temperatures and increasing frequency and intensity of heatwaves and droughts. Understanding the interaction between post-fire regeneration and climate is thus essential to predict future biodiversity of fire-prone ecosystems.

Keywords: fire, climate, variability, germination, resprouting

Acknowledgments: We thank CIDE technician Guillermo Benitez López for his main role during fieldwork. We also thank F. Tubenchlak, R. Zomer, and B. López Gurillo for help in the field, and M. Dorce Baulenas and A. Camacho Santamans for help with the germination experiment. Fire maps were acquired thanks to Generalitat Valenciana, Junta de Andalucía, Generalitat de Catalunya. CIDE is a joint institute of the Spanish National Research Council (CSIC), the University of Valencia, and the regional government of Valencia (Generalitat Valenciana). We declare no conflict of interest. This work was supported by the Generalitat Valenciana through the program Santiago Grisolia (GRISOLIAP/2017/176), and projects FOCSEC (PROMETEO/2016/021 and FOCSCALES (PROMETEO/2021/040).

Fire in the Earth System Abstracts
Vol. 2 FES-218
Granada, Spain, 4-8 July, 2023

FIRE INTENSITY EFFECTS ON SOIL MICROBIOTA IN SHRUB ENCROACHED SUBALPINE GRASSLANDS

[1]Alfaro-Leranoz, Andoni, [2]Escuer, Marta, [1]Quintana, Silvia, [1]Martí-Dalmau, Clara and [1]Badía-Villas, David

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[2]*Escuela Politécnica Superior, Universidad de Zaragoza, 22071 Huesca, Spain*

Abstract

Livestock density reduction and the loss of the traditional use of fire is facilitating the encroachment of secondary grasslands, which is provoking a woody fuel accumulation that leads to a higher fire risk (Castellnou et al., 2010). Prescribed fires are performed under optimal conditions to minimize the damage to the soil. Although, they could have effects on soil microorganisms, even when the soil thermal range is low, because they respond to perturbations faster than soil physical and chemical properties (Santín & Doerr, 2016). For that reason, they can be used as bioindicators of soil health and quality. The objective of this study is to evaluate the immediate effects of different fire intensities on the soil microbial community under shrub encroached grasslands in the subalpine stage. For this study, soil monoliths were taken from an area located in the municipality of Asín de Broto (Central Pyrenees, Spain), under a *Echinospartum horridum* (Vahl) Rothm. encroached grassland. Then, the monoliths were transported to the lab and burned at 4 different intensities, combining the temperature (50 or 80 ºC) and the residence time (12 or 24 min) at 1 cm depth. Some monoliths were not burned and preserved as controls. Subsequently, soil samples were taken from the topsoil (0 – 3 cm) and several soil biochemical properties will be measured: community level physiological profiles (CLPPs), basal soil respiration, enzymatic β-D-glucosidase activity, microbial biomass carbon, total organic carbon and nitrogen, labile carbon and recalcitrant carbon. A previous work performed in the same location, showed that the potential functional diversity of the original microbial community (unburned samples) was low and the community was focused on the degradation of complex carbon compounds (Alfaro-Leranoz et al., 2022). After a prescribed burning, the potential functional diversity increased considerably, coinciding with a significant increase of labile carbon. We hypothesize that the increase happened because of the labile carbon inputs produced by the burning of the vegetation, that is supported by a significant increase on the electrical conductivity, which is a sign of ash incorporation. In this case, we do not expect such a great increase, because no vegetation was present in the experimental burning. Even though, the fire could lead to a transformation of the recalcitrant carbon into more labile forms and produce changes in the microbial biomass and its activity (Arregui et al., 2022), and, therefore, changes in its potential functional diversity.

Keywords: soil biodiversity, soil microorganisms, CLPPs, fire severity

References

Alfaro-Leranoz, A., Marti-Dalmau, C., Badia-Villas, D., Navarro, E., & Sancho, M. del C. (2022). Long-term evolution of soil biochemical properties after shrub prescribed burnings in two sites of Central Pyrenees (Spain). X International Conference FuegoRED 2022, Évora (Portugal), 19 – 21 October 2022. Arregui, M. E., Perpiñá, O. O., Paula, A., Domínguez, C., & Villas, D. B. (2022). Evaluación de las condiciones de quema controlada que influyen en atributos biológicos y físicos de suelos bajo Echinospartum horridum. Revista de Ciências Agrárias, 45(4), 161–165. Castellnou, M., Kraus, D., & Miralles, M. (2010). Prescribed burning and suppression fire techniques: from fuel to landscape management. Best Practices of Fire Use Prescribed Burning and Suppression Fire Programmes in Selected Case-Study Regions in Europe, January, 3–16. Santín, C., & Doerr, S. H. (2016). Fire effects on soils: The human dimension. Philosophical Transactions of the Royal Society B: Biological Sciences, 371(1696), 28–34. https://doi.org/10.1098/rstb.2015.0171

Acknowledgments: We thank Fran, from Asín de Broto, for taking the time to drive us to the study area.

Fire in the Earth System Abstracts
Vol. 2 FES-248
Granada, Spain, 4-8 July, 2023

Fire-prone animals: adaptive responses in lizards

[1]Álvarez-Ruiz, Lola, [2]Belliure, Josa and [1]G. Pausas, Juli

[1]*CIDE-CSIC*
[2]*University of Alcalá*

Abstract

Fire is a natural process in many ecosystems. In animals, fire ecology research has focused on fire effects on abundance and persistence of populations. However, the mechanisms behind the observed patterns of animal responses remain unclear. After a wildfire, the low mortality observed in burrowing lizards suggests the resiliency of their populations to fires. Thus, lizards likely have adaptive traits to cope with fires, or even to benefit from them. Here, we unravel these traits and present our advances in this matter. Before a fire arrives, early fire detection is expected to be particularly important for fire avoidance. Reptiles use sensory cues like smell and sound to detect threats; our results suggest that lizards use those cues to detect coming fires. During a fire, there may not be enough time to flee. Reptiles often survive sheltering in crevices or under rocks, and some have the ability to withstand the high critical temperatures reached in shelters during a fire. The very recent postfire environments may be inhospitable; however, reptiles have the ability to endure days without eating and enter a state of torpor. Moreover, wildfires induce environmental changes that reptiles can benefit from. We found that fire reduced parasite load in lizards. Other benefits could come through postfire enhanced thermoregulatory opportunities or the increasing availability of some prey (i.e: pyrophillous insects). Also, fire-disturbed landscapes induce phenotypic plasticity in lizards. We found that lizards adjust their dorsal coloration likely to optimize their thermoregulation in burnt areas. Wildfires' strong effects on animal communities must be assessed by taxa. Here we advocate for more studies to fill the knowledge gaps in reptiles' fire ecology and hope to provide a conceptual framework to study fire effects and adaptive responses in other animals through a comprehensive approach.

Keywords: fire adaption, global change

Acknowledgments: This work was supported by Ministry of Economy and Competitiveness and Ministry of Science, Innovation and Universities from the Spanish Government (grant numbers CGL2015-64086-P, PGC2018-096569-B-I00, BES-2016-078225). We thank the main technician, G. Benítez, and all the CIDE members that happily helped in the fieldwork. CIDE is a joint institute of the Spanish National Research Council (CSIC), the University of Valencia, and the regional government of Valencia (Generalitat Valenciana).

Fire in the Earth System Abstracts
Vol. 2 FES-251
Granada, Spain, 4-8 July, 2023

A reconstruction of fire and vegetation in Cantabria, northern Iberian Peninsula throughout the Holocene using a multi-proxy approach

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Abstract

Sedimentary palaeofire records are critical to our understanding of past ecology, fire, climate, and human-land relationships in postglacial quaternary environments. This data provides insights into the favourable environmental (e.g., flora and vegetation) and climate (e.g., hydrological) conditions that impact fire propagation, intensity, and frequency.

Here we present a study of a multi-proxy approach to reconstruct fires in Cantabria throughout the Holocene from a peat record site (Ríofrío peatbog, Vega de Liébana, Cantabria in the northern Iberian Peninsula, 43.037°N, 4.697 W°, 1740 MASL). Besides contributing valuable palaeoecological knowledge, our work will fill in research gaps of postglacial quaternary environmental history of the Iberian peninsula's mountain regions (Ruiz-Fernandez et al., 2016) and validate charcoal classification methods.

Macroscopic and microscopic charcoal concentrations in peat records are established palaeofire proxies. During a fire, charcoal particles undergo primary deposition via aeolian fallout, with the size decreasing over distance (Whitlock & Larsen, 2005). The concentration and deposition rate of particulate charcoal, through counting and size classification, can signal the timing, intensity, patterns, and proximity of the fires to the deposition site. The morphology (i.e., qualitative particle identity classification) and morphometry of the particles (i.e., length:width ratio calculations) provide information on the kind of flora that burned (Enache and Cumming 2006; Mustaphi and Pisaric, 2014; Umbanhowar and Mcgrath, 1998).

As such, we have combined these approaches: at a 1 cm resolution, we applied the 27 classifications method from Mustaphi and Pisaric (2014) and placed them into size classes; we also determined the length:width ratios and organic matter content (loss on ignition, LOI). Additionally, we looked at pollen and non-pollen palynomorphs (NPP) to

further interpret and validate signals of past climate, dominant burned flora, and surrounding vegetation.

From this multi-proxy data, aside from a fire reconstruction, we will distinguish periods of open versus forested vegetation (i.e. maintenance fires versus newly burned from charcoal and pollen data; Fyfe et al., 2003; Pérez-Obiol et al., 2012; Rodríguez-González et al., 2023). The study allows us to validate secondary charcoal deposition through erosion proxies (i.e., NPP). Organic matter data (i.e., LOI) could provide us with indirect connections between fire dynamics and large-scale climate processes (i.e., flooding, Ishii et al., 2017).

Keywords: fire, palaeoclimate, particulate charcoal, landscape

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Fire in the Earth System Abstracts
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Fitness benefits of fire-stimulated flowering in Mediterranean geophytes

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Abstract

Fire-stimulated flowering is a widely recognized strategy in fire-prone ecosystems, such as Mediterranean ecosystems. Species with this strategy flower more profusely in postfire conditions than in absence of fire. This strategy occurs specially in herbaceous plants, most of them geophytes that use stored reserves in the belowground organs for a quick post-fire bloom. However, little is known about the fitness benefits of this strategy. We studied geophytes in Southern Spain and compared flowering in recently-burned areas with flowering in adjacent unburned areas. We found that fire stimulated dormant belowground bud banks, increasing flowering density in burned areas. Individuals in the burned areas showed higher pollen deposition in their stigmas and higher reproductive success. Our findings suggest that fire-stimulated species, when they flower quickly after fire, can benefit at different stages of their reproductive cycle, from flowering initiation to seed production and recruitment.

Keywords: Fire ecology, geophyte, postfire flowering, pollen deposition, wildfire

Fire in the Earth System Abstracts
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Water storage capacity and wettability of ecosystem elements (plants, woody fragments) from post-fire areas

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Abstract

Fire is a major threat across various forest types because of its effects on the soil's physical, chemical, and biological properties. Burning changes soil acidity, water storage capacity, and nutrient concentration by consuming plant biomass, litter layers, and soil organic matter.
Fires also strongly change the hydrological properties of the forest floor.
The knowledge of the water cycle is crucial for the practical preservation and exploiting their capabilities. Plant wettability is an important parameter characterising the plant's ability to retain water on its surface and is linked to the ecosystems' hydrological and ecological functioning. This research investigates the relationship between leaves and wood wettability based on contact angle measurements and water storage capacity for areas covered by fire last year (B) compared to adjacent areas where there were no fires (U).
The research was conducted in the Los Guajares area. We used photographs and angle measurements in graphic software for the wetting contact angle measurements on the plants' surface, and the weighing method for the plant surface water storage determination.
The results clearly indicate that the average water capacity (mS) decreases with the increase of the contact angle (mCA) of the drops to the surface of both branches and leaves collected on both burned and unburned surfaces.
For woody fragments, branches of dry but unburned mango show the highest water capacity after 24 hours of immersion in water (S24) equal to 1.10 [g g-1] of water. This is confirmed by the fact that dead wood is a great reservoir of water.
Burnt pine wood retained 0.07 [g g-1] of water and fresh mango branches only 0.40 [g g-1]. Burnt pine wood showed a small initial water capacity (S = 0.12 g g-1) but at the same time, the side surface was not hydrophobic because the dripping water did not form drops but soaked in immediately.
The water capacity of leaves of new plants growing on B and U are not statistically different (on average 0.31 g g-1), while the inclination angles indicate highly wettable for U and wettable for B.

Keywords: Wetting contact angle, Interception, Los Guajares, retention.

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Fire in the Earth System Abstracts
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Fire and predation shape postfire regeneration of Pinus halepensis populations.

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Abstract

Wildfires are a natural disturbance in many ecosystems. Consequently, plant species have acquired traits that allow them to persist in fire-prone environments. Aleppo pine (*Pinus halepensis*) is a common tree species in the Mediterranean region. Its post-fire regeneration depends on the degree of serotiny, that is, the number of cones that remain closed (no seed dispersal) for more than a year, and that they open during a fire. Due to the relevance of this serotinous species in a world with increasing fire activity, we focus on better understanding the factors that explain the variability in the postfire regeneration capacity. On one hand, we asked about the role of fire regimen on the age of maturity of populations. We found that short fire intervals select for precocity of serotinous cones, and this translates in larger canopy seed banks. On the other hand, we wondered how predation pressure by squirrels affects serotiny. Our results show that predation decreases serotiny levels of populations, and increases cone defenses against predation. Our results also indicate that, within a population, these cone defenses modulate predation, and ultimately, the serotiny degree of the trees. These findings contribute to explaining the postfire regeneration potential in this pine species, which is very relevant in the context of change in fire regimes happening in the Mediterranean basin. These results also have direct management implications; selecting seeds from populations with high fire activity and low predation pressure for restoration projects would increase the resilience capacity of the restored woodland to face novel fire regimes with increased fire frequency.

Keywords: maturity age, serotiny, fire ecology, fire regime changes, seed predation

Acknowledgments: We thank G. Benítez, the main field technician in this study, L. Álvarez and R. Posada for their help during the fieldwork, and M. Zomer for grammar comments on the manuscript. We also thank Generalitat Valenciana and Junta de Castilla la Mancha for provide the fire maps of the study area. This work has been supported by a research project (FIROTIC, PGC2018-096569-B-I00) and a fellowship (FPU16/06412), both from the Ministry of Science, Innovation and Universities from the Spanish Government. We declare no conflict of interest.

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Reducing forest carbon vulnerability to forest wildfires through climate-smart management

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Abstract

Forests are crucial for regulating global carbon and mitigating climate change. The increasing frequency and intensity of forest disturbances in the future may put at risk many ecosystem services like carbon sequestration. After a disturbance, carbon is released into the atmosphere and forests may change from carbon sinks to source. Climate-smart forest management can improve the forest carbon balance by reducing disturbance vulnerability to avoid emissions and increase carbon sequestration. We here propose a method to estimate wildfire-induced risk to forest climate mitigation by combining fire hazard assessment with estimate of the vulnerability of forest carbon stock and sinks. We assessed fire hazard using a burn probability indicator calculated by the FlamMap simulation tool. The model was initialized using vegetation and topography data collected in the field in combination with existing forest plans, and climate scenarios reflecting expected impacts of climate change on atmospheric and vegetation moisture. The study area at Galeata (Apennines, Italy) is composed by heterogenous forest stands ranging from coniferous afforestation to broadleaved coppice stands dominated by hop-hornbeam and pubescent oak. For each forest stand we calculated the burn probability and carbon sink and source, and combined these to create a fire risk map to inform priorities for silvicultural prevention. We analysed the main factors increasing the fire risk in this region. The burn probability was highest in stands dominated by hop-hornbeam and pubescent oak. The most important driver of burn probability was indeed the forest type, in which case the broadleaved stands were more exposed to fire. Additionally, elevation and aspect affected burn probability with lower elevation forests at E- through S- to W-exposed slopes being more susceptible. A combination of burn probability map together with maps of carbon sink and source may help to evaluate the overall risk to carbon release in case of wildfire. Such maps may be used to efficiently plan climate-smart forest management and help in decision-making and cost-benefit analysis

Keywords: climate-smart forestry, wildfire disturbance, fire risk maps

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Envisioning a new rural landscape for Centre Region, Portugal

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Abstract

Rural fires represent a complex problem in Mediterranean countries, with high social and economic costs, such as fire suppression investment. Agriculture abandonment, associated with the economic raise of pulp industry, increased fire risk. This is aggravated by the lack of forest management, explained by demographic and economic constraints, such as depopulation and land property fragmentation.
In Portugal, fires occur mainly in Centre Region, a landscape dominated by maritime pine and eucalyptus forest. In the megafires of 2017, this region was the most affected, representing 16% of total region area (455000 ha). The new landscape should be diversified, with more areas of broadleaved native species, agriculture and pastures. These land uses would contribute to diversify local economies with agriculture products, non-wood products (e.g. nuts, honey and mushroom) and nature tourism. Forest recovery itself would generate business opportunities, such as native species nurseries and forest management companies. This landscape change would also improve ecosystem services provision, such as resilience to fire, biodiversity, soil and water conservation.
To achieve this, a landscape transformation model - FIRELAN - was applied to Centre Region. This model integrates different principles related to fire behaviour and ecological suitability into a land-use plan, using the river basin as a landscape unit. The FIRELAN model is made up of landscape components that fall into three types of systems: physical, biological and cultural. For each component there is a set of potential land uses that can be promoted. These potential land uses were compared to the existent land uses in Centre region and landscape transformation actions were proposed.
The results show that it would be advisable to implement landscape restoration actions in about 35% of the region's area and that with the implementation of this plan, agriculture could increase from 23% to 35% and native species could be expanded in 31% of the region. Existing agriculture and forest land uses can be maintained in about 58%.
Finally, based on the concept of green firebreaks, the linear components of the model have been defined as priority intervention areas. These areas correspond to 22 % of the Centre region and correspond to the physical linear components (streams, valley bottoms, ridgelines, hilltops and headwaters) and the cultural linear components (urban and rural settlements protection buffer, the road protection buffer and the energy and communications infrastructures protection buffer). These priority intervention areas were defined to guide policy makers on the planning of landscape transformation.

Keywords: Landscape Planning, Fire, Resilience, Portugal

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Holistic and Integrated Wildfire Risk Management in Slovakia - Introduction of Slovak Pilot Study

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Abstract

Slovakia has joined the Europe-wide initiative to fight forest fires through the SILVANUS project (H2020 scheme). On April 24-26, 2023, the Slovak partners of the project - the Technical University in Zvolen, the Institute of Informatics of the Slovak Academy of Sciences, 3MON company, Plamen civic association and the fire brigades of the Fire and Rescue Service, municipalities voluntary fire brigades, fire brigades of the Armed Forces of the Slovak Republic, foresters of OZ Polana and representatives of Biospheric Reserve Polana, were the demonstration took place, provided the demonstration of the Slovak pilot. The demonstration was related to the presentation of information and technological support for all the phases of wildfire risk management: prevention and preparedness, detection and response and recovery and restoration. The results of wildfire risk assessment using holistic and also integral approach (information support) for wildfire prevention and preparation phase were presented. In the second phase (wildfire detection and response), there were several technologies deployed which outputs are a valuable source of real time data supporting the decision-making process of comand staff. There were demonstrated and tested the possibilities of deployment of the OPTIX smoke detection CCTV system, which operates in 24/7 mode and allows monitoring of the territory in a 360° radius. The outputs from the camera system are visualized in the operation/control centre, from where they are further sent to the Fire and Rescue Service's operations centre in the form of a text message or MMS (photos) about the detected fire. Verification of the wildfire is carried out by drones operated by foresters. In addition to fire verification, drone technology has also been deployed to monitor the territory during the fire to support the intervention commander. In addition, SWARM of drones have been used to map the fire-affected area and create a continuous orthophotomap. In the locations, where there are problems with GSM signal, 2 technologies were deployed: a stand-alone Starlink satellite internet and a drone using Starlink satellite internet, which allowed to create the local GSM network. The Colossus ground robot technology was deployed to extinguish the fire, transport the firefighting assets as well as an injured person. For supression of the wildfires, a pond system of water transport, helicopter with a bambi bucket in the undercarriage, which was filled from the large-capacity FIREFLEX tank. For the forest recovery, restoration after the wildfire, the Sybila forest growth simulator was applied.

Keywords: wildfire, prevention, detection, responce, restoration

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Field observation sheets to identify resilience to forest fires in Chilean Mediterranean landscapes

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Abstract

Due to global anthropogenic and climatic pressures, landscapes lose more and more elements that make them resistant to disturbances, however, what makes a landscape effectively resistant is currently not so well defined. Therefore, for this work, a resilient landscape will be understood as one that is capable of preserving its various components (biogeographic and/or human) based on the lessons learned and the ability to self-organize after repeated disruptive events.
The general objective was to evaluate the landscapes of the urban-rural interface areas in the Metropolitan Area of Concepción (AMC) in Chile from the perspective of landscape studies with the purpose of advancing toward the construction of more resilient physical-human landscapes to the fire.
This qualitative work presents a field worksheet that was applied in urban-rural interfaces to identify elements of fire-resistant landscapes, which stands out for being accessible to stakeholders and researchers. Likewise, the main findings of the application of the field worksheet are presented, where 5 clusters and two landscape typologies were identified.

Keywords: wildfires, resilience, socio-ecological systems, landscapes, urban-rural interface

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REDUCING WILDFIRE HAZARD WITH FOREST FUEL TREATMENTS IN A WILDLAND-URBAN INTERFACE – HOW CAN NETWORK OPTIMIZATION HELP?

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Abstract

In forested regions of North America, land managers often carry out preventive treatments of flammable forest fuels to protect critical human infrastructure from wildfires. However, planning fuel treatments in complex landscapes is challenging because it requires an assessment of trade-offs between the cost of treatments, potential wildfire behavior and human infrastructure protection priorities. We examine a wildfire hazard reduction strategy to allocate forest fuel treatments (such as prescribed burns or strategic forest thinning) for a protection of critical human infrastructure in the Banff National Park, Alberta, Canada, a topographically complex and wildfire prone area. We present a linear programming model to allocate forest fuel treatments to minimize the wildfire hazard to the Banff town site (the area of concern) while accounting for possible behavior of forest fires in the area and considering key budget and cost constraints. We used a stochastic fire behavior simulation model to estimate the likelihoods of wildfire spread to the area of concern and formulated a Critical Node Detection (CND) problem that used these estimated probabilities to find a pattern of fuel reduction treatments to minimize the likely spread of fires to the area of concern. The use of sophisticated fire behavior simulation models helps account for a multitude of factors influencing the spread of fires in heterogeneous landscapes. Our solutions provide several strategies for reducing the risk of fires to critical human infrastructure under realistic budget constraints and such, can assist strategic planning of fuel reduction activities in regions with an active fire regime.

Keywords: Community wildfire protection, Wildfire fuel treatment, Critical node detection problem, Linear Programming, Network interdiction

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Ecosystem Vulnerability analysis to Barcelona wildland-urban interface fires WUICOM – BCN

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Abstract

Wildfires are the main natural disturbance that affects the Mediterranean area, and it is expected to worsen in the global climate change scenario. The fire regime has changed, mainly due to climate and human activity. The international community specialized in wildfire management recognizes the inability to solve and treat the problem strictly from the field of emergencies. The classic prevention model is being questioned, since it is not an issue of extinction capacity or economic resources destined to extinction, but an issue of landscape's ability to integrate and modulate disturbances.
This study, part of the "WUICOM – BCN: Interface Communities resilient to Barcelona's Wildfires", contains the results of the preliminary vulnerability analyzes regarding the fire risk of the urban-forest interface in the city of Barcelona. This methodology takes into consideration wildfire scenarios in the Collserola mountain range within the Barcelona municipality ecosystems potential losses of values are accounted by ecosystem vulnerability indicators such as ecosystem sensitivity and adaptability. We have implemented this methodology to analyze vulnerability in Barcelona WUI areas and identified those that can be more threatened in case of wildfire. The information collected must be used to make a pre-selection of the areas of interest of the WUICOM-BCN project among which the location of the study cases or living labs must be chosen and carry out their characterization in detail.
Results of this study will be key to inform risk-reduction public policies, as they provide insights on those WUI areas within Barcelona municipality that should be prioritized along with the specific issues that should be tackled.

Keywords: Ecosystem vulnerability, Barcelona wildfire risk, landscape values, WUI areas

References

Vulnerability analysis to wildland-urban interface fires in metropolitan areas: an integrated approach (Pastor, E.; Caballero, D.; Rodríguez, I; Arenas, M.; Morán, P.; Canaleta, G.; Vacca, P.; âgueda, A.; Planas, E.) https://doi.org/10.14195/978-989-26-2298-9_123

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The InduForestFire Project: questioning the current fuel management practices in Portugal and insights for developing fire-smart management strategies

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Abstract

The InduForestFire project seeks mitigation solutions to avoid damage caused by large fires in industrial zones (IZs). In Portugal, the structure and composition of vegetation around IZs plays a strong influence on fire hazard around and inside the industrial perimeter. However, the existing knowledge in this regard is still insufficient for the development of efficient management strategies. Based on fire behaviour simulations and in situ data collection, the project has already achieved some important results to guide effective fuel management and more adequate prevention actions for Portugal. The first results indicate that the expansion of mega-fires, like those of 2017, can be locally interrupted by patches of broadleaved forest. We identified that using the broadleaved forest in the WUI areas of the IZs of the central region of Portugal can reduce the fire intensity up to five times. In this scenario, fires that exceed the suppression capacity in current pine and eucalypt forests (>4m flame length) can be effectively suppressed in broadleaf forests under extreme fire weather (1.4m flame length). We sampled 30 pairs of adjacent eucalyptus, maritime pine, and broadleaf stands in the same region to contrast these results and assess fire hazard. Our statistical models (GLM) demonstrate significant differences in the rate of spread and flame length between broadleaves vs pines and eucalyptus, and the last two did not show significant differences between them. Based on a multivariate analysis, we identified that the lower fire behaviour in broadleaves is associated with a higher canopy cover and higher 1h fuel moisture. We also evaluated the effect of fuel reduction on fire behaviour in fuel breaks, in different types of forests. For this, we sampled more 30 pairs of Managed Areas vs. Unmanaged Areas, in eucalyptus, maritime pine, and mixed stands. Our results showed a trade-off between the beneficial reduction in fuel load and fuel bed depth, which supposedly justified the management criteria, and the more severe weather conditions (higher wind speed and lower relative humidity) in managed areas. Only one statistical test (out of 12) showed significant differences in fire behaviour between the three types of stands. From these results, the project corroborates the urgent need to discuss the efficiency and relevance of current forest management in Portugal, simply based on the reduction of surface and canopy fuels and which does not encourage, for example, the use of more

resilient species in the territory.

Keywords: Wildland Fire Behaviour, Fire Hazard, Forest Management, Forest Composition, Portugal

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Characterisation of forest fires in the wildland-urban interface area in Galicia in the year 2022: Fires with an operational situation of risk for the populations.

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Abstract

In recent years, society has come to believe that forest fires are becoming more and more dangerous, and this has been widely reported in the media. In southern European countries, this is also exacerbated by more frequent and longer periods of drought. The availability of fuel at different times of the year makes the classic summer fire season longer and more unstable. All this, together with the depopulation of rural areas, makes wildland urban interface (WUI) fires more important. They affect populations, cause economic damage and dangerous situations for the civilian population and other non-forest assets. This study aims to characterise the fires of the year 2022 in the northwest region of Spain (Galicia) in which the activation of a level 2 situation has been necessary. This type of fire has meant the evacuation and confinement of hundreds of people on different occasions, as well as the need for resources from the Spanish state to extinguish them. In total, up to 25 fires have been of this type, accounting for up to 8% of the total number of fires, the highest figure in the last 10 years. This trend has been increasing with very marked years for the study area. The characterisation is based on meteorological data such as temperature, wind, fire weather index and its derivatives. Severity is calculated using remote sensing techniques, which together with parameters such as slope and orientation are the common factors analysed. The size of the fire is not presented as a relevant value, as it depends on the proximity of the fire to the population.

Keywords: FWI, confinement, Landsat, wildland urban interface, civil protection

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Socioeconomic factors at the base of wildfire risk in peri-urban contexts: the Mediterranean experience, comparing Italy, Spain and Greece

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Abstract

Understanding the role of wildfire drivers is essential to implement more effective prevention strategies at the regional scale and to promote specific mitigation actions at the local scale. By considering the population distribution as the elementary analysis domain, the present study investigates the spatial distribution of wildfires in the Mediterranean biome.
A Mediterranean fire-prone area with variable climate regimes, heterogeneous landscapes and increasing human pressure. Assuming that a denser road network increases the probability of wildfire occurrence, results of a quantitative analysis exploring the relationship between spatial location of ignition points and roads were presented. The empirical findings of this study contribute to ascertaining the role of roads, urban areas, urbanization and citizen's behaviour as a direct (or indirect) cause of wildfires in the Mediterranean region. Forest fires are a worldwide issue today due to land use changes and climate change. We review the Socioeconomic factors that affect the evolution of forest fires in the Mediterranean. The critical issue for forest fire evolution is the urban and periurban areas such as the impact of roads at the base of wildfire risk in peri-urban contexts: the Mediterranean experience, comparing Italy, Spain and Greece

Keywords: Indicators, Human activity, Land-use, Spatial analysis, Mediterranean basin

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Fire in the Earth System Abstracts
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Assessing public preferences for a wildfire mitigation policy in Crete, Greece

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Abstract

The increased frequency and severity of wildfires in the Mediterranean region generates significant damages in ecosystems and landscapes while harming human populations. Institutional complexities, along with socioeconomic and demographic changes encouraging development into the wildland-urban interface, rural abandonment, and focus on fire suppression, are increasing the vulnerability and flammability of Mediterranean ecosystems. Developing effective strategies for managing wildfire incidence and its aftermath requires understanding of the public preferences for wildfire policy characteristics. Here we elicit public preferences for wildfire mitigation policies employing a stated choice experiment applied in Crete, Greece. A region with typical Mediterranean landscape experiencing significant development and rural-to-urban migration that disrupts existing fire regimes. We estimate conditional logit, mixed logit and latent class models to study the general public's preferences and willingness to pay for limiting wildfire frequency and agricultural land burnt, maintaining landscape features, and managing post-wildfire recovery. Results of our study show that measures to manage post-wildfire damage are consistently valued as the most positive among the sampled respondents, achieving values that range between €25.92 in conditional logit model to €46 in one of the latent classes identified. Improving the landscape quality follows in importance, although it shows more heterogeneity in the responses. The latent class approach allowed to identify that those associated with either the agricultural or the tourism sector of the sampled individuals, displayed significantly different preferences for the proposed attributes. Overall, our findings indicate that there is a strong preference amongst the general public to shift current policies based on suppression towards more integrated approaches dealing both with prevention and post-fire management. The outcomes of this study serve to guide decision makers on targeted management plans based on their audience.

Keywords: ecosystem services, discrete choice experiment, wildfire-management, economic

valuation

Fire in the Earth System Abstracts
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Wildland Fire Dispatcher Working Environments

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Abstract

We examined multiple aspects of wildland fire dispatcher working environments, including shift length, overall morale and attitude, safety, and effects on mental and emotional well-being. Personal well-being is deeply connected to working environment in this population, and we provide the first assessment of these conditions reported in the scientific literature. We used surveys, cognitive testing, sleep studies, and biomechanical measurements to analyze variables related to performance, well-being, and overall morale. Results show several areas where improvements can be made.

Keywords: Wildland firefighters, health, environmental health, morale, working conditions, survey

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See complete list at www.wildlandfiresurvey.com

Fire in the Earth System Abstracts
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Awareness and preparedness of population at wildfire risk

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Abstract

Forest fires pose a recurrent threat with significant consequences for populations residing in the wildland-urban interface (WUI). These areas are of critical importance for preventing and managing inhabited areas with high fire risk due to the presence and the likelihood of substantial personal and material damage caused by fire. While eliminating the risk of fire may not be feasible under current conditions, mitigating the potential impact of fires on populations can be achieved through the application of preventive and mitigation measures. This communication aims to present the findings of a study that sought to determine the level of awareness and preparedness of the population in responding to fires.
The study employed personal and online interviews conducted with households situated in rural and peri-urban areas of Galicia (NW Spain), where forest fires have had a high incidence. A structured questionnaire was administered consisting of questions on the causes of forest fires, risk perception, fire preparedness of the population, and preventive measures to be taken to minimize the potential damage caused by fires.
The findings highlight the need to promote self-protection measures among the population through specific regulations, incentives, and insurance, with a focus on the construction materials of buildings and the surrounding area. Furthermore, the results suggest that public education campaigns may be necessary to enhance the population's understanding of the risks posed by forest fires and the measures that can be taken to reduce their impact. Our results show the importance of assessing the level of awareness and preparedness of the population to respond to forest fires. Promoting preventive and mitigation measures and enhancing public education and awareness are crucial steps in reducing the potential impacts of forest fire on populations residing in the WUI.

Keywords: preparedness, wildland-urban interface, wildfires, Galicia

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Conditions impacting procedural and operational errors in wildland fire dispatchers

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Abstract

Wildland Fire Dispatchers work in stochastic and high demand environments. As such, they experience high workloads, high stress, and sleep restriction. We examined the impacts of these variables on procedural and operational errors using logbooks. Results show strong correlations between workload, stress, sleep, and cognitive performance.

Keywords: dispatch, error, wildland fire

Fire in the Earth System Abstracts
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Quantifying land fragmentation impacts on fire at global, biome and population scale

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Abstract

Human land use change (LUC) affects a third of the terrestrial surface, whose fragmentation results in large-scale biodiversity loss, habitat degradation, changes to the surface energy balance and biogeochemical cycling, resulting in around one-third of global carbon (C) emissions. LUC is forecast to increase substantially by 2100, while C emissions and attendant increases in global temperatures will perturb atmospheric and hydrologic circulations, combining to increase the future frequency and severity of fire event, the global area prone to frequent fire (+ ~30%), and population-exposure to their immense socioeconomic cost. LUC and fire may thus be united by a third theme: how differential pathways toward socioeconomic development feed back onto socioeconomic risk. To date however, no process-based representation of the link between the two has been developed, severely restricting the capacity of a sustainable land and transport infrastructure policy to plausibly reflect their cost-benefit implications with respect to fire probability. It also fundamentally hampers mechanistic understanding and forecasting of fire behaviour, and efforts to understand humans' role in altering prehistoric fire regimes. Here we target these shortfalls by using a global land surface model to quantify the impact of land fragmentation on fire, and the spatial and biome - scale sensitivity of fire to population density and fragmentation extent. We find that overall, fragmentation leads to decreases and increases in annual burned area (BA) of -21.5 and +17 mHa yr-1, equivalent to around 4% and 3% of global BA, (net ~1%), although this masks localised BA changes of <-90% and >+100%. Generally, highly fragmented regions experience less fire, while low-moderately fragmented regions saw a positive effect on BA. The BA response to increasing fragmentation was highly biome-specific however, with a generally decreasing BA trend over temperate grasslands, and a positive sinusoidal BA trend over tropical forest areas. While the effect of fragmentation on BA and fire intensity was generally coupled in sign, we found that in large swathes of boreal and tropical forest, fragmentation could lead to less BA but greater fire intensity. Tropical forests are shown to be especially fire-sensitive to fragmentation, as has been suggested empirically, with modelled increases in fragmentation-related fire activity greatest over existing areas of deforestation and plantation clearing, particularly in

Indonesia and Amazonia. Overall, the geographic and biome-specific fire effects of fragmentation found herein provide a starting point for risk-based impact assessments of sustainable economic, land and transport development policies in an increasingly anthropocentric future.

Keywords: Fragmentation, global burned area, land use policy, tropical degradation

Acknowledgments: SB was funded by the FirEUrisk project, a European Union Horizon 2020 research and innovation program, Grant Agreement No. 101003890.

Fire in the Earth System Abstracts
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Community-Based Fire Management in East and Southern Africa's Savanna-Protected Areas

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Abstract

The introduction of fire suppression policies and expansion of exclusionary protected areas in East and Southern African savannas have engendered a wildfire paradox. Outside protected areas, livestock have replaced fire as the dominant fuel consumer. While inside their boundaries, wildfire intensity has increased due to accumulating flammable biomass. Community-Based Fire Management (CBFiM) is recognised as an alternative bottom-management strategy to address the wildfire paradox and promote equitable fire governance across conservation landscapes. Yet, there has been little investigation into the implementation and effectiveness of CBFiM across East and Southern Africa’s savanna-protected areas. We employed a social-ecological systems framework to develop a systematic map of the published literature on the framing and features of CBFiM in this context. We characterise the challenges and opportunities for their design and implementation, focusing on the relationship between governance systems and community participation in fire management. We find that CBFiM projects are commonly governed by the State and international NGOs retaining decision-making power and determining access to savanna resources and fire use. Existing CBFiM projects are limited to communal rangelands and are developed within existing Community-Based Natural Resource Management programmes prioritising fire prevention and suppression. Planned CBFiM projects propose an exclusive early-dry season patch mosaic burning regime to incorporate indigenous fire knowledge into modern scientific management frameworks, but evidence of indigenous and local peoples’ involvement is scarce. To provide equitable fire management, CBFiM projects need to address inequalities embedded in protected area governance, persisting anti-fire wisdoms, centralised suppression policies, and account for changing state-society relations in the region.

Keywords: community-based fire management, social-ecological systems, protected areas, savanna, colonialism

Fire in the Earth System Abstracts
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What message do we want to convey? An analysis of the media treatment of largest fires in Spain

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Abstract

Leading think tanks in Integrated Fire Management seem to agree on the need to modify communication on wildfires to promote social prevention. The goals seem clear: improving social understanding by informing about the causes and overcoming the simplistic interpretation of the fatalism of ignitions and meteorological conditions, as well as relativising the technological myth; contributing to the understanding of the fragility and vulnerability of the environment; avoiding sensationalist treatments; favouring the recognition of the positive role of agricultural activities regarding the prevention of forest fires; avoiding the media and political manipulation of fires; or assuming the management of fire risk as an opportunity for the development of rural areas.
Building on this theoretical framework, we will undertake a systematic literature review to identify approaches and themes, as well as analyse a sample of the 10 largest fires in Spain over the last 10 years (2013-2022) based on their treatment in both the national and regional newspapers, using the Atlas.ti tool. The analysis of written media focused on a selection of five national newspapers (El País, El Mundo, ABC, La Vanguardia and 20minutos) and 10 local newspapers for the 3 largest forest fires recorded in each year of the 2013-2022 period (30 fires in total). Editorials and opinion pieces for the same period in the 5 selected national newspapers are also analysed.
Our purpose is to identify and analyse the discourses, today questioned, of fire exclusion in the media treatment of wildfires, to understand the construction of the misleading social perception that all studies attribute to public opinion and to try to develop keys for the implementation of alternative communication actions based on the fire ecology paradigm, the promotion of resilient rural landscapes and the construction of fire-adapted communities.

Keywords: Wildfire communication, Risk communication Management, Framing.

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Evacuation priority in the municipality of Alvaiázere: Comparing evacuation models in emergency situations

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Abstract

The year 2017 in Portugal was marked by a devastating wildfire season that resulted in extensive burned area and significant loss of infrastructure and human lives. Since then, several initiatives have been implemented to improve the safety of people and assets in Portugal, such as the "Safe Villages, Safe People" programs, managed by the Civil Protection Agency (ANEPC) since 2018.
This study aimed to analyze the villages (built-up areas) with the highest evacuation priority, in the municipality of Alvaiázere, considering the population density and the time required to evacuate by car to the nearest safe location with shelter. These two variables represent, respectively, exposed population and their response capacity at the village level.
To obtain the map of villages, the boundaries of all the villages were mapped using the built-up areas dataset. Population density at village level was obtained by estimating the number of residents for 2021 according to the variation in the resident population between 2011 and 2021 in the overlapping civil parishes. To calculate the evacuation time, two types of safe locations (destination points) were considered: i) the villages where the Safe Villages (SVs) is already implemented, as a wildfire shelter is selected, and have less than 60% of forest and shrubland in their Village Protection Zone (500m surrounding the village), and ii) the parish councils. The geographic coordinates of the implemented SVs and the location of the parish councils were extracted. A cost-distance was then calculated using GIS tools, with paved roads as ideal path and slope integrated as “cost". Then, the distance in meters of the preferred path from each village to the nearest SV or parish council was calculated, being subsequently converted into time. Both variables were classified based on quintiles, and a matrix was created to combine the two variables.
In Alvaiázere, 35 SVs were implemented so far and only 17 SVs considered as destination, and there are 5 parish councils. Regarding evacuation priority, 9% of villages have a very low priority and 10% of villages have a very high priority (highest quintile). These villages are the ones that require the longest time to reach the nearest shelter and have a higher number of residents. The analysis of these two components can contribute to prioritizing villages in emergency situations and help planning the implementation of protection measures within the municipality.

Keywords: Wildfire, Population, Coping Capacity, Safe Villages

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Identifying priority villages for wildfire mitigation based on exposure and vulnerability levels at the local scale

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Abstract

In the last decade, extreme wildfire events have occurred in Southern Europe, United States of America, Chile and Australia. In Portugal, the devastating fire season of 2017 has brought to light the fragilities of the wildfire management system and the need to improve the self-protection capabilities of both individuals and communities. This study aimed to assess wildfire risk specifically for human settlements, testing the procedure in three regions of mainland Portugal, representing the west coast (Oeste), the south coast (Algarve) and a central inland sector (Viseu-Dão-Lafões). The wildfire risk analysis procedure, which includes the calculation of three components (hazard, exposure and vulnerability), was adjusted to the spatial extent considered and the data available, to obtain wildfire-related metrics representative for villages. Hazard levels were computed for the surrounding area of villages, using 2 size buffers surrounding the perimeter of villages: i) 100 m; ii) 500 m. The area classified as high and very high hazard (critical area) was retrieved for the two buffers, based on a structural map that combines landcover and topographic conditions. Human exposure was based on the number of residents in each village, using the latest Census data (2021). For vulnerability, the Total Dependency Index (TDI) was calculated, as a proxy of the self-protection abilities of the resident population. This index represents the ratio between young + elderly people (more dependent) and adult population (with more autonomy).
First results indicate that 11% of villages within the three study areas have more than 50% critical area in their surrounding 100 m buffer, increasing to 18% for the 500 m buffer. In these most critical villages, there are 34 700 residents, with 80% living in only 6 villages, 5 located in the central inland area. The procedure applied can contribute to prioritize villages throughout the country, regarding the need to implement wildfire prevention and mitigation strategies. These might include as well landscape conversion measures, whose effects in burn probability can be simulated based on vegetation changes in the surrounding buffers of villages.

Keywords: Wildfire mitigation, villages, human exposure, dependency index

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Between peatlands and fires: livelihoods of peatland communities in Southeast Asia

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CIFOR-ICRAF

Abstract

One area that needs more systematic understanding in the context of sustainable peatland management in Southeast Asia is the interaction between the communities and the peatland. Through a variety of income-generating activities, communities earn income from peatlands. At the same time, their activities may have impacts on the peatland conditions. The paper aims to answer the following question: What are the communities' major livelihood sources from peatland, and what are the implications of their livelihood generation on peatland conditions? Using the Sustainable Livelihoods Approach and literature review, we map the contexts and assets that shape the livelihood strategies of communities in Southeast Asia, which produce livelihood and peatland outcomes. Communities are mainly the victim of fires, and they are not in a powerful position both in terms of assets and their ability to shape policy and institutional contexts. On the one hand, their livelihood strategies mainly depend on extracting from peatlands. On the other hand, there is an increasing awareness among communities of the benefits of paludiculture, although not yet on a mass scale. As such, their livelihood outcomes are not yet sustainable, and the peatland outcomes are not conclusive. Efforts from various stakeholders are required to empower them to move away from activities that trigger fires while maintaining or improving peatland conditions.

Keywords: peatland, fires, livelihoods, paludiculture, Southeast Asia

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Fire in the Earth System Abstracts
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Population and major wildfires

Doctor, Alfonso M.

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Abstract

Paper carried out within the CILIFO project (Iberian Centre for Research and Fight against Wildfires) (https://cilifo.eu), of the Interreg Spain-Portugal Cross-border Cooperation Programme (POCTEP), in its subproject B.1.2.2. Characterisation of historical wildfires, where anthropic factors of major fires (LWF, larger than 100 hectares) were studied. The relationship between the two was analysed, taking from the former the most cited in the scientific literature. The influence of demographic evolution on the production of LWF was approached by crossing population data at the municipal scale with the spatial distribution of the affected areas in the province of Huelva, the most forested and with the most LWF in Andalusia. Within the context of wildfires as a complex phenomenon, the results indicate that their determinant is not the mere population loss -because it takes place in areas both not affected and heavily affected by LWF- but loss of inhabited places and resident population outside the municipal capitals, which requires to focus, within the framework of policies for both fire prevention and fight against rural depopulation, not so much on the maintenance/recovery of the population as on secondary settlements.

Keywords: wildfires, depopulation, CILIFO, Huelva.

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Fire impact on soil hydrology in Mediterranean groves and orchards

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Abstract

Fire has been used in the Mediterranean orchards and groves to remove the pruned branches. The EU policies promote the use of chipped pruned branches to promote the restoration of the soil system. Soils under the use of fire to burn the chipped pruned branches use to be bare and induce high erosion rates and loss of water due to surface wash. On the other hand, the soils covered with chipped pruned branches show higher erosion rates. Moreover, farmers use to light a fire on the leaf cover during winter to maintain “clean” the soil which results in a bare soil surface. This research investigates the impact of chipped pruned leaves and burnt leaves on soil water infiltration in the soils of persimmon plantations in Valencia, Spain. We selected 10 paired plots to compare chipped pruned branches with mulch-covered soils and ask for covered soils. The measurements were done in January and August 2022. We used a single-ring infiltrometer. Ten samples per site were carried out. The results show an increase in infiltration in the areas where chipped pruned branches were used. The use of fire resulted in a reduction in soil infiltration capacity. The use of mulches has been found in Mediterranean orchards as a sustainable practice (Cerdà et al., 2018ª, b; 2021; López-Vicente et al., 2020), and is a positive nature-based solution (Keesstra et al., 2018).

Keywords: Fire, Soil, Infiltration, Orchards, Mediterranean.

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Fire in the Earth System Abstracts
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The impact of plant types on water repellency as a consequence of forest fires.

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Abstract

Forest fire induces changes in plant cover and soil properties. Fire also changes the soil's hydrological properties. Soil infiltration, soil water retention, and runoff discharge are modified by the heat and the organic matter losses. The hydrological response of the soils affected by forest fires is highly determined by the impact of soil water repellency (DeBano, 2000; Doerr et al., 2000). In the Mediterranean climatic conditions water resources are key for ecosystems and soil water repellence determines the wettability of the soils. After the forest fire in Beneixama (15/7/2019). A set of plots were selected to measure the evolution of the soil water repellency. A paired plot approach was designed with burnt and unburnt areas under Pinus halepensis, Quercus coccifera and Quercus ilex. A hundred drops were measured in 10 plots per plant species on control (unburnt) and burnt soils at 0, 1, 2, 5 and 10 cm depth. The Water Drop Penetration Time method was applied (Wessel et al., 1988) in the summer 2019, 2020, 2021, and 2022. The results show that Pinus halepensis induced an increase in water repellency in comparison to other plant species. The impact of fire reduced dramatically the water repellency and this reduction affected all the species involved in this research. We found an increase in soil water repellence on the 2 cm depth layer after the forest fire. During the three postfire years the water repellency was partially recovered in all three plant covers. We discuss the impact of plants species on soil properties and runoff generation and confirm the role of plants on the water and soil characteristics in the Mediterranean (Doerr and Thomas, 2000; Cerdà and Doerr, 2007; Schnabel et al., 2013; Cerdà et al., 2021).

Keywords: Fire, Wildfire, Plants, Soil, Infiltration, Beneixama, Mediterranean.

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Fire in the Earth System Abstracts
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Looking for “fire” and “forest fire” concepts in the Spanish Primary School curricula. New Challenges for environmental education

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Abstract

Fire is present in all biomes of the Earth except Antarctica. Fire has been recorded for 400 million years. Fire is part of human culture as was used as a tool (1 million years ago) by the hunter-gatherers, and by farmers, since agriculture was developed 12000 years ago, and is used in festivals such as the bonfires, which are very relevant for the Mediterranean culture. Our research evaluates the information given to the students in Primary Schools in the Spanish Educational System. Fire is recurrent yearly in Spain with forest fires that affect close to half a million hectares in the worse years. Fires are for the Spanish citizens an environmental, but also a social issue. We quantified the presence of the word “fire” during the six courses of Primary School. Although forest fires must be flighted with education (McCaffrey, 2004) within the education system (De’Arman and York, 2021) to improve prevention (Xanthopoulus et al., 2022; Diekman et al., 2010; Mondozzi et al., 2001), our findings show that the word “fire” is being seen as negative. Although “forest fires” are part of nature, within the education system they are seen as a risk for goods and people. We discuss the need to be more informative and also introduce forest fires as part of nature. A holistic view of nature is necessary for our educational system.

Keywords: Fire, Forest, Spain, Primary, School, Education, Teaching.

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Fire in the Earth System Abstracts
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MULTITEMPORAL ANALYSIS OF LAND-USE CHANGES IN THE 2022 FOREST FIRE THAT OCCURRED IN THE GUÁJARES COMARCA (GRANADA, SPAIN)

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Abstract

Forest fires are a great concern for humankind, especially in rural areas, since there is an important relationship between nature and society. In addition, non-controlled forest fires represent the loss of natural resources and soil nutrients, generating possible irreparable economic losses, desertification, displacement of the household, etc. Little is known about spatiotemporal changes in land uses before and after forest fires occur considering long term-approaches, for example, 50 years, also combined with satellite images to assess recent changes. In 2022, in Los Guájares, Granada, 5,000 ha were affected by a forest fire reaching a perimeter of 150 km. To date, the origin and causes of this forest fire are unknown. We hypothesize that the high intensity of this fire could be originated due to non-planned land use changes. Therefore, to investigate if any specific spatiotemporal change in land uses in this forest fire was determinant, we used a dataset characterized by aerial images from 1956 to 2013 (approximately every 10 years), images from the Sentinel 2 satellite from March 2022 to March 2023 (approximately every month), using geostatistic tools as well as indexes such as NBR (Normalized Burned Ratio) and NDVI (normalized difference vegetation index).

Keywords: land management, regional geographic analysis, land-use changes, Los Guájares,

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CHARACTERIZATION OF KEY PROPERTIES IN THE WATER-SOIL-PLANT SPHERE IN THE 2022 GUÁJARES FOREST FIRE

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Abstract

In 2022, in Los Guájares, Granada, 5,000 ha were affected by a forest fire reaching a perimeter of 150 km. To date, the origin and causes of this forest fire are unknown. The general objective of the research is to establish the bases for the realization of a first map of soil properties, especially hydric and biological, in soils subjected to different uses, in recently burned and adjacent areas. This objective is intended to be, in turn, the starting point for the application of a larger-scale project. The research presents a multidisciplinary and transversal approach, aimed at a problem with global repercussions that requires an urgent response and from a multiscalar point of view: the soil-water-plant relationship within the framework of productive activity and natural risks. We sampled a total of thirty rings (15 in a severely affected burned area and 15 in a non-burned mango plantation) to assess hydrophobicity (drop test), saturated hydraulic conductivity and water retention capacity. Moreover, using an online geographic information tool designed by Auravant, we will assess vegetation changes and status before and after the forest fire.

Keywords: land management, water-soil-plant,forest fire, Los Guájares,

Acknowledgments: Plan Propio de Investigación y Transferencia de la Universidad de Granada. 2022 Programa 1. Proyectos de Investigación Precompetitivos. Caracterización de propiedades clave en la relación agua-suelo para el estudio de la influencia del fuego en el balance hídrico y el

carbono para el planteamiento de estrategias de restauración.

Fire in the Earth System Abstracts
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Effectiveness of the dehesa system to prevent and fight against wildfires

Pulido, M., Castaño, F.M., Abdennour, M.A., Barrena-González, J., Gabourel, A., Fernández de Castro, G., Corzo Gajón, A. and Lavado Contador, J.F.

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Abstract

The Spanish region of Extremadura has suffered at least four remarkable wildfires in summer 2022 and spring 2023. They have drawn the attention of the most important national media and have also generated currents of opinion on how to manage its environment. In this line, we have discussed the role of the largest land system in the region (dehesa) as tool to prevent and fight against wildfires. To do that, firstly, we have checked official statistics (GWIS) to estimate the percentage of wildfires happened in dehesas. And we confirmed that the class in which dehesa can be included (grass/shrubs) reached its maximum in 2013 with 34.3% of the total number of wildfires. Nonetheless, this value is usually less than 10%, shrublands are not exactly dehesas and the number of wildfires does not necessary mean important fires. Secondly, we have estimated the average volume of watering ponds that dehesa farms use to have to store surface water in summer for livestock drinking. For doing that, we have assessed the volume of water of representative watering ponds by using drones (equipped with LIDAR) and GNSS systems that generated accurate 3D models. We found a significant equation between the surface covered by water (observable from aerial images) and their total volume (accurately estimated by us): $y = 0.0009x^2 + 0.1219x - 13.186$; $r^2 = 0.9985$, where x is water surface expressed in m^2 and y is water volume expressed in m^3. We conclude that dehesa system is an excellent tool for fire prevention since its statistics of burned area is still quite low. In addition, we suggest that livestock should be introduced in the public forests of Extremadura (183,000 ha of land surface) to create similar land systems. Regarding water storing, the average volume of watering ponds in dehesas is about 100 m^3 per pond. It could mean enough water and good visibility for helicopters that take about 1 m^3 in each action.

Keywords: livestock, watering ponds, water volume, land management, Extremadura

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Fire in the Earth System Abstracts
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Assessing the Spatial Distribution and Size of Water Bodies for Fighting Forest Fires in Extremadura, Spain

Pulido, M., Barrena-González, J., Amine Abdennour, M., Castaño Martín, F. M., Gabourel Landaverde, A., Corzo Gajón, A., Lavado Contador, J. F. and Fernández de Castro Martínez, G.

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Abstract

The spatial distribution of water bodies plays a crucial role in supplying water to combat forest fires in Extremadura, Spain. The region of Extremadura is characterized by a Mediterranean climate with hot and dry summers, which significantly increases the risk of forest fires. In this region, the high-risk fire zone (HRF) covers 15,415 km2, which represents 37% of the total area. In this context, the strategic presence and size of water bodies, such as reservoirs, lakes, and livestock ponds, are essential to ensure an adequate water supply during fires. Therefore, the objective of this study was to analyse the spatial distribution and size of water bodies in HRF areas in Extremadura. To do this, a map of all existing water bodies in these areas was generated by combining hydrological information, the 1:10,000 topographic map, and historic and current orthophotos. In addition, to correctly identify the water bodies and their spatial distribution, were classified into 5 classes that vary according to size: (1) < 0.0001 km2, (2) 0.0001–0.001 km2, (3) 0.001–0.01 km2, (4) 0.01–0.1 km2, and (5) > 0.1 km2. The results showed that the total number of identified water bodies is 32,086, covering a total area of 24.28 km2, which represents 0.16% of the HRF. This represents a density of 2.08 water bodies/km-2. However, this density varies according to size. While the water bodies of class 1 have a density of 1.10 bodies/km2, class 4 is only 0.02 water bodies/km-2. Regarding the total number by classes, class 2 had the most water bodies identified (16,976), and class 5 had the least (8). Regarding their spatial distribution, the results show that classes 1, 2, and 3 are distributed equitably and with an acceptable density throughout the HRF. However, class 4 and especially class 5 have a more uneven distribution throughout the HFR. In addition, in some natural regions where the recurrence of forest fires is higher, water bodies of a certain entity were not observed, which raises doubts about the correct supply of water for firefighting. In conclusion, it could be said that the density of identified water bodies in the HRF is acceptable. However, the distribution of larger classes deserves to be reviewed in areas of low density and with high rates of recurrence of forest fires.

Keywords: Water supply, Forest fires, Spatial distribution

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A Bibliometric Analysis of Forest Fires

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Abstract

Due to the mega forest fires in recent years, the interest in scientific research on forest fires is increasing. The importance of studies on forest fires in combating climate change and the evaluation of these studies on forest fires will contribute to the literature. This study aims to make a bibliometric analysis of the studies on forest fires. In this context, the studies listed in the Web of Science database were identified by selecting the subject search option and searching with the keywords "forest fire" or "fire management" or "fire risk" or "human perception" or "forest fires". As a result of the searches, a total of 43884 studies were reached, and then this number was reduced to 32185 by selecting article and review article types. WoS Category "Forestry" was selected and the number was reduced to 3426. SCIE-SSCI-ESCI was selected from WoS Index options and this number decreased to 3219. Finally, "Forest Fires" was selected from the citation topics micro option and the last 15 years were selected as the year (2009-2023) and the final number was 1387. Bibliometric analysis method was used in the evaluation of this research. 1387 articles were uploaded to VOSviewer computer software and co-author-organisations, co-author-country, co-occurance-keywords, citation-documents, citation-sources, citation-author, citation-organisations, citation-country and co-occurance-abstract fields were matched and the results obtained were analysed. The most co-authored article was Keeley (2009b), the most cited journal was International Journal of Wildland Fire, the most cited author was William J. De Groot, the most cited organisation was the US Forest Service, the most cited country was the United States of America, the most cited keywords were "fire management, forest fires and wildfire" and finally the most used word in the abstracts was "forest fire".

Keywords: Forest fires, human perception, bibliometric analysis

References
Web of Science

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Fire versus chipped pruned branches impact on soil infiltration in vineyards. The "Els Alforins" study site, Valencia, Spain

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Abstract

Vineyards are being seen as a source of sediments and water due to the abuse of herbicides and plowing (Richter and Negendank, 1977; Prosdocimi et al., 2016; Biddoccu et al., 2018; Rodrigo-Comino, 2018; Rodrigo-Comino et al., 2018). The highest erosion rates within the world's agricultural land are found in vineyards (Panagos et al., 2015; Borrelli et al., 2021) and the future will be also negative due to the expected climate change (Panagos et al., 2021). There is a need to develop new strategies to reduce soil and water losses and restore the soil functions and soil properties that will restore the basic ecosystem services (Keesstra et al., 2016). Within the new strategies: cover crops, mulches, catch crops, or geotextiles (Keesstra et al., 2019; Rodrigo-Comino et al., 2020; Cerdà et al., 2021) farmers will prefer to use local and nature-based solutions such as chipped pruned branches (Keesstra et al., 2018). The infiltration capacity of soils is a relevant factor in soil erosion and runoff delivery. This is an easy-to-measure soil property that informs about soil sustainability. The steady-state infiltration rate informs about the soil health from a hydrology point of view.
This research evaluates the impact of chipped pruned branches on soil erosion and runoff loss control in rainfed vineyards. We selected two paired fields to measure the infiltration rate by means of a single-ring infiltrometer in the summer of 2022 (July) when the soil was dry. Two hundred measurements (100 in each of the fields) were carried out in a Control field (burn chipped pruned branches) and a Mulch field (chopped pruned branches). The measurements last 60 minutes and the Horton equation was fitted. The steady-state infiltration rate was calculated for each infiltration envelope. The results show that the soil infiltration rate ranged from 35.33 to 234.23 mm h-1 in the control field and from 33.45 to 244.31 mm h1. The average steady-state infiltration rates were 89.32- and 91.32-mm h-1 respectively for control and Mulch plots. It was no statistical differences in the infiltration capacity of soils. We discuss if the 3 years of mulch application was not enough to trigger a change in the soil infiltration capacity.

Keywords: Vineyards, Infiltration, Soil, Chipped pruned branches, Fire,

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Fire in the Earth System Abstracts
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Study of the evolution, hazard factors and management of forest fires in Malaga province

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Abstract

The investigation has the aim of evaluating the problem of forest fires in Malaga province, analysing the different factors that intervene in their danger and the prevention and extinction measures that are carried out, in order to find the weak points of the territory (or, mostly, of the human that inhabits it) and propose lines of action to improve this serious situation. For this, the evolution of the number, affected area and casuistry of forest fires has been analysed. A descriptive study of the characteristics of the province that are related to them has been carried out, and the incidence of climate change has been studied. The incidence in the territory of different hazard factors related to relief and meteorology, the characteristics of the vegetation and land uses, and the one induced by the human, have been shown and analysed, with special emphasis on the role of the flammability of the vegetation. The availability of INFOCA means and the "protection" against forest fires, by the public administration, of spaces with protection figures and public forests have also been verified. Finally, the effectiveness of the prevention and extinction measures in Malaga province has been contrasted, and measures of the first type have been proposed, which have been considered insufficient. The usefulness of this work lies in the demonstration of the multiplicity of factors to be taken into account in the management of forest fires, which influence in their occurrence and propagation, as well as the lack and importance of prevention measures.

Keywords: forest fires, hazard factors, climate change, flammability, prevention measures

Fire in the Earth System Abstracts
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The impact of wildfire on water resources in the Serra da Estrela Mountain, Central Portugal

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Abstract

Mountains play an important role as reservoirs of high-quality fresh water, which is fundamental for human communities as well as for ecosystems. Wildfires lead to considerable impacts on water resources, which may cause serious disruptions in the volume and quality of water resources (e.g. Espinha Marques et al., 2021).
Serra da Estrela is the highest mountain range in Mainland Portugal (1993 m a.s.l.) and comprehends two main protected areas: the Serra da Estrela Natural Park (SENP – 888 km2) and the Estrela Geopark (encompassing the SENP area and its surroundings – 2216 km2), whose natural heritage, including its geodiversity and biodiversity, has been for decades studied and valued. In 2022 Portugal was the third most affected European Union country by wildfires and, in August 2022, over 250 km2 of the Serra da Estrela territory were destroyed by a wildfire (San-Miguel-Ayanz et al., 2023) which disturbed a wide variety of mountain habitats.
With the present work, we intend to contribute to the knowledge of the post-fire exports of trace elements and organic compounds into water bodies in Serra da Estrela. The first sampling campaign took place in October 2022, after the fire and before any rain event, and included the selection of four springs (two of them potentially affected by the wildfire), and four superficial water streams (three located in the burned areas and one in an area that was not affected by the wildfire). Sampling campaigns are being performed every two months for one year, with the in situ measurement of pH, electrical conductivity, and temperature. In the field, the water samples were also properly preserved to be analysed in the laboratory: colour, turbidity, total alkalinity, bicarbonates, total organic carbon, total hardness, major inorganic ions, metals and PAH.
The results show differences in the chemical composition of water samples collected in areas affected by the wildfire, when compared to those from non-affected areas.
It is hoped that the research results will contribute to the sustainability of water resources in this mountain region during recovery from a major wildfire, in the context of climate change.

Keywords: mountain area, wildfire, springs, streams, trace elements, PAH

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Fire in the Earth System Abstracts
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Monitoring the evolution of fire affected forest and agricultural land after the Los Guajares wildfire September 2022

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Abstract

In September 2022, a wildfire devastated the region of Los Guajares (Granada, Spain) and surrounding mountainous areas. It burnt in total around 50 km² of shrubland, pastures and agricultural land. The area is located in the transition between sub-humid to semi-arid western Mediterranean region, the development and recovery of fire affected areas depends largely on the climatic conditions in the upcoming months and years, as well as on the human actions.
Between the villages of Guajar Alto and Guajar Faragüit we have chosen an area where on steep slopes we can find: severely affected dense forest, severely affected matorral, severely affected olive groves, heat affected olives and non-affected olives. Especially the olive orchard shows ideal conditions, as it is mainly located on the same slope, overall terraced and managed by the same farmer.
Here, we will present the first results, as we started monitoring the area with aerial photographs with different qualities in October 2022. These will allow the monitoring of vegetation revovery, but also to identify areas of runoff generation (and consequent soil erosion) as well as the extent of soil management on the different surfaces. In March 2023 we started measurements of soil physical properties, which is still going on. These include saturated and unsaturated infiltration capacity as well as aggregate stability
The monitoring programme will be continued in the upcoming years.

Keywords: Los Guajares Wildfire, monitoring, aerial photography,

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Hydrological impacts of wildfires on diverse climatic regions

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Abstract

Wildfires are a natural, commonly occurring phenomenon for many forest ecosystems, affecting vegetation distribution and density, but they also can exert a considerable influence on the affected region's hydrology, leading to changes in river runoff until vegetation and hydrological processes return to their prior state. Although numerous studies have explored the hydrological consequences of forest wildfires at the basin and river level, studies following comparative and large-scale approaches remain limited. To address this gap, our work utilises an extensive dataset of runoff observations worldwide, as well as MODIS burned area data and other climate variables, enabling a systematic evaluation and comparison of the hydrological response to forest wildfires across various hydrological regions and biomes, from boreal to mid-latitude and equatorial areas. Through our analysis, we uncover contrasting impacts of wildfires on hydrological processes, underscoring their pivotal role of hydroclimatic factors in shaping their hydrological response. Notably, we find that mid-latitude river discharges are the most affected by wildfires. In contrast, wildfires in the equatorial and sub-tropical regions affect river runoff to a smaller degree.

Keywords: wildfires, burned area, river runoff,

Fire in the Earth System Abstracts
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Effect of Fire Treatment on Aggregate Stability and Splash Components in Laboratory Condition

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Abstract

The present study was planned with the aim of investigating the effect of fire on soil aggregates stability and splash erosion components in laboratory conditions on the rangeland soil in Kajur watershed located in the north of Iran. The corresponding experiments were done in three control plots and 12 plots covered with dry residues of rangeland species with four densities (250, 500, 750 and 1000 g m-2) based on the mass of plant residue per unit area and cpnsequently with four different fire intensities in three replications. Then, splash cups were placed on the soil surface and rainfall with an intensity of 60 mm h-1 and a duration of 30 minutes was simulated, and the splash erosion components including upward, downward, total and net splash were measured. The soil aggregate stability was also investigated by comparing the mean weighted diameter of the soil aggregates before and after the rainfall simulation in all plots. The results showed that the effect of fire treatment on reducing total and net splash variables and increasing soil aggregate stability was significant at 95% and 99% confidence levels, respectively. With the increase in the intensity of the fire treatment, in general, the trend of changes in soil aggregate stability and splash components was increasing and decreasing, respectively. The fire treatment with a intensity of 250 g m-2 of the dry residues of the rangeland species reduced total and net splash by 35 and 44%, respectively, while the treatment of fire with the intensities of 500, 750 and 1000 g m-2 of the dry residues of the rangeland species reduced total and net splash more than 95%. Although the soil aggregate stability increased significantly with increasing the intensity of the fire treatment, the reduction of the total and net splash in the fire treatments with an amount of >500 g m-2 of the dry residues of the rangeland species was no longer significant. The significant participation of small particles of the soil surface without aggregation in the splash changed the intensity of the effect of fire treatment. The percentage of reduction of total and net splash due to the fire treatment with different intensities was not the same, which shows that the splash in the upstream and downstream directions did not decrease in the same proportion. The soil aggregate diameter from the control treatment to fire treatments with low to high intensities had a decreasing trend, generally.

Keywords: Aggregate Diameter, Fire Management, Hydrophobicity, Rain Erosion, Soil Conservation.

Fire in the Earth System Abstracts
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Plant species impact on runoff and soil erosion in a Mediterranean shrubland

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Abstract

Shrubland is a Mediterranean biome characterized by densely growing evergreen shrubs adapted to fire events. To date, scientific research has focused on the impact of vegetation on soil erosion mainly through the control that plant biomass or plant cover exerts on sediment delivery and runoff discharge, being the individual plant species' influence on hydrological and erosional processes not achieved in detail. The objective of this research is to determine: i) runoff and soil losses in shrubland-covered rangeland at Sierra de Enguera, Spain; and ii) how four plant species affect soil and water losses. We measured soil cover, soil properties, runoff discharge and sediment yield under natural rainfall for five years (2010-2014) in a typical shrubland burnt in 1999. Four plant species were selected with 4 plots each: Ulex parviflorus Pourr., Pistacia lentiscus L., Quercus coccifera L., and Rosmarinus officinalis L. Despite that the soil properties and plant cover did not exhibit statistically significant differences among plant species, the runoff discharge was lower on Q. coccifera (4.87 %, SE 0.24) and P. lentiscus (6.24 %, SE 0.51) than on U. parviflorus (13.41 %, SE 0.58) and R. officinalis (13.84 %, SE 1.23). Sediment concentrations were, respectively, 3.91, 4.33, 4.31, and 4.88 g l-1, and the differences between R. officinalis and the other species were statistically significant. The runoff discharge determined differences in soil erosion rates amongst the plant species with lower rates on P. lentiscus (1.36 Mg ha-1 y-1) and Q. coccifera (1.53 Mg ha-1 y-1), than on U. parviflorus (3.17 Mg ha-1 y-1) and R. officinalis (3.85 Mg ha-1 y-1). This long-term in situ study indicated that Q. coccifera and P. lentiscus are more efficient in controlling runoff discharge and soil losses than U. parviflorus and R. officinalis one decade after a fire. We discuss these results in light of the recent findings by the scientific community on the role of the canopy cover (rainfall interception), soil macropore and root system, and the water repellency that controls the hydrological response of the soil (e.g. runoff generation, infiltration). The information supplied by 5 years of research is relevant for restoration and rehabilitation programs and advises that Q. coccifera and P. lentiscus are the most efficient plant species to control soil and water losses within the Mediterranean shrubland. This is an applied science approach for the better management of rangelands.

Keywords: Plants, Shrubland, Plots, Rainfall, Runoff, Soil erosion, Sediment, Mediterranean

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Fire in the Earth System Abstracts
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Fire concept at the Degree in Agrifoods and Rural Environmental Engineering. Universitat Politècnica de València and the Degree in Geography and Environmental Sciences at the University of València

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Abstract

We review the use of the term fire in the degree in Geography and Environmental Sciences at the University of Valencia and the Degree in Agrifoods and Rural Environmental Engineering at the Polytechnic University of Valencia. The results show that the term fire is not used or used with a sense of risk. The use of fire by humans and the importance of fire on the Earth System is not shown, although in both curricula the human impact on the Earth is a relevant issue. Fire is a key to understanding Earth's biogeochemical cycles and the human impact on Earth. We discuss the need to improve this situation.

Keywords: Fire, Education, University, Spain, Soils

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Fire in the Earth System Abstracts
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Soil water repellency in Pinus sp. plantations affected by forest fires in Temperate climatic conditions.

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Abstract

Earth science research is moving towards holistic investigations that show the interaction of different spheres involved in the biogeochemical cycles (Atekwana and Slater, 2009). Scientific research is more efficient at the frontier of the scientific disciplines where little research has been done. This is a very fruitful strategy to advance scientific knowledge, as different scientific backgrounds join and generate new knowledge. This STSM is based on this idea. Soil water repellency involves water, minerals, life, and air spheres (Doerr et al., 2000), and has been found in various climatic and pedological regions of the world. For example, Walden et al., (2015) found an increase in soil water repellency in the reforestation of Eucalyptus. Kobayashi and Shimizu (2007) found high values of water repellency in Japanese cypress resulting in a shortage in soil water storage. Miyata et al., (2007) registered an increase in runoff due to the high-water repellency in the same experimental area. Ma et al., (2017) found water-repellent soils in China, and Hrabovsky et al., (2020) in The Little Carpathians in Europe. During the last two decades, it has been confirmed that soil water repellency is a global soil property of the Earth System and that it is not anymore, an issue restricted to the forest fire-affected land (DeBano et al., 2000) or the citrus plantations on sandy soils (Jamison, 1947), that have been the two-pioneer research on soil water repellency in the world.
Soil water repellency is edaphic property enhanced by soil organic matter and organic products such as oils and waxes. Fire disturbs the degree and spatial distribution of soil water repellency. This is especially relevant in soils covered with species rich in resins, oils, and waxes such as the Pinus sp. The objective of this research is to determine the degree and distribution of soil water repellency in Pinus sp. plantations in temperate climatic conditions. The information collected will shed light on the importance of forest fire on soil hydrology and how a fire will reallocate the water-repellent layers. A spatial distribution assessment of the water repellency at different depths will contribute to understanding the role of fire as a critical factor in the changes in soil hydrology.

Keywords: Fire, Repellency, Soil, Water, The Netherlands, WDPTR

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Fire in the Earth System Abstracts
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Fire against chipped pruned branches mulches in olive orchards. Their effect on soil hydrology

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Abstract

Soil and water losses resulting from conventional citrus plantations are often considered non-sustainable due to the high rates of soil degradation. To achieve sustainability and land degradation neutrality in citrus production new strategies should be developed to avoid non-sustainable soil and water losses. The use of chipped pruned branches as mulch is evaluated here as an alternative option to traditional burning carried out by farmers. We selected two paired plots under Glyphosate treatment for 30 years, with bare soils (no weeds or catch crops), in the control plot the branches were burnt (CON), meanwhile on the chipped pruned branches plot were chopped as a mulch (BRA). The pruning was done on March 30th, 2019, and the pruned branches were collected and chopped in a nearby field (30 m). After July 21st a set of 25 paired plots (50 plots) were established in the field with plots covered with chopped pruned branches (CON) and bare (CON). The amount of mulch applied was 125.9±30.9 g m-2 of chipped pruned branches. We used a rainfall simulator at 55 mm h-1 rainfall intensity for one hour on a 0.25 m2 plot to properly determine the time to ponding, the time to runoff, and runoff and sediment discharge. The results show that the soils of the Control (CON) and chipped pruned branches mulch-covered ones (BRA) are similar in grain size, organic matter, water content, and bulk density. However, the cover increased in the BRA ones due to the mulch created by the chopped branches. The ponding, runoff initiation, and runoff outlet were faster in the CON plots (49’; 96’; 133’) than in the BRA plots (104’; 242’; 458’), respectively. Runoff discharge also found large differences: 72% versus 44 % for the CON and BRA plots, on average. Runoff concentration was 9.2 and 5.9 g l-1, Sediment delivery 112.43 and 33.38 g, and soil erosion 2.22 and 0.55 Mg ha-1 h-1, respectively for CON and BRA plots. The use of chipped pruned branches as mulch caused a sudden decrease in runoff and soil losses, increase soil moisture, and reduced soil erodibility due to the cover of the litter. The use of chipped pruned branches contributes to an immediate soil and water loss reduction which is due to the mulch effect.

Keywords: Spain, olive, Runoff, Soil Erosion, Rainfall Simulators

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Fire in the Earth System Abstracts
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Fire against chipped pruned branches mulches in olive orchards. Their effect on soil hydrology

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Abstract

Soil and water losses resulting from conventional citrus plantations are often considered non-sustainable due to the high rates of soil degradation. To achieve sustainability and land degradation neutrality in citrus production new strategies should be developed to avoid non-sustainable soil and water losses. The use of chipped pruned branches as mulch is evaluated here as an alternative option to traditional burning carried out by farmers. We selected two paired plots under Glyphosate treatment for 30 years, with bare soils (no weeds or catch crops), in the control plot the branches were burnt (CON), meanwhile on the chipped pruned branches plot were chopped as a mulch (BRA). The pruning was done on March 30th, 2019, and the pruned branches were collected and chopped in a nearby field (30 m). After July 21st a set of 25 paired plots (50 plots) were established in the field with plots covered with chopped pruned branches (CON) and bare (CON). The amount of mulch applied was 125.9±30.9 g m-2 of chipped pruned branches. We used a rainfall simulator at 55 mm h-1 rainfall intensity for one hour on a 0.25 m2 plot to properly determine the time to ponding, the time to runoff, and runoff and sediment discharge. The results show that the soils of the Control (CON) and chipped pruned branches mulch-covered ones (BRA) are similar in grain size, organic matter, water content, and bulk density. However, the cover increased in the BRA ones due to the mulch created by the chopped branches. The ponding, runoff initiation, and runoff outlet were faster in the CON plots (49’; 96’; 133’) than in the BRA plots (104’; 242’; 458’), respectively. Runoff discharge also found large differences: 72% versus 44 % for the CON and BRA plots, on average. Runoff concentration was 9.2 and 5.9 g l-1, Sediment delivery 112.43 and 33.38 g, and soil erosion 2.22 and 0.55 Mg ha-1 h-1, respectively for CON and BRA plots. The use of chipped pruned branches as mulch caused a sudden decrease in runoff and soil losses, increase soil moisture, and reduced soil erodibility due to the cover of the litter. The use of chipped pruned branches contributes to an immediate soil and water loss reduction which is due to the mulch effect.

Keywords: Spain, olive, Runoff, Soil Erosion, Rainfall Simulators

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Wooden construction, supply difficulties due to the loss of forest mass due to forest fires, among other causes

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Abstract

In Chile, programs are promoted to strengthen the use of wood in construction and reduce carbon dioxide emissions in the construction sector. Forests, planted and natural, help reduce atmospheric carbon, although the data still doesn't allow adjusting a model of use vs. conservation to maintain the balance, since it underlies the fact that, in the face of the inability of state control and of the owners, the forests are exposed to forest fires with high intentionality as the cause, burning the vegetation to use the soil for other purposes or to sell it as firewood, so the purpose of conservation is lost. The owners of mostly certified plantations manage sustainable harvests, adjusting their planting rates to their needs, supplying the industrial wood sector, mainly with radiata pine for the sawmill industry, which in turn supplies wood remanufacturing and engineering (cross-laminated, plywood, reticulated, laminated), strengthening the availability of products for wood construction. The supply is in uncertainty scenario because the forestry sector is not growing at the speed it had. The study measured citizen perception and expert panel from a region affected by forest fires, consulting them regarding:-substitution of steel and concrete by wood to reduce emissions associated with manufacturing, transportation, installation and reuse of construction materials, -plantations and native for structural use in the construction sector, -greater use of wood products as a climate solution, -greater area of native forest to increase carbon reserves, -planted forests for industrial use and/or integration of native forests, - such as stopping deforestation (COP26 agreement) and, -current legislation for forest fires, -perception native stocks and plantations loss for fires and, -social and environmental benefits that forests satisfy. It is a complex socio-ecological scenario, this joint analysis methodology (citizens and experts) allowed a better understanding that the population focuses its responses on perceptions rather than knowledge, associating forest fires with climate change, since they do not know how to maintain the balance between resources and needs and the expert panel recommends that it is the duty of the State, academic and private actors to improve the understanding and adaptation of all for a sustainable industrial development, avoiding excesses, abuses, but also providing the assurances so that they continue to operate and grow to satisfy the "better with wood" needs of the population.

Keywords: wood construction, forest fires, decarbonization, sustainable forest management, forest plantations

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Fire in the Earth System Abstracts
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Human perceptions of fire expressed through the arts: a science centre’s journey (so far) of the art-science interface

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Abstract

There is no one way of understanding anything – this is particularly true for wildfires, with their complex interactions between bio-physical and socio-economic, cultural and political dimensions. We can learn more, and can make greater difference, by bringing those different scientific disciplines together. This logic also applies to bridging science with arts and humanities. Through art and creative approaches we can share diverse voices, especially of those not in the academic world, and do so in a way which connects with people in novel and often profound ways. The Leverhulme Centre for Wildfires, Environment and Society is a globally-focused, scientific research centre which is engaging with the arts and artists to explore and share diverse perceptions of wildfires. In this talk, we will share what we have achieved and learnt so far, working in collaboration with Arts Cabinet, a research platform that functions as a space to experiment with different forms of artistic knowledge production. This includes: (i) our work and editorials connecting artists and scientists - including ‘Seeing Fire: Perspectives Through Art and Science’ and ‘Wildfires (Working Title)’; (ii) our work with Torres Strait Islander artist, Clinton Naina, in collaboration with University of Melbourne and Science Gallery London, and his piece ‘Stolen Climate’, exploring colonisation, country, climate and fire in Australia; and (iii) our collaboration with Kenyan artist Shadrack Musyoki and Strathmore University (Nairobi), including participatory murals on fire and climate justice. The talk will reflect on the opportunities, challenges, and different ways in which art and science can connect, and its potential role for improving our understanding of wildfires.

Keywords: culture, art, interdisciplinarity, perceptions

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Spatiotemporal trends in burn severity in the last two decades for mainland Portugal

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Abstract

Wildfires can pose severe threats to human lives and assets as well as to biodiversity on a global scale. Due to climate, land-use changes, and often inadequate forest management, wildfire regimes are also in transition. In particular, increasing fire severity causes slower post-fire recovery times and depletion in the resistance and resilience of ecosystems.
Satellite remote sensing (SRS) Earth Observations (EO) allow us to characterize the ecological impacts of wildfires and assess spatiotemporal trends in fire severity. The SeverusPT project is currently pursuing the objective of harnessing SRS/EO time series to characterize wildfire severity. Our primary objectives of this exploratory research paper are two-fold: (i) assess national and regional spatiotemporal trends in fire severity and burnt area, and (ii) evaluate if fire severity regionally scales up with the total burnt area.
Satellite image time series (SITS) were obtained to calculate fire severity through the Normalized Burn Ratio (NBR) and the difference between pre- and post-fire (ΔNBR). Trend analyses were employed to quantify fire severity and burned area spatiotemporal patterns. Linear regression assessed the association between total burnt area by year/region (predictor) and fire severity (response).
Preliminary results show that at a national level, from 2001 until ca. 2008 - 2009 there was a general decrease in fire severity, followed by a reversal of this trend. This turning point has led to a general increase, with new severity highs formed in 2017 and 2020. We also found wide variation in fire severity at the regional level (NUTS-III), and trend

analysis displayed that most regions increased both in burned area and severity.
Linear regression showed that burned area and fire severity are correlated despite this association being highly structured at the regional level, forming a continuous spectrum from highly area-severity coupled regions (e.g., AM Porto, Médio Tejo, Viseu, Coimbra, Alto-Minho) to less coupled ones (e.g., Cávado, Trás-os-Montes, Alentejo). These results may support that the increasing amount and size of the burnt area will scale up into higher fire severity for specific regions.
These preliminary results show that satellite image time series allow assessing the spatial variation and the temporal trends of fire severity in a standardized fashion. Mapping fire severity, its spatiotemporal variation and addressing its environmental drivers are now more crucial than ever to understand its dynamics and support fire management and prevention.

Keywords: Fire severity, Burnt area, Spatiotemporal trends, Remote Sensing, Earth Observation

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Fire in the Earth System Abstracts
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EFFECTS OF THE SIERRA BERMEJA WILDFIRE OF 2021 ON SOIL PROPERTIES AND VEGETATION COVER

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Abstract

Sierra Bermeja is one of the most environmentally diverse Mediterranean mountains and one of the most important ultramafic outcrops in the world. Thus, the aim of this work is to analyse the short-term evolution of the area affected by the Sierra Bermeja forest fire (province of Malaga), in order to demonstrate how the regeneration and recovery of this ecosystem, which is key to the management of its territory, is progressing. The fire burned 8,401 hectares, making it one of the most devastating fires in the province in decades. It affected approximately 28% of the area of Sierra Bermeja. Spatial remote sensing techniques, field work, sampling and a search for the main eco-geomorphological characteristics (vegetation and soils) of the study area have been used. The results show that: i) moderate-high and high severity occupies about 57% of the burned area, which has caused serious environmental problems in core sectors ii) however, certain areas have experienced remarkable recoveries, especially in scrubland environments, and iii) the fire caused significant changes in certain soil properties, e.g. structural stability and organic matter.

Keywords: Forest fire, soil, vegetation cover recovery, Sierra Bermeja.

Acknowledgments: This study is part of the work carried out in the research project called "Environmental Climate Change and Biodiversity Laboratory (Lifewatch EnBi2Lab)" (LW-2019-UMA-01-SU), being co-financed by the European Union and the University of Malaga through the European Regional Development Funds (ERDF), through the call of the Ministry of Economy, Industry and Competitiveness.

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FRISCO: Assessing and managing post-fire risk of water quality contamination

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Abstract

Fires can change vegetation cover and soil properties, often enhancing surface runoff and sediment transport processes. The ash produced by these fires can also be mobilized and contaminate downstream water bodies with fine sediments, heavy metals, nutrients, and organic carbons. Moreover, mobilized ashes can deposit in streams and reservoir beds and be resuspended for years after the fire, prolonging the disruption of urban supplies in time. Forest and water managers can take some steps to manage these risks, including preventive forest management planning and contingency planning for emergency interventions in the burnt areas themselves and at the treatment plants. However, the variables to quantify these risks are generally poorly quantified in most fire-prone watersheds. Fire regimes might be known, but the relationships between fire characteristics and impacts on water quality are difficult to assess without good datasets, and the costs and benefits of different mitigation approaches are usually not well understood. To further complicate matters, the fire impacts on hydrology and sediment processes tend to vary significantly across climatic regions, making it difficult to transfer knowledge. This presentation will provide an overview of the issues surrounding the assessment of the post-fire risk of water quality contamination. It will also provide an example on how this is being done in Portugal, through project FRISCO: Managing Fire-Induced Risks of Water Quality Contamination (FCT, ref. PCIF/MPG/0044/2018). The project, now in its fourth and final year, has (i) determined the most important fire and post-fire conditions leading to fire-induced water contamination events, through a detailed analysis of a 20-year water quality dataset for over a hundred water supply reservoirs, linked with a concurrent atlas of fire severity; (ii) developed, together with water managers, a risk assessment index that can be used after a fire to inform managers on the need for further action; and (iii) is assessing multiple post-fire intervention options, from the biophysical and socioeconomic perspectives, to help inform managers on which actions they can take to address the issue. This project provides a blueprint for how these issues might be addressed by water managers in other fire-prone watersheds.

Keywords: water contamination, post-fire risk, sediment connectivity, water management

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ASH-DERIVED EFFECTS ON SOIL PARTICULATE ORGANIC MATTER AND NUTRIENTS FOLLOWING EXPERIMENTAL FIRE

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Abstract

After fires, the ground is covered by ash, which is important to the postfire environment because of its effect on hydrological behavior and its fertilizing properties. Ash-derived effects are difficult to assess in the field but can be measured by experimental burns in the laboratory. In this study, we analyzed the ash effects on soil organic matter (SOM) with focus on particulate organic matter (POM) after a laboratory burn intended to reproduce the conditions of prescribed burning as conducted in the southern Pyrenees (Spain). POM is a SOM fraction consisting of partially decomposed plant debris that is abundant in mountain soils and susceptible to both thermal and microbial degradation. Twenty-five undisturbed soil blocks were collected in a grassland encroached by the shrub *Echinospartum horridum* and managed by prescribed fire in Yebra de Basa (Huesca). Soil blocks were covered with plant material equal in amount and type to that observed in the field and were then subjected to different burning treatments (of short or long duration with low or high Intensity vs. control) using a blowtorch in an external combustion tunnel. Part of the blocks was separated for the analysis of immediate fire effects. For the other blocks, the ash cover was removed from one half of them and all were kept in a greenhouse irrigated daily for 5 months. Blocks were layered at 0-1 and 1-3 cm depths for analysis. Bulk soil was analyzed for total SOM and N and plant-available (Olsen) P. POM was separated by chemical dispersion and sieving and density fractionation using a $ZnCl_2$-sucrose solution (density of 1.6 g/cm^3). POM was quantified and analyzed for its fiber composition (by Van Soest method) and contents of major nutrients (N, P and K). The concentrations of nonparticulate organic matter (NPOM) and N were calculated. Burning produced immediate losses of up to 70% of SOM at 0-1 cm that came in similar proportions from POM and NPOM despite POM was less abundant than NPOM in soil before fire. Burning altered the POM composition, removing cellulose, hemicellulose and nonstructural components thus leaving more refractory lignin-type components. These changes reverted after 5 months in soils devoid of ash, but were still

apparent in ash-covered soils. Severe burning also produced an enrichment of the remaining POM in P and K and an increase in Olsen-P after 5 months. Our results suggest an intense POM mineralization after fire enhanced by the nutrients in ash.

Keywords: soil organic matter, prescribed fire, pastoral burns, laboratory burns

Fire in the Earth System Abstracts
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Influence of the intensity of the forest fire and the effects on the properties of the soil, the case of Sierra Mijas (Málaga)

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Abstract

Fire is one of the main destroyers of forest areas in Mediterranean ecosystems, characterized by highly irregular rainfall, with mild temperatures, exchanging dry seasons with warm ones, with which susceptibility to forest fires increases, due to to the dry vegetation in summer, together with its pyrophilic nature, and the appearance of torrential rains from the dry season, eroding large amounts of soil, soils that are more fragile if they have been subjected to combustion, in such a way way, such as nutrient flushing. In the present study we take as a reference the short-term effects on the soils as a consequence of the forest fire of July 2022 in Sierra Mijas, with which we have been able to determine its incidence through various factors such as lithology, topography, vegetation, land use, intensity and severity of the fire.
For this, an analysis of the affected area has been carried out, since it is essential to understand the effectiveness of post-fire management treatments and to identify the most positive practices in each area. The example studied in this work puts an essential aspect, which is the result of the interaction of physical-natural and human factors, and cannot be understood without paying attention to the territorial impact of fire.
Fire radically transforms the visual aspect of the landscape and the different aspects that make up the eco-geomorphological system. The elimination of the vegetal cover leads it to a rexistatic state, which is also exacerbated by the post-fire management of the burned area, without taking into account, not only aspects related to the hydro-geomorphological dynamics and its direct consequences, but with the visual quality of the landscape and its recovery in the post-fire situation, which could also be a determining factor in the local economic scale. As conclusions we can highlight how the stability of aggregates has decreased in the samples analyzed, causing a considerable fragility of the soil against erosion. In addition, superficial crusts have appeared, which have caused conditioning in the face of water infiltration processes and, therefore, have modified the hydrological dynamics of the soil. This work represents a first approximation in the analysis of the eco-geomorphological dynamics in a Mediterranean area recently affected by a forest fire.

Keywords: Fire, Soil, Ecosystems, Mediterranean

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Post-fire forest recovery in the framework of precision restoration: what to do and what not to do.

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Abstract

Post-fire forest management usually seeks to recover the original –or another kind of– forest. To accomplish this objective, it is common to use a very interventionist perspective, in which a high intensity of management and, often, the overwhelming use of technology and power measured in terms of heavy machinery prevail. During these activities, removal of burnt wood (salvage logging) is a common practice, which in the end may imply additional disturbances to the system. Moreover, a common end result is the massive planting of trees to generate a dense forest as quickly as possible. Here, I advocate for the use of a different perspective in which the main objective is to promote the natural dynamics of the ecosystem, reducing the cost and the impact of management while increasing its success and efficiency. This falls within what we proposed as "precision forest restoration", a process in which the focus is to ensure that most of the seeds or seedlings used in the restoration can become adult trees by taking advantage of ecological processes. In the context of post-fire forest recovery, more attention should be paid to positive ecological interactions such as seed dispersal, negative plant interactions such as herbivory or seed predation, and the role of post-fire biological legacies (e.g., burnt wood) as elements that promote forest recovery by modifying the microclimate, providing essential nutrients in the long term, or protecting against herbivory. A post-fire precision forest restoration approach may use very low-technology approaches as well as cutting-edge advances such as a precise aerial drone seeding or even artificial intelligence, but, in any case, it should minimize further impacts in the ecosystem. In this regard, what we should not do is keep the current strategies of massive post-fire salvage logging, massive tree planting, or the construction of erosion barriers as they are currently done.

Keywords: post-fire salvage logging, forest restoration, precision restoration, compound disturbances

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Towards a Resilient Role Reporting: Farmers, the Rural and Wildfires' Journalistic Narratives in Spain

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Abstract

Forest fires are often initiated around rural areas and sometimes caused by the works of farmers and agricultural machinery. This paper discusses the role that farmers and rural dwellers play in the media reporting of wildfires. Reporters inform from these areas, interview people, and gathering footage and information that is processed and ensembled in journalistic storytelling. In this task, they apply news-values like material and human affectation, updated information on the episode, causes and consequences, political reactions, under a rational to elaborate an attractive story to the audience. Sometimes they get this using strong statements, spectacular footage, and human-interest stories, that can activate dramatic views. This research argues that in recent years we face a change of the role of farmers and rural residents that switched from being framed as a cause/problem to being depicted as active/solution agent. However, the paper criticizes that this change is still being built under the logics of extinction and suppression. The study argues that the roles of extinction of the rural population, or suppressionist, under the logics of emergency, bring the role of rural dwellers and farmers to both, the active -when contributing to the extinction works- or passive -under dramatic accounts and their victimization-. The case studied a purposive selection of images, language and reporting narratives with a special focus on the cases of Santa Coloma de Queralt (2021) and Castelló-Teruel (2023). Considering previous research (Castelló 2023; Plana 2011) and guidelines on the topic (Plana, Font, and Serra 2016), the paper proposes to better integrate the role of the rural population in journalistic coverage through the proposal of what the author labels Resilient Role Reporting (RRR) in which the population is recharged with agency. Some examples of extensive livestock coverage or valorization of small farms integrated into the landscapes close to forest areas are given. The study proposes diverse forms of adding agency to the rural dwellers in the journalistic stories, so the rural actor becomes part of the solution in the stories in a mid-term basis. In this way, it is proposed to accentuate the valorization of the "new rurality" initiatives as a resilient-action and management of forests.

Keywords: resilient role reporting, wildfire media coverage, risk communication, rural communities, farmers, journalism

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Wine producers as landscape wildfire stewards against wildfire

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Abstract

Wildfires represent a recurrent threat to Mediterranean forests. Agricultural parcels amidst the forested landscape constitute a key fuel discontinuity, which is a crucial infrastructure for the fire responders to attack with security, and/or to modify the wildfire spread behaviour. Maintaining those fields active constitute a security service to parts of the landscape (WUI-homes, parcels of forests). Yet, northern Mediterranean (particularly mountain) agriculture is progressively being abandoned, thus increasing forest continuity and consequently the risk of larger wildfires. The abandonment of agricultural land is accelerating because of the ageing of the farming population and the small size of the new projects of Neo-rural population. Then we have been able to observe during 21st century a deep change in agriculture social and physical landscape that will go on evolving these 20 next years.
The vision of those agriculture producers on wildfires is hence crucial to activate fire-resilient landscape management. Our exploratory study is based on in-depth interviews and field visits to wine-producers in Mediterranean Spain, Portugal and France, turning around 3 main questions: Which are the productive factors of vineyard managers and wine producers that relate to wildfire risk/ Which are their concerns? Are them interested in engaging in fire- reduction measures? What is the existing support of administrations in this field/ Is it necessary to improve it and how? We will present part of the results we obtained from these interviews. On the same line, a survey has been spread in late April in four countries (Spain, Portugal, Italy and France) and some analysis could be presented in July.

Keywords: wildfire, fire risk, wine sector, landscape resiliency

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Going beyond communicating about risk: Learning from community-led wildfire initiatives

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Abstract

In present times of Global Change, there are increasingly extreme wildfires despite fire suppression efforts, entailing disaster and socioenvironmental injustices. In response, there is a need for alternative approaches to address and engage with wildfires. But not only that: it is time to critically review present risk communication practices, and question whether the ways we communicate about wildfires are still up to current challenges. This is particularly urgent for rural communities, who are often impacted first and hardest by wildfires.
Now, the Wildfire Suppression Paradigm has - up to date - greatly informed the field of Wildfire Risk Communication. That is, by taking an approach that is predominantly focused on the risk dimension of wildfires, whereby generic, expert-driven messages are conveyed towards the public, to nudge these towards certain risk reduction behaviours. Yet, given the increasing impacts of extreme wildfires on our socioenvironmental systems, such a communicative approach has shown to be limited. Not only in preventing and mitigating wildfires, but also in addressing the underlying causes of disaster, and by excluding the voices and knowledges of many, such as those who have for generations lived with fire in rural areas.
Therefore, we need to go beyond focusing only on wildfire risk, and instead recognise wildfires as inherently part of our socioecological systems, and long-term, complex processes that occasionally become visible through flame and smoke. This calls for taking more inclusive, locally embedded, and participatory approaches to communicating about wildfires. Through my research with a community-led wildfire initiative – Pego Viu in SE Spain – we can learn about communicating in such ways. By responding to local needs and interests, acknowledging people's knowledges and experiences, and collaboratively co-constructing ways forward, these initiatives address critical aspects often overlooked in conventional Wildfire Risk Communication practices. To finalise, we conclude that it is only by truly engaging and communicating with communities that we will be able to face the challenges of our times.

Keywords: Risk Communication, Community-Led Communication, Wildfire Communication, Local and Rural Knowledges, Community Engagement.

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WildFireSat: The Canadian Operational Mission

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Abstract

The Government of Canada has committed to delivering the WildFireSat operational satellite mission, to be launched in 2029. The mission aims to adapt fire monitoring science to deliver the world's first dedicated operational wildfire monitoring satellite mission. WildFireSat is designed with a uniquely Canadian solution to address critical gaps in satellite fire monitoring for Canada's diverse geography, and to primarily address the needs of wildfire and smoke management. This presentation provides a summary of the system design, the concept of operations, alignment with existing systems, value-added data products, data delivery systems, and knowledge exchange strategy. The mission will deliver comprehensive situational awareness to wildfire managers and decision-makers in near-real-time, support smoke and air quality forecast services and carbon emission estimates.

Keywords: wildfire, fire monitoring, mapping, thermal infrared, wildfire management, carbon emission reporting, air quality forecasting, smoke forecasting, data services, earth observation, satellite, remote sensing

Fire in the Earth System Abstracts
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Creation and implementation of a decision-making tool focused on the automation, scaling, updating and dissemination of information related to variables that affect the risk and behaviour of fire.

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Abstract

Since 2017, the CETEMAS Foundation has collaborated with the Regional Department of the Environment and Land Management of Asturias (Forestry Service) and the Regional Department of the Presidency (SEPA; Emergency Service of the Principality of Asturias), in the development of tools based on the use of remote sensors to semi-automatically generate and update cartography related to variables that describe existing forest fuels in Asturias. Within the framework of the European Interreg-Sudoe Project called PLURIFOR (2016-2019), a municipality-scale methodology was developed in order to obtain an “information window” (25-metre grid) related to variables which have a strong influence on the risk and behaviour of forest fires (Sánchez García et al., 2019): information from the National Forest Map of Spain (MFE) (DGDRPF, 2012), LiDAR data from the National Aerial Photogrammetry Plan (LiDAR-PNOA, 2015) and the Galician Fuel Model Photoguide (Arellano et al., 2017).

Continuing from this, with the aim of generating products and offering geospatial services that facilitate decision-making policies/strategies in forest fire prevention and extinction tasks, work is being carried out to configurate a tool to generate cartography on a regional scale, focusing on its automation and scaling, as well as improving the reliability, access and management of data for practical use. With respect to reliability, among the aspects to be addressed is the need to minimize the existing dependence on the update periods of the data sources.

This work will present the latest developments addressed:

- Automation, scaling, updating, and dissemination of the results through a process execution model and the construction of an open data medium that can be consulted and/or exploited through an entity’s own Spatial Data Infrastructure (SDI), therefore providing a channel to facilitate the management of spatial data, metadata and visualization services.

- Creation of an update tool which works by detecting changes in vegetation cover

through satellite images, and its validation for different scales of analysis (regional and local) and data sources (Sentinel2 and SPOT7).

Keywords: Forest fires, spatial data, LiDAR, Sentinel2, SPOT7

Fire in the Earth System Abstracts
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A method to evaluate the probability of lightning causing wildfires

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Abstract

Finding the lightning event that ignited a natural wildfire is not a trivial task. Several factors, such as data inaccuracies, the possible long duration of the holdover time phenomenon (i.e., the time between lightning-induced fire ignition and fire detection) of lightning-ignited wildfires (LIWs), and the potential large number of lightning events surrounding the location at which the LIW was discovered, complicate the match between lightning and wildfire data. Therefore, usually it is not possible to distinguish unambiguously the lightning strike that ignited a wildfire and so several lightning events may be identified as possible candidates for the ignition source (Moris et al., 2023). Current methods to select lightning causing LIWs are relatively simple and apply some parameters, such as a buffer area centred at the wildfire discovery point to account for location errors of both lightning and wildfires, and a temporal window backwards in time from the wildfire discovery time to account for holdover time (Moris et al., 2020). A selection criterion may then be applied to select a single lightning event that may have ignited the wildfire. However, these methods tend to ignore two issues: (1) the location accuracy data of each single lightning event (i.e., error or confidence ellipses) provided by ground-based lightning locations systems; and (2) the relative frequencies of holdover time (i.e., probability distributions that fit well empirical data on holdover time). Here, we present a new method to evaluate the probability of lightning causing wildfires. This method combines two probabilities. First, a spatial probability of lightning events attaching an area of interest centred at wildfire discovery points. This spatial probability is based on previous work (e.g., Hugh et al., 2017) and has been adapted to fit data on LIWs. Second, a temporal probability using distributions of holdover time built with data from a global database of holdover time (Moris et al., 2022). This temporal probability indicates the probability of reaching a certain holdover duration. The new method can be used to answer two types of questions: (1) what is the probability that a wildfire was caused by lightning?; and (2) what is the most likely lightning event that caused a certain LIW?

Keywords: natural wildfires, lightning, spatial accuracy, holdover time, probability

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Risk analysis and mapping for wildfire management in the Aegean Islands of Greece

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Abstract

Over the years, civil protection agencies have been calling for a deeper integration of information technology and wildfire management that can assist managers in making informed decisions at every stage of wildfire response and mitigation. We present a system called fireAEGIS (in the framework of the project AEGIS+) that was designed as a decision support system for the islands of the Aegean Archipelago in Greece. fireAEGIS combines real-time data integration, predictive modeling, risk assessment, decision optimization, mobile accessibility, historical data analysis, training resources, system integration and continuous improvement to empower wildfire management teams with the necessary tools and information for effective decision-making and response to wildfires. System architecture is founded on a WebGIS interface, accessible through both mobile devices and web browsers. fireAEGIS can gather and integrate real-time data from various sources, including weather stations, live cameras and ground sensors, providing unimpeded and free access to the recorded data archive. The historical data analysis module stores and analyzes historical wildfire, enabling decision-makers to identify trends, patterns and lessons learned from past events. Wildfire history has been produced from analyzing all the available satellite images from the Google Earth Engine since 1980, using algorithms that map fire severity and enable perimeter delineation. This knowledge can inform decision-making processes, such as resource allocation, prevention strategies and post-fire recovery efforts, through the ArcGIS Operational Dashboard interface. The system can also employ advanced predictive modeling techniques and simulation tools to forecast the behavior and spread of wildfires, utilizing the Minimum Travel Time Algorithm under different weather conditions over a web interface that requires minimum inputs from the end-users. Inputs include fire duration, ignition point, fuel moisture scenario, preferred weather station to retrieve the latest recorded wind speed and direction, or manually provide them. Users can also access and retrieve the spatial outputs from their past simulations. Finally, the WebGIS component provides risk analysis and mapping capabilities that help prioritize resources and actions for effective fire response and evacuation planning. Users can assess datasets or create web maps of the potential risks posed by wildfires to different areas, including residential zones, infrastructure, natural resources and wildlife habitats. All modules that comprise fireAEGIS were requested by the engaged stakeholders of the region, and their integration and interplay allow for seamless data access, enhanced situational awareness

and streamlined coordination among different agencies. The system is accessible at http://aegisplusrisk.aegean.gr/.

Keywords: fire behavior modelling, decision support system, weather monitoring, AEGIS+, WebGIS

Acknowledgments: Project “Coastal Environment Observatory and Risk Management in Island Regions AEGIS+” (MIS 5047038), implemented within the Operational Programme “Competitiveness, Entrepreneurship and Innovation” (NSRF 2014-2020), co-financed by the Hellenic Government (Ministry of Development and Investments) and the European Union (European Regional Development Fund).

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Optimizing Fire Severity Mapping using the Image Compositing Technique: An Assessment of the Effects of the Compositing Period and the Reducing Statistical Method on Fire Severity Signal.

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Abstract

Fire severity is an important component of the fire regime as it accounts for the immediate and long-term effects of fire on the ecosystems. Remote sensing data and the image compositing technique allow the assessment of fire effects over large regions through time by generating spectral fire severity composites. However, the accuracy of these composites is influenced by different parameters including the compositing period used to filter pre-and post-fire images such as the lag timing (time elapsed since the fire) and seasonal timing (season of the year) as well as the reducing statistical method used to combine all pixels into a single image. In this study, we have evaluated the effect of these parameters on the severity signal measured by the Relativized Burnt Ratio (RBR), derived from Landsat using the Google Earth Engine (GEE) platform. Specifically, we focused on determining the optimal combination of these parameters to generate severity composites that accurately differentiate between burned and unburned areas, better correlate with field measures of severity (Composite Burned Index – CBI), and cover the entire study region. We generated different severity composites using various compositing periods and statistical methods in several fires (n = 1,466 from 1985-2017) within a large Mediterranean area of Central-Spain, as well as in their surrounding unburned areas. The compositing period included the lag timing (initial assessment: year of fire; and extended assessment: year after the fire) and the seasonal timing (with or without seasonal changes between pre-and post-fire images). The statistical methods used were Mean, Median, Medoid and Quality-mosaic (Min-Max). The effect of these parameters on RBR values was determined by ANOVA and post-hoc tests, and the intra-annual variability of RBR values was assessed using the Mann-Kendall test. Finally, the correlation between each severity composite and CBI was estimated for two large fires in Eastern-Spain (Guadalajara [n = 73] and Yeste [n = 32]) using second-order polynomial regression models. The initial assessment during the same seasonal timing of the pre-and post-fire composites (pre: summer; post: summer), in combination with the Quality mosaic better-detected fire severity signal and differentiated between burned and unburned areas in this Mediterranean area. These severity composites also showed the strongest fit with CBI (R2 = 0.80; 0.61 for Yeste and Guadalajara, respectively) and the highest spatiotemporal coverage. This study provides valuable insights for optimizing fire

severity mapping across large areas through time, using the image compositing technique in a semi-automatic manner.

Keywords: Fire severity mapping, image compositing, RBR, initial and extended assessment, central tendency and range statistics, seasonality, Google Earth Engine

Fire in the Earth System Abstracts
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Wildfire hazard and social vulnerability on evacuation decision: Methodological proposal applied to municipalities of Central Portugal

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Abstract

The development of prevention and adaptation actions is extremely important in a forest fire scenario, in order to minimise the loss of goods and people. Several professionals argue that the safest action that residents can take when threatened by a forest fire is evacuation. Thus, evacuation risk assessment may be decisive in saving human lives and preventing injuries, since it provides civil protection agents with important tools and data for the development of effective evacuation strategies. For instance, it allows considering the different social groups that may be more or less vulnerable and, on the other hand, positioning the combat means in areas more or less susceptible to fire.
This study aims, based on (i) the evaluation of the fire hazard, obtained from biophysical variables, and (ii) the social vulnerability, determined from socio-demographic variables, (iii) to identify the villages with a higher risk of evacuation and rescue in the municipalities of Lousã and Sertã (Central Portugal). The analysis of social vulnerability to evacuation is based on 4 distinct approaches: i) population and structure, ii) differentiated access to resources iii) population with special evacuation needs, and iv) all the previous components.
The results obtained show that more than 70% of the two municipalities present a high and very high fire hazard. Regarding social vulnerability, the results enable the identification of the settlements considered most vulnerable to evacuation. In the case of Lousã municipality, it includes the populations located to the southwest, in the parishes of Gândaras and the parish union of Lousã and Vilarinho, while in Sertã, the most vulnerable settlements appear in a scattered way throughout the municipal territory. When assessing the evacuation risk, resulting from the product of Hazard X Social Vulnerability, the model identified the most problematic settlements, located in physical spaces highly susceptible to the occurrence of forest fires (surrounded by highly combustible species) and with the prevalence of an aging population.

Keywords: Wildfire, vulnerability, susceptibility, evacuation, Central Portugal

Acknowledgments: The research team gratefully acknowledge the Portuguese Foundation for

Science and Technology (FCT) for its support under the framework of the research project PCIFIAGT/0061/2019 -EVACUARFLORESTA - Decisões e Planos de Evacuação em Cenários de incêndio Florestal, financed by FCT through National funds.

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Digital Mapping Burn Severity in Agricultural and Forestry Land over a Half-Decade Using Sentinel Satellite Images on the Google Earth Engine Platform: A Case Study in Isparta Province

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Abstract

Fires have significant impacts on vegetation and ecosystems globally, with varying intensity depending on the severity and duration of the fires. The Difference Normalized Burn Ratio (dNBR) is a powerful tool for assessing burn severity in agricultural and forested areas and is commonly used to measure and predict the extent of fire-affected regions. This study utilizes the Google Earth Engine platform, enabling efficient large-scale spatial analysis. By leveraging Sentinel-2 satellite imagery and code developed on the Google Earth Engine platform, the aim is to evaluate the burn severity over five years (2018-2022) relative to 2017 and assess the fire impacts on land cover. Spatial analysis was conducted using the dNBR index calculated from images captured in August, representing the peak fire season. The burn severity is classified into four levels: "Low," "Moderate-Low," "Moderate-High," and "High" severity classes, providing insights into the changes over the five years. In the Isparta Province, the burned areas are measured as follows: 505 km², 230 km², 287 km², 409 km², and 1672 km² in the "Low" severity class; 27 km², 28 km², 32 km², 46 km², and 217 km² in the "Moderate-Low" severity class; 14 km², 13 km², 15 km², 18 km², and 36 km² in the "Moderate-High" severity class; and 7 km², 4 km², 5 km², 5 km², and 4 km² in the "High" severity class. The results indicated an increase in burn severity in the "Low," "Moderate-Low," and "Moderate-High" classes compared to 2017, while minimal changes are observed in the "High" severity class within agricultural and forested areas. These findings suggest that burn severity in agricultural and forested regions within the study area undergoes changes influenced by global climate change, variations in fire frequency, and size. Notably, agricultural areas show a more significant increase in burn severity class spatial size compared to forested areas. Assessing the long-term impact of fire-induced land cover changes is crucial for effective fire management and ecosystem preservation. This study showcases the potential of open-source platforms for swift, user-friendly, and sustainable management of fire-affected areas. Furthermore, future advancements are expected by utilizing more comprehensive data sources and developing enhanced analysis methods.

Keywords: Burn Severity Index, Sentinel-2, Google Earth Engine, Agriculture land, Forestry land

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Modelling the linkages between structural fire risk and fire impacts in forest areas: the case of Águeda catchment

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Abstract

Erosion and sediment connectivity are key processes to determine sediment transport and delivery to downstream water bodies. These crucial processes are also impacted and often enhanced by wildfires. To our knowledge, there are no studies that explicitly model the combination between structural fire risk, post-fire erosion risk and sediment connectivity, particularly in forest areas. In this study, we couple in-stream aquatic sensing, three approaches of risk assessment already tested for Águeda catchment, namely, the Structural fire risk (SFR), the Morgan–Morgan–Finney erosion model (MMF), and, the Index of Connectivity (IC), using Monte Carlo uncertainty analysis, to generate a new Fire Risk-Erosion-Sediment Connectivity Mapping (FESCM) framework. We then evaluate the predictor variables associated with FESCM using the algorithm Random Forest. FESCM was mapped using five classes to be aligned to the Portuguese law and the results indicate that the most important predictor variable was the vegetation. This study provides a method for combining SFR, MMF and IC in a new tool (FESCM) to identify spatial patterns in fire risk and erosion-sediment-connectivity to aid in the understanding and management of watershed sedimentation.

Keywords: Structural fire risk, post-fire erosion risk, sediment connectivity, MMF, IC

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Assessing the social and biophysical conditions that define pyroregions in mainland Portugal

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Abstract

Wildfires occur unevenly in the territory, driven by different biophysical and social factors. Understanding the spatiotemporal distribution of wildfires can help identifying common characteristics and/or dissimilarities between regions. In this research, we use specific fire metrics, from historical fire data from 2000 to 2021, to explore the possibility to identify groups of municipalities based on their pyrosimilarities. We employed four different clustering models to identify and compare groups of municipalities (pyroregions) in mainland Portugal. We calculated different fire metrics, namely cumulative percentage of total burned area (BA), cumulative percentage of BA during summer months, mean annual number of fires, and the GINI index for BA over time. We used GIS and programming with R software to apply the methodological procedure using the several clustering methods. Afterwards, by combining the outcomes of the four methods using majority placement, we established a unified classification for the pyroregions in Portugal. Additionally, a redundancy analysis (RDA) was conducted to identify the biophysical and social factors influencing these fire patterns. The first results categorized the country into four clusters, with 77% of the municipalities being consistently assigned to the same group across different methods. ClusterA (CL-A), located in central Portugal, had the highest percentage of cumulative BA but a low average number of fire occurrences. CL-B, which covers the municipalities in the northwest, had the highest average number of dispersed fires. CL-C, disperse for all Portugal, had the second highest average number of fire occurrences, primarily outside the summer season. CL-D stretches along the west coast, south and centre of the country, had generally lower values for all metrics except the Gini index, indicating concentrated fires in specific years. The RDA preliminary analysis yielded an R2 of 0.14. Significant axes ($p < 0.001$) accounted for 36.2% and 10.0% of variance. CL-A and CL-B displayed clear distinctions, with the proportion of forest and shrublands as primary differentiating factor. CL-C and CL-D lacked clear differentiation, being influenced by anthropogenic and climatic factors like agriculture and temperature. Overall, natural land uses played a crucial role in distinguishing CL-A and CL-B, while CL-C and CL-D were more influenced by anthropogenic and climatic factors. Our findings have the potential to enhance territory management programs aimed at mitigating forest fires in the identified pyroregions. Additionally, the identification of the social and biophysical conditions describing the pyroregions enables the development of targeted actions, tailored to the specific characteristics of each area.

Keywords: wildfires, clusterin, redundance analysis, pyroregion, Portugal

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Post-fire malleability analysis in Pinus halepensis ecosystem through multitemporal phenological metrics applied to MODIS GPP (MOD17A2H) product

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Abstract

The recovery of vegetation after a fire depends on the interactions and inhibitions of reproductive strategies of affected species, the biological legacy of the ecosystem, the severity or intensity of the fire, rainfall anomalies, and other variables related to the topographic-morphological context or applied anthropogenic actions. Throughout the recovery process, physio-taxonomic changes occur with direct implications for the amount of carbon fixed by colonizing formations based on the efficiency in the use of photosynthetic radiation. This amount of carbon can be quantified through the phenological analysis of inter- and intra-annual variations in gross primary production (GPP). The main objective of this study is to describe the interannual phenological variations of GPP in two *Pinus halepensis* fires located in the municipalities of Zuera (2008) and Luna (2015), in the province of Zaragoza. This analysis was conducted using a time series of the MOD17A2H product from the MODIS sensor (compounded every 8 days with a spatial resolution of 500 m), which quantifies the carbon fixed by ecosystems, taking into account variables such as incident solar radiation, surface reflectance, and temperature. We used data from the two years prior to the fire and the subsequent evolution, using pixels in burned and control areas (unaffected by the fire) to characterize the eco-physiological malleability of the ecosystems. Three phenometric variables calculated with TIMESAT 3.3 software were selected, corresponding to the season amplitude (the difference between the maximum and base values of GPP), the length of the season, and the integral of the annual spectral-phenological curve (from the GPP value of 0 to the maximum value within each season). The results of the phenometric analysis show significant differences between control areas and those affected by fire in dates after the fire (average GPP before the fire: 23.95 g C/m^2, post-fire: 17.14 g C/m^2). The effects of fire on the duration of the season and the amplitude of the GPP value during the season were transient. However, the integral of the spectral-phenological curve maintains significant differences for several years after the fire, indicating the incomplete eco-physiological recovery of these ecosystems despite the regenerative effectiveness of *P. halepensis*. These results indicate that the analysis of GPP phenometrics can be a useful tool for studying the resilience of fire-affected forest

ecosystems in terms of productivity.

Keywords: Land Surface Phenology (LSP), TIMESAT, Resiliencie, Time Series, Remote Sensing

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The impact of wildfire experience in the adoption of preparedness measures to reduce future losses in industries

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Abstract

Extreme wildfires in Portugal have caused severe damage to factories located either in industrial parks or in isolated industries surrounded by forested areas. In 2017, at least 551 companies suffered losses affecting more than 4,500 jobs; in 2022, 13 factories recorded damage too. The aim of this work is to assess the impact of direct experience with extreme wildfires in the adoption by the industries of preparedness measures to reduce social and economic losses. Data were collected through an online survey applied to companies affected by wildfires in 2017 and 2022; in addition, a semi-structured interview was implemented in industries located in the municipalities of Arouca, Castelo de Paiva, Vale de Cambra, Oliveira de Frades e Vouzela affected in 2017, and the municipality of Albergaria-a-Velha affected in 2022. In data analysis a methodological triangulation was used. The preliminary results show: i) most of the companies did not develop risk reduction measures before being affected by wildfires; ii) the industries that suffered more losses had activities related to wood, plastic, and paper; iii) industries that did not suffer losses had implemented 1.9 times more risk reduction measures before wildfire occurrence, than the ones that suffered damage; iv) after wildfires, companies that suffered losses developed more risk reduction measures. The preliminary results of this work permit concluded that the type of activity (which defines the type of raw material used), the architectural characteristics of the buildings and the material used in their constriction, the management and storage conditions of materials and products, and the adoption of fire risk reduction measures influence the occurrence of losses. Direct experience is not in itself a factor that promotes the adoption of risk reduction measures if the factory did not suffer losses. The findings of the research allowed us to identify functional preparedness categories that may be used to support industries' preparedness.

Keywords: Extreme wildfires, Preparation, Damage, Businesses

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Automated mapping of U.K. upland burning using Sentinel 2 imagery and Deep Neural Networks

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RSPB

Abstract

Prescribed burning is widely used in the UK uplands to support gamebird shooting and to a lesser extent for grazing (Douglas et al. 2015: Davies GM et al. 2016). In the UK, upland heath and blanket bog ('moorland') often overlies carbon-rich soils and has internationally important conservation value. Prescribed burning in such habitats is contentious and there are concerns over its impact on carbon sequestration, water quality and habitat condition.

There is however little detailed information on spatial patterns in burning, the overlap with protected areas and soil carbon and, importantly, whether these patterns are changing (although see Douglas et al. 2015). This information is required to inform the development of policies for sustainable management and whether these are proving effective.

This talk will describe the development of an automated approach to mapping of prescribed burning in the UK uplands and present results. This work has been undertaken using temporal composite Sentinel 2 optical remote sensing imagery in a deep learning modelling framework using the Google Earth Engine Platform. Our top performing model has an overall accuracy of 96.7% providing good confidence in our predictions. We discuss the applicability of this approach to other ecosystems.

Keywords: Managed burning, Earth Observation, Remote sensing, Deep Learning

Fire in the Earth System Abstracts
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Wildland fire detection and segmentation on aerial images using a vision transformer approach

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Abstract

Wildland fires are a worldwide natural disaster, causing significant damage to ecosystems, economy, property, and loss of lives. Wildfires contribute significantly to air pollution, disturbances in ecological balance, human and financial losses, and a wide range of environmental consequences (Ghali and Akhloufi, 2023). Wildland fires occur in numerous countries such as the United States, the Arabian Gulf, and the European Union countries (Aytekin, 2023). Moreover, in early May 2023, more than a hundred forest fires forced tens of thousands of people in British Columbia and Alberta provinces in Canada to evacuate (NASA, 2023). Many researchers devoted their time to develop early wildland fire detection systems to reduce the frightening statistics of wildfires as well as to prevent their devastating damages (Ghali and Akhloufi, 2023). More recently, drones or UAVs (Unmanned Aerial Vehicles) were employed to help manage fires thanks to their ability to monitor large areas and to provide real-time information (Akhloufi et al., 2021). Additionally, the integration of UAVs with infrared and/or visual sensors helps in detecting wildfires during daytime and nighttime. Recent work in wildland fire segmentation has shown impressive results thanks to the use of deep learning (DL) techniques. The fire segmentation results were employed to extract fire geometrical features and used as inputs to the wildfire propagation models. However, there are still various challenges such as the presence of smoke, detection of very small fires, background complexity, and image degradation. To address these challenges, we present, a wildland fire segmentation method based on DL models. Two vision transformers, TransFire and TransUNet, were employed in detecting and segmenting the visual surface of wildfires on aerial images. TransUNet and TransFire achieved excellent results with an accuracy of 99.9% and 99.83%, respectively, using very large aerial dataset, FLAME (Shamsoshoara et al., 2021). They also outperformed recently published models and showed the ability of vision transformers to correctly differentiate between wildfire scenes and no wildfire scenes (Ghali et al., 2022). More specifically, we demonstrated the ability of these models to extract the finer details of wildland fires on aerial images and overcome current challenges, such as the detection of very small fires, background complexity, the presence of smoke, and image quality.

Keywords: Wildfire, vision transformer, deep learning, aerial images, fire detection

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Fire in the Earth System Abstracts
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Capabilities of unmanned aerial vehicles for the classification of forest fuels in Mediterranean environments using machine learning techniques

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Abstract

Forest fires are one of the main disturbances in Mediterranean ecosystems. In order to understand fire behaviour in a forest stand it is necessary to know the forest fuels, as they provide valuable information on fire spread and intensity. In this study we evaluated the ability of unmanned aerial vehicles (UAVs) to classify Prometheus fuel types in several forest environments in Aragon (NE Spain) using machine learning classification models. We used two UAV units: i) a SenseFly "eBee Classic" with RGB (Sony-WX) and multispectral (Parrot Sequoia 4 spectral bands) cameras, which allowed us to obtain vegetation indices and photogrammetric point clouds; and ii) a "DJI Matrice 300 RTK" with a LiDAR sensor (DJI Zenmuse L1) to obtain three-dimensional point clouds of the entire vegetation structure, thanks to its ability to penetrate the canopy down to the ground. Both point cloud dataset allowed the generation of variables related to vegetation structure (i.e. height and density) and textural features using the grey-level co-occurrence matrix (GLCM) approach. The ground truth was formed by the fuel types estimated in the field. The Dunn's test of multiple comparisons determined the most relevant structural and textural variables and vegetation indices to be included in the predictive models generated using Support Vector Machine with radial (SVM-R) and linear (SVM-L) kernels and Random Forest (RF). The results show that UAVs can successfully classify fuel types, with higher overall accuracies when classifying with RF and when using the LiDAR UAV (accuracy=75%) instead of the optical UAV (accuracy=71%). The main confusions between types were found in types 3 and 6, many of which were classified as type 2 and 7, respectively. However, the confusions found in type 3 were minor when classifying with the LiDAR UAV. The SVM-R and SVM-L models achieved lower overall accuracies and higher confusions in all fuel types. These results show the capacity of UAVs for forest fuel classification using machine learning techniques and their potential for Mediterranean forests management.

Keywords: Fuel models, UAVs, Random Forest, Support Vector Machine, Mediterranean forests

Acknowledgments: This work was supported by the Spanish Ministry of Science, Innovation, and Universities through an FPU predoctoral contract granted to R.H. (FPU18/05027), and by the

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The influence of teleconnection patterns on wildland fire

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Abstract

Wildland fire is a natural disaster affecting the ecosystem, human property, and even human life. Three conditions need to be satisfied for fires: fuel, ignition source, and favorable weather conditions to spread fires. Teleconnections refer to climate anomalies being related to each other in geographically separated regions, they play an important role in local to large-scale fire occurrence by modifying the fuels and fire weather conditions. However, it is not clear so far how teleconnections influence wildfire. Here we used the random forest method, 11 teleconnection climate indices (CIs), three kinds of fire indicators (atmospheric-, hydrologic-, or vegetation indicators), and burned area (BA) data from 2003 to 2018 to study how the CIs influence BA (the pathways from CIs to fire indicators and then from fire indicators to fire). The results show that according to the influenced region fraction, the Tropical Northern Atlantic index (TNA, 23.6%) is the most important climate index followed by El Niño Southern Oscillation (ENSO, 20.1%), Indian Ocean Dipole (IOD, 15.7%), and Pacific–North American Pattern (PNA, 13.0%). The vegetation-related indicators (normalized difference infrared index (NDVI) and gross primary productivity (GPP)) tend to be highly related to both CIs and BA followed by hydrologic-related indicators (fire weather index (FWI) and aridity anomaly index (AAI)). The atmospheric-related indicators (vapor pressure deficit (VPD) and shortwave downward radiation (Rad)) are barely related to the CIs as they are more variable in time while the CIs serve more like long-term influence.

Keywords: wildland fire, teleconnection, fire indicator

Fire in the Earth System Abstracts
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ONFIRE DATASET: A DATABASE OF NATIONAL FIRE DATA

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Abstract

Understanding the distribution of wildfires in time and space is crucial for effective prevention and mitigation of these devastating events. However, current knowledge is limited due to the exclusion of small fires and the short coverage period provided by global remote sensing datasets. To address this gap, we introduce ONFIRE, a gridded burned area (BA) database of national wildland fire data.
By compiling ground mapping data from national agencies, ONFIRE provides monthly burned area information on a common 1º × 1º grid in five regions: Australia, Europe, Canada, Chile, and the United States. This approach leverages the expertise of local researchers and agencies, ensuring the inclusion of the best available knowledge. ONFIRE serves as a comprehensive and integrated resource for researchers, Non-Governmental Organizations, and governmental agencies studying wildfires.
By complementing the existing gridded burned area data derived from remote sensing, this dataset provides a valuable opportunity to enhance our understanding and evaluation of fire regime changes and the factors that drive them in these regions. Here, we explore the opportunities and limitations associated with utilizing this dataset, as well as we discuss the potential for future extensions of this open-source solution. We particularly encourage researchers and fire agencies to contribute their data to the ONFIRE initiative.

Keywords: burned area, fire database

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Likely future changes in the conducive conditions to the extreme wildfire events in Europe.

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Abstract

Likely future changes in the conducive conditions to the extreme wildfire events in Europe.
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Abstract
The current global change is increasing the occurrence of extraordinary wildfires that overwhelm the suppression capacities, provoking substantial damages, and often resulting in human fatalities. Pyrocumulonimbus (PyroCb) development during convective fire-atmosphere interaction is a key factor causing these extreme and unpredictable wildfire events. There are still a lot of unknowns concerning the conditions conductive to PyroCb, but atmospheric instability together with hot surface conditions have been broadly accepted as key environmental factors triggering their occurrence. Although future scenarios point to an increase in global temperature worldwide, we still need more precise information about how PyroCb conditions will change in the future at the continental scale. Here we analyzed the likely effect of climate change on the potential conditions conductive to PyroCb formation through the analysis of the

Continuous Haines Index (C-Haines index) as a proxy of atmospheric instability, in combination with Fire Weather Index (FWI) as a proxy of near surface extreme climate conditions, during three period spans: historical period 1995-2014, near future: 2041-2060 and far future: 2081-2100 at the Pan European scale. We used monthly datasets of five general circulation models from the sixth phase of the Coupled Model Intercomparison Project (CMIP6) under SSP1-2.6, SSP2-4.5, and SSPP5- 8.5 scenarios. Our preliminary results point to a situation in which the concurrence of atmospheric instability and hot surface conditions will be more frequent than in the historical period. Our findings provide novel information about future conditions of extreme wildfires, which can help the preparedness of land-manager and policymakers to mitigate these likely dangerous fires.

Keywords: atmospheric variables, climate change, continuous haines index, fire weather index, pyrocumulonumbus.

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Fire in the Earth System Abstracts
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Assessing the role of climate change in the rate of spread of wildfires in the Iberian Peninsula

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Abstract

Climate change is influencing the rate of spread of wildfires by reducing fuel moisture and by altering vegetation patterns. However, the magnitude of these changes is hard to quantify due to the important role of humans on fire ignition and spread. By using wildfire observations and outputs from different general circulation models, we quantified the influence of climate change on the rate of spread of wildfires that took place in the Iberian Peninsula between 2001 and 2021. A general increase of the rate of spread was found since the pre-industrial period attributable to the reduction in fuel moisture associated with a warmer atmosphere. Climate change and atmospheric CO2 fertilization are also enhancing vegetation growth, whose influence on the rate of spread could potentially be even higher than that of the temperature increase. Although fire behaviour is not determined solely by climate or weather conditions, our results suggest a significant increase in the rate of spread of the Iberian Peninsula wildfires attributable to climate change.

Keywords: Wildfires, Climate change, Attribution

Fire in the Earth System Abstracts
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Feedbacks on weather via fire-generated aerosols over Greece

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Abstract

Wildfires are a major source of atmospheric aerosols and can have significant impacts on air quality and radiative forcing. In our work, we have utilised the Weather Research and Forecasting model coupled with Chemistry (WRF-Chem) to study the impact of wildfires on aerosol pollution and associated meteorological feedbacks, focusing on the geographical area of Greece as a test case. We study the summer season of 2021, during which intense wildfire activity occurred in the country. We conducted sensitivity experiments with and without emissions from fires as well as perturbations to the initial conditions to quantify the impact of such emissions on atmospheric pollutants, aerosol optical depth (AOD), radiative forcing and key weather variables such as temperature. We demonstrate that the impact of wildfires on AOD influences the local temperature over the fire affected areas negatively. Our study identifies fire-emitted aerosols as a significant factor affecting the evolution of short-term meteorological conditions, with implications for weather prediction, and provides new insights into the mechanisms leading to such effects.

Keywords: Greece, WRF-Chem, Wildfires, Airpollution

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Fire in the Earth System Abstracts
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Fire severity overwhelms climate, soil moisture and topography in shaping vegetation recovery trajectories at short-term after fire in Mediterranean communities

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Abstract

Extreme wildfires may cause unpredictable shifts in the composition and structure of Mediterranean plant communities, and, ultimately, may hinder vegetation recovery trajectories and ecosystem resilience. Most research in fire ecology and remote sensing fields has primarily concentrated on assessing vegetation greenness as an indicator of post-fire vegetation dynamics (e.g. Helman et al., 2015; Prodon and Diaz-Delgado, 2021), rather than focusing on the recovery of biophysical properties using robust physical-based models. The latter approach would allow to disentangle vegetation recovery drivers, considering the variability of biophysical properties intrinsic to the species assemblage of each vegetation community (Fernández-Guisuraga et al., 2021). Moreover, the development of comprehensive models that integrate a wide range of fire regime and geophysical variables is still lacking in the current literature. Here, we investigated the role of fire severity and a comprehensive set of geophysical drivers in the post-fire vegetation recovery of Mediterranean landscapes. The fractional vegetation cover (FCOVER) recovery was selected as a resilience indicator retrieved from Sentinel-2 imagery by the inversion of the PROSAIL-D radiative transfer model (Verhoef et al., 2007; Féret et al., 2017) in Pinus sylvestris (Scots pine) forests and Cytisus oromediterraneus (black broom) shrublands. We selected 18 variables pertaining to fire severity, climate, post-fire soil moisture and topography as predictors of FCOVER recovery, calculated as the ratio of post-fire to pre-fire FCOVER. Random Forest regression (RFR) was used to disentangle the influences of fire severity and geophysical drivers on community-specific FCOVER recovery. The estimated FCOVER showed a good agreement with field validation data (R2 = 0.91), without significant under or overestimation. Fire severity was the most important variable in driving FCOVER recovery in black broom shrublands and Scots pine forests at short-term after fire. Pre-fire climate, soil moisture and topography variables were not meaningful predictors at this time scale. Our findings offer novel insights into the processes that underlie resilience after extreme wildfire events in the western Mediterranean Basin. Pre-fire management efforts should be undertaken to avoid the fuel conditions most susceptible to high wildfire severity.

Keywords: Pinus sylvestris, radiative transfer model, resilience, shrubland

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Impact of Fire Frequency and Severity on Post-Fire Recovery and Growth of Mediterranean Serotinous Pines

Víctor Fernández-García, Leonor Calvo, Elena Marcos

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Abstract

The projected warmer and drier climate in the Mediterranean Basin is expected to increase the frequency of fires and severity of burns in pine forests (Vázquez et al. 2015: Flatley & Fulé, 2916). The aim of our study is to evaluate the impact of fire frequency and burn severity on the medium-term recovery and growth of Mediterranean serotinous pines. We specifically examined a serotinous pine forest dominated by P. pinaster, which experienced a high-intensity crown fire in the summer of 2012. Additionally, we analyzed the number of wildfires from 1978 to 2012 and assessed the burn severity of the most recent fire (2012) using the dNBR spectral index. Our field sampling was focused on a 3000 ha area, considering three fire frequency scenarios and two burn severity scenarios. Four years and three years after the wildfires, we measured the density, coverage, and height of pine seedlings, as well as the coverage of woody understory species, in 936 plots measuring 1m^2 each. The findings indicate that the density and coverage of pine seedlings were low following two fires combined with high severity, as well as after three fires, regardless of burn severity. We observed that high severity contributed to the height development of pine seedlings only when the cover of woody species was not extensive, probably due to greater resource availability for pine growth (Pausas et al. 2003) in this area. The interaction between the cover of woody understory species and pine regeneration demonstrated that interspecific competition was more apparent in scenarios with fire frequency and severity that were most favorable for seedling establishment and growth. These results emphasize the negative ecological implications of a potential future regime characterized by higher fire frequency and severity (Fernandes et al., 2008). They also suggest that the natural recovery of serotinous pines may be insufficient to restore full forest cover after two wildfires in a span of 34 years. Therefore, it is crucial to minimize the occurrence of frequent severe fires to safeguard serotinous pine forests. This can be achieved by strategies such as breaking up fuel continuity, reducing surface fuel accumulation, and promoting the utilization of non-timber resources provided by these stands

Keywords: Competition, Fire regime, Pinus pinaster, Seedling growth, Seedling recruitment

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Medium-term impact of post-fire straw mulching and tree logging debris treatments on soil bacterial community.

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Abstract

Post-fire management treatments, such as mulching and tree logging debris, are employed to mitigate soil degradation and enhance vegetation and soil recovery (Ferreira et al., 2015). These treatments create new conditions in the soil where they are applied, resulting in changes in solar radiation and the introduction of organic matter from straw or wood (Marañón-Jiménez and Castro 2013). Consequently, these changes have implications in soil functionality, and in the soil bacterial community (Lucas-Borja et al. 2020). This research aimed to evaluate the effects of two post-fire treatments in the soil bacterial community composition in the medium term (3 and 4 years after the wildfire).
The study was conducted in Sierra de Cabrera, located in the North-West of Spain, in a large wildfire occurred in the summer 2017. Two months after the wildfire, the regional government implemented straw mulching and tree logging leaving the branches debris in areas severely affected by the fire. Soil samples were collected 3 and 4 years after the fire from treated and untreated burned areas. A total of 40 samples were collected and frozen until DNA extraction and sequencing. Amplicon sequencing of the 16S rRNA gene was performed to study the bacterial community composition in the different treatments and years.
Changes in the soil bacterial community in the medium term were analyzed at high (phylum) and low (genus) taxonomic levels. Both post-fire treatments altered the phyla composition. In straw mulching, only Proteobacteria and Gemmatimonadetes showed significant increase 3 years after treatment, while no significant differences were observed for any phylum 4 years after. Logging plus branches debris treatment displayed significant differences for Actinobacteria (decrease) and Firmicutes (increase) 3 years after treatment. Only Firmicutes maintained significant differences 4 years after treatment but with an abundance decrease with respect to non-treated areas. At the genus level, more differences among treated and non-treated areas were observed over time. However, only the genus Ralstonia had a high abundance in the treated areas in both years and treatments.
In conclusion, the results showed that the medium-term effects of straw mulching and logging plus branches debris treatments on the bacterial community composition are greatest at low taxonomic levels, such as the genus level. Notably, the genus Ralstonia is a discriminant taxon between treated and untreated areas. In treatment areas, higher

abundances of this genus were observed for both treatments, three and four years after the treatments.

Keywords: Soil bacterial community, post-fire management, straw mulching, cut plus lopping.

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Response of soil microbial community to different wildfire history in Pinus pinaster forests: fire recurrence, fire return interval and time since the last fire.

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Abstract

A modification of the natural fire regime of an ecosystem, implies a direct and indirect selective pressure on the soil biological community. During the last decades, changes in land use and climate are altering fire regime characteristics across Mediterranean ecosystems, increasing fire frequency or severity. We hypothesise that increasing fire recurrence might select microbial phyla with fire-adapted traits. The main objective of this work was to discern whether an increasing fire recurrence alters the post-fire recovery capacity of the soil microbial community of *P. pinaster* stands in the Central-West of the Iberian Peninsula. We characterized the soil fungal, bacterial and archaea communities at the phylum level across a 43-year fire chronosequence with high fire recurrence (up to 3 fires) by Illumina MiSeq sequencing. Study sites were chosen to differ in the number of fires (1 to 3), in the time elapsed since the last fire and the interval between the last two fires. In burned sites, fungal community showed a dominance of *Ascomycota* at the expense of *Basidiomycota* phyla. In parallel, bacterial community reported a higher relative abundance of Actinobacteria, *Gemmatimonadetes* and *Patescibacteria* phyla in burned soils, and a decrease of *Proteobacteria*, *Acidobacteria* and *Verrucomicrobia* phyla. However, fire did not affect archaea community composition, at least at the phylum level. Despite these changes observed in the relative abundance of some phyla shortly after fire, the overall fungal and bacterial communities showed high capacity to recover after fire, regardless the previous fire history (recurrence or time between the last two fires). Thus, fungal and bacterial community structures showed a clear phyla re-assemblage related to the time since the last fire, indicating that fire had a significant effect on soil microbial structure during about four decades after fire. The differences between burned and unburned forests and the post-fire succession in fungal, bacterial and, to a lesser extent, archaeal community structure seen to be driven by variables related to carbon and nutrients pools and mineralization rates.

Keywords: bacteria, fungi, fire regime, ecological succession

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Fire in the Earth System Abstracts
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Fire behavior in NW Europe: Spatiotemporal patterns and drivers

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Abstract

Greater fires have recently been recorded in Northwest Europe. Knowing the status of fire in this area is critical because several climate projections show that fire activity will increase in this temperate area in the future. Unknowns regarding the fire regime and drivers in northwest Europe are revealed by this study by characterizing key aspects of fire behavior: The Rate of spread and other indicators of fire progression, using an innovative approach to cluster VIIRS hotspots into fire perimeter isochrones. At this scale, we identified 102 large fires that occurred between 2012 and 2022. We evaluated the seasonality of fires as well as relationships between ROS and Burned Area. We also looked for environmental drivers such as land cover, fire weather rankings and fuel phenology (temporal variation of greenness/moisture). The results show significant differences in land cover, with ROS and burned area clearly peaking in March and April. The median ROS during these peak months is approximately 0.09 km/hr., and 66% of the burned area occurs during this spring period. This peak decreases in February and May, indicating the length of the main fire season. Fires with higher ROS tend to have a larger burned area. No significant relationship could be found between FWI and the occurrence of these larger fires. On the other hand, seasonal variation of vegetation indices, specifically the timing of season onset and offset, showed to be a key variable for describing different types of fire behavior. In less studied areas that are now seeing an increase in these types of disasters, it is crucial to describe the seasonal variation of fires and to unsterstand its drivers. Accurate ROS data is critical for determining elevated fire risk periods, the effectiveness of available suppression techniques, and appropriate land and fuel management strategies.

Keywords: Rate of Spread, VIIRS, Fire Occurrence, Burned Area, Land Cover, FWI, Vegetation Indices, Phenology

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Fire in the Earth System Abstracts
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Protecting Wildland Firefighters' Health: saving the lives of those who fight to save us

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Abstract

Climate change and global warming have been contributed to the rise of forest fires across the globe. The proximity of firefighters to wildfires exposes them to a complex mixture of pollutants. In June 2022, occupational exposure as a firefighter was classified as "carcinogenic to humans" by the International Agency for Research on Cancer. However, up to date, very few studies have been focused on the relationship between wildland firefighting occupational exposure and health outcomes. Bio4Fox study aims to characterize wildland firefighters' exposure in a pre- and during a wildfire season to identify a set of appropriate (bio)markers for the surveillance of wildland firefighters' health. We aim to enroll around 200 northern Portuguese wildland firefighters. Here we present some preliminary data characterizing the exposure of these firefighters in the fire stations before the wildfire season. Around 172 northern Portuguese wildland firefighters (141 males and 31 females; mean age of 37.5± 10.9) recruited before the wildfire season of 2021 were enrolled in this analysis. Information on sociodemographic data, lifestyle and occupational exposure was obtained via a comprehensive questionnaire. Genetic instability was assessed in buccal cells through the Buccal Mucosa Cytome (BMCyt) assay. Lower frequencies of micronuclei and pycnotic cells (cell death biomarker) were observed among firefighters taking vitamin supplements and consuming vegetables daily, respectively ($p<0.05$). Being part of Permanent Intervention Teams (full-time firefighters) or part of the Command team, contributed to higher frequencies of cells with condensed chromatin (cell death marker) and karyolitic cells, respectively ($p<0.05$). Our findings will furnish a better characterization of Portuguese wildland firefighters in a pre- wildfire season. We expect to contribute to the implementation of health and safety measures highly needed in this sector.

Keywords: Wildland fires, Firefighters, Occupational Exposure, Biomonitoring

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Wildfire smoke exposure, does it affect our health?

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Abstract

Wildfires have a negative impact on the environment, ecosystems, and human health. Smoke from wildfires contains harmful pollutants such as particulate matter, carbon monoxide, nitrogen dioxide, and volatile organic compounds. These pollutants can cause immediate adverse health effects, mostly related to the respiratory system, such as wheezing, shortness of breath, coughing, and exacerbation of pre-existing health conditions (e.g., asthma, bronchitis, and chronic obstructive pulmonary disease). In addition to short-term health effects, exposure to smoke has also been linked to long-term population health effects. Epidemiological studies have shown a positive association between wildfire smoke exposure and both respiratory morbidity and all-cause mortality. This has been particularly evident in susceptible populations including children, older adults, pregnant women, and individuals with chronic diseases. Thus, it is important to mitigate wildfires' impact on the human population through prevention and awareness actions. Prescribed burning, fuel breaks, water reservoirs, forest access roads, meteorological warnings, and information campaigns to promote the individual responsibility of citizens are examples of some important preventive measures. In parallel, it is crucial to strengthen the fire response structure so that forest fires can be rapidly detected and suppressed at early stages, preventing human loss/threats.

Keywords: wildfire, smoke, health, population

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How to mitigate firefighters' occupational exposure in non-fire settings?

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Abstract

Wildland firefighters are at greater risk due to the nature of their work, being considered one of the most dangerous occupations in the world. Their proximity to fire exposes them to high temperatures and high concentrations of hazardous pollutants (e.g., volatile organic compounds, PAHs, carbon monoxide). Besides the evident forms of firefighters' exposure to pollutants, in the field, other relevant occupational contamination sources exist. Firefighters are also exposed to pollutants in the return to the fire station and into the building via contaminated vehicles, personal protective equipment, among others. It can greatly influence the indoor air quality contaminating the "clean" areas (e.g. offices and bedrooms) where firefighters remain for long periods. Such exposure can be easily modified through changes in systems, protocols or behaviours, representing potential useful intervention targets. Fire stations must be designed in compliance with legal standards and regulations to maintain the good air quality in the workplace, including the circuit of "contaminated" and "clean" areas to guarantee a clean airflow within spaces. The implementation of efficient ventilation systems must be a concern, particularly in the areas of the fire station where contaminated material is handled. The air quality of fire stations should be regularly monitored to guarantee safe exposure levels to air pollutants. Preventing contamination will keep firefighters and other fire station personnel protected from smoke-related contaminants. Fire stations should have a standard set of guidelines with safe practices and policies to protect the safety and health of firefighters.

Keywords: indoor air quality, firefighters, non-occupational settings

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Fire in the Earth System Abstracts
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Pyric herbivory: Developing a landscape level application of the fire-grazing interaction

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Abstract

Fire and grazing (referred to as pyric herbivory) can interact to provide benefits through many ecosystem services from promoting heterogeneity across complex landscapes. I will synthesize the research from the past 25 years on pyric herbivory and discuss the potential and limitations to its application. Specifically, I will focus on the effects of pyric herbivory and heterogeneity on livestock production, biodiversity, invasive species, and rangeland conservation in a changing climate. The research on pyric herbivory represents a comprehensive and broad test of fundamental rangeland principles, such as the need for uniform distribution and calls to decouple fire and grazing. In the context of rangeland systems it is important to discuss the human dimension and the challenges with adoption of these principles across broad spatial scales. Challenges with adoption is the dependence of grazing management on prescribed fire which currently has minimal application on rangelands. There is strong adoption on lands that are capable of using fire for land management.

Keywords: grazing, biodiversity, landscapes, prescribed fire, conservation,

Fire in the Earth System Abstracts
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The Prairie Project: Restoring Grasslands in the Great Plains with Fire and Grazing

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Abstract

Grasslands and savannas in the Great Plains of the United States are rapidly being converted to woodlands in a process often described as woody plant encroachment. The consequences of this conversion are myriad but include alterations to grassland biodiversity and disruption of water and biogeochemical cycles. In addition, the loss of forage for animal producers is potentially catastrophic. Traditional methods of controlling woody plants using mechanical or chemical treatments is generally cost prohibitive. In addition to woody plant encroachment, ranchers and farmers in the region are challenged by other environmental threats including occasional catastrophic wildfires and extended heat waves. We contend that the widespread adoption of pyric herbivory (the synergistic application of fire and grazing) and mixed-species grazing (cattle [Bos taurus] and goats [Capra spp]) would not only make grasslands and savannas more resilient to woody plant encroachment but would also enhance the profitability and resiliency of livestock production systems. These management strategies control woody plants, increase biodiversity, improve grassland ecosystem function, and favor livestock production. Although this management paradigm holds tremendous potential by mimicking original grassland disturbance regimes, it has not been widely adopted because of cultural constraints. Saving the remaining natural grasslands in the Great Plains and elsewhere will require a widespread shift in cultural norms – facilitated by targeted government incentives and a coordinated program of regional research, extension, and education that involves farmers and ranchers as key stakeholders.

Keywords: patch burning, pyric herbivore, woody plant encroachment

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PYRIC HERBIVORY FOR MOUNTAIN HABITAT RESTORATION IN SW EUROPE: LEARNING FOR THE CHALLENGES AND THE TRADE-OFFS OF DIFFERENT REGIONAL CONTEXTS

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Abstract

The traditional use of fire for pastoral purposes has survived in the 21st century in some regions of south-western Europe. While the secular aim of the practice has been the reduction of shrub encroachment and the maintenance of open grasslands for the provision of fodder to domestic herbivores, today the pastoral practice faces complex objectives as are the restoration of high environmental valuable habitats or the reduction of fuels in critical areas to wildfires. In consequence, the traditional use and knowledge of fire is nowadays combined or substituted by a professional firefighter use in many areas. In spite of the interest, pyric herbivory -the combination of fire and herbivores to create resilient and biodiverse mosaic landscapes- faces many environmental, socioeconomical and regulatory challenges that need to be solved. The Interreg SUDOE Open2preserve project launched in 2018 eight experiences of pyric herbivory in seven regions of Spain, Portugal and south France with the aim of sharing scientific and technical knowledge on the combined use of fire and grazers as a restoration tool and as a control of fuels build-up. Beyond, a general picture of the historical, social, political and regulatory context of the different regions was achieved. Through the regional comparison, a clear picture emerges about the strengths and weaknesses of the implementation of the practice in the SW European territory, which are discussed in this presentation and that may help to establish the baseline for the development of

regulations and policies favourable to the use of a safe and suitable pyric herbivory in Europe.

Keywords: Pyric herbivory, policies, regulations, resilient landscapes

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Canals y col. 2023. Coyunturas y problemáticas regionales de las montañas del sudoeste de Europa y restauración de hábitats mediante prácticas de herbivorismo pírico: el proyecto Open2preserve

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An integrated education-extension approach for developing agents of change and innovations to affect cultural change - Promoting adoption and public support of pyric herbivory and multi-species grazing

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Abstract

The sustainability of livestock production and other ecosystem services in the Great Plains rangelands is under threat by climate change and associated frequent and intense droughts and wildfires and woody plant encroachment. Pyric herbivory and multi-species grazing are two management practices that are effective for reducing the risk and impacts of drought, wildfire, and woody plant encroachment, but their adoption and policy support have been limited. There is an urgent need to promote adoption and public understanding of these practices to increase resilience and sustain livestock production and other ecosystem services of the Great Plains rangelands. The main goals of the integrated education-extension component of the Prairie Project are (1) to support innovative ranch managers as agents of change to mentor other ranch managers in adopting pyric herbivory and mixed-species grazing in their practice, (2) to develop next-generation of progressive land managers and professionals through engagement of 4H/FFA groups in monitoring research on the effects of pyric herbivory and mixed-species grazing in demonstration ranches, and (3) to develop agents of change in secondary and undergraduate institutions through faculty and curricular development and action research to promote rangeland literacy. We will discuss the design and implementation of intensive activities through 2-year Ranch Manager Cohorts, 4H/FFA Cohorts, and Educator Cohorts, as well as the synergy among these cohorts and with the research activities of the Prairie Project. This presentation will focus more on the educator cohorts. We have organized three 2-year Educator Cohorts with 32 participants from diverse secondary and higher education institutions. Each cohort started with an intensive summer workshop focused on current science of rangeland ecology and ecosystem services, pyric herbivory and multi-species grazing, as well as the current

learning science and inclusive and high-impact pedagogy. It was followed by monthly cohort meetings focused on professional development, sharing and supporting participants' work, and community building, as well as individual consultations. Cohort participants have developed high-impact educational materials related to fire and grazing, implemented in their own classes, assessed the impact on student learning, and many of them have presented their work and findings in professional and education conferences to engage a broader audience of educators and professionals. Pre- and post-surveys of the students in the classrooms of the participants and project team members have shown significant changes in knowledge and attitudes related to rangeland literacy, especially the roles of fire and grazing in sustaining rangelands and their ecosystem services.

Keywords: agents of change, current and future practitioners, educators, rangeland literacy, pyric herbivory and multi-species grazing

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Developing Learning Experiences to Increase Student Understanding of Rangeland Ecosystem Services and the Essential Role of Fire and Herbivory

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Abstract

Students that understand ecological processes and ecosystem services have the potential to be informed contributors to environmental decision-making in their communities. Students lacking such knowledge are often unaware of the relationships between sustainable resource use and natural systems. One of the primary goals of the Prairie Project is to develop innovative learning activities related to best management practices in rangeland ecosystems in an effort to reduce misconceptions about and to increase knowledge of rangelands and the ecosystem services they provide. The Prairie Project is collaborating with secondary teachers to develop learning experiences that will increase student understanding of rangeland ecosystem services and the supporting role of pyric-herbivory. Teacher participants were recruited through social media announcements, previous collaborations, and outreach to school districts. Intensive summer workshops were used to build learning communities of educators and facilitators to support lesson-development efforts. Monthly meetings are being used to further promote the development, implementation, and assessment of lessons. The essential components of the Prairie Projects lesson-development framework included: 1) a general introduction of science, management practices, and issues relevant to rangelands; 2) teacher decision-making on how to best integrate such concepts in a manner that is appropriate and meaningful to their classroom situations; 3) identification of academic standards and science practices to be met by the lesson; 4) lesson development with facilitator support providing specific conceptual, technical, and pedagogical guidance along with financial support for materials; 5) lesson implementation in the classroom; 6) assessment of lesson effectiveness; 7) lesson modification for future use; and 8) teacher presentation of lessons and their impacts. As a result of this collaboration, a variety of innovative lessons

have been produced, such as research experiences, collaborative activities, case studies, authentic inquiries, and free-response questions. Teachers have presented their lessons and resulting student impacts at professional workshops and conferences. The lessons produced are now available as resources for other instructors to use or modify. Initial comparisons between pre- and post-lesson surveys and results from related assessments indicate that students have experienced a reduction in misconceptions about and an increase in understanding of rangeland ecosystem services and effective rangeland management. In addition, instructors have become agents of change not only in their classrooms but also in their schools, associations, and communities. The Prairie Project's experiences in lesson development could be beneficial to other science communication or public relations efforts related to fire ecology and ecosystem services.

Keywords: Education, Curriculum Development, Science Communication, Rangelands, Ecosystem Services, Pyric-Herbivory

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Open2preserve, SUMHAL, Pyriclab and COMPAS: four pyric herbivory projects in South Spain.

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Abstract

In South Spain, the abandonment of traditional agricultural and forestry practices, together with the new climatic scenarios, is endangering the response capacity of many mountain ecosystems, increasing the probability of large forest fires and the loss of biodiversity. New approaches for fire prevention and forest management, as extensive grazing, are being implemented within the fire prevention services. Nonetheless, above a certain amount of fuel load, grazing is not an effective tool. In this case, pyric herbivory (PH) could be an alternative. This is a preventive forestry tool against fires that combines prescribed burning followed by targeted grazing. This practice emulates the disturbance regime of natural ecosystems, where fire and herbivores control the cycle of terrestrial plant matter. In South Spain, among other sites, this was a traditional practice used by shepherds for improving pasture quality, which also contributes to fuel load control. However, it has been abandoned for more than 60 years, due to rural exodus and legislative issues. In Andalusia since 2018, four research projects (R+D+i) have addressed PH as a central topic: Open2preserve (Interreg SUDOE-UE), SUMHAL (LIFEWATCH-2019-09-CSIC-13, POPE 2014-2020), Pyriclabs and COMPÁS (Spanish Government: MICINN and MITECO-Fundación Biodiversidad, respectively). Globally, they aim to prevent big forest fires, and to promote resilient landscapes, biodiversity and local economies. In Andalusia, Pyriclab continued on the Open2preserve's pilot experience as a livinglab. Vegetation, soil and insects are monitored before the burning and over three years after it, in order to provide information for decision-making to forest managers. COMPAS goes one step forward and aims to define the legal, social and technical framework necessary to use pyric herbivory in preventive forest and environmental management in Spain (including Andalusia), while promoting green employment. Specifically, it will focus on: 1) research and development of new PH

models, 2) new technologies for PH (GPS collars, virtual fences, drone monitoring of the vegetation), 3) proposal of new regulatory and legislative frameworks that allow PH as management tool in natural areas, 4) new business models that include private investment to create resilient landscapes, and 5) education and training on PH for technicians to enhance employment in rural areas. In Andalusia, the pilot experiences are located in Sierra de Gádor and Sierra de Filabres (Almería). These projects pretend to set solid foundations for PH as an additional tool for fire prevention in Andalusia, by providing relevant scientific knowledge and by promoting the necessary legal changes and the green employment.

Keywords: Andalusia, extensive livestock, fuel control, Mediterranean natural areas, prescribed burning

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Investigating the Vulnerability of water reservoirs to post-fire water contamination in Portugal.

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Abstract

In recent years, the Mediterranean basin, particularly Portugal, has witnessed a concerning increase in the extent and frequency of wildfires. Beyond their instant threat to human lives, these wildfires have also secondary effects on both humans and ecosystems, including the deterioration of water quality in downstream surface waters. Elevated levels of ash and accelerated erosion rates resulting from wildfires have the potential to introduce an influx of nutrients, sediments, and other water quality-related components, thereby posing a threat to drinking water supplies. To assess this risk, episodes of post-fire water contamination have been identified through changepoint analysis in a dataset of over 60 reservoir water quality time series spanning multiple decades. Further, the influence of possible post-fire water contamination drivers such as fire characteristics, watershed properties, reservoir attributes, and climatic drivers was explored through logistical regression analysis using generalized additive models. These findings were then used to develop an index for water managers based on which post-fire water contamination could be predicted and further to perform a deterministic risk analysis for each of the studied reservoirs based on data from 1990 – 2020.
Our findings indicate that 13.6 % of all wildfires resulted in increased levels of total suspended solids (TSS), which is a key parameter for water supply systems. Notably, the most significant changes occurred during the exceptionally severe fire seasons of 2003 - 2005 and 2017, with the southern reservoirs experiencing the greatest impacts after 2003 - 2005, where large wildfires coincided with major drought. Fire size emerged as the primary driver of post-fire water contamination, while reservoir and climate-related characteristics, such as water levels, also played a significant role in determining elevated TSS or NO3 levels. The risk analysis helped to identify key reservoirs that were at major risk, while generally central Portuguese reservoirs showed elevated risk because of the high fire activity in the area, whereas the elevated risk in southern Portuguese reservoirs stemmed more from their importance for public water supply.
The outcomes of this study can have implications for numerous case studies and modeling efforts, providing valuable insights for water managers to anticipate and address potential future threats.

Keywords: post-fire hydrology, water quality, suspended sediments, changepoint analysis, logistic regression

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Deadwood decay across an elevational gradient in a burnt Mediterranean pine reforestation

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Abstract

Dead wood remaining after wildfires is an important source of nutrients that are released during decomposition. The study of the decomposition rates is relevant to understand the role of burnt wood as a driver of soil fertility and to plan management activities in the burnt area. However, post-fire wood decomposition rates are still poorly understood, particularly in Mediterranean-type ecosystems. In this study, four plots were established after the 2005 Lanjarón fire (Sierra Nevada Protected Area, southeast Spain) across an elevation gradient (1477, 1750, 2053 and 2317 m a.s.l.). At each plot, standardized samples of logs of 75 cm length and variable diameters were left on the ground for long-term monitoring. The baseline for the initial wood density and nutrient content (C, N, and P) was established, and subsequently, a subsample of 30-50 logs per plot were collected at various intervals for analysis (after 2, 4, 8, 10 and 15 y for wood decomposition and after 2, 4 and 15 y for nutrient content). After 15 y, the logs had lost an overall 55% of their density. The greatest density loss occurred during the final 5 y of the study. Contrary to studies in other climates, large-diameter logs decomposed faster than small-diameter logs, which might have resulted from a higher moisture content in larger logs. During the study, across all the plots, there was a reduction in C concentration of between 4.92% and 8.39%, whereas P concentration increased between 4.41% to 76.62% and C/N ratio increased between 10.85% and 86.75%. N content decreased by 1.42% – 35.90% in three plots and increased by 12.49% in another plot. Hence, nutrient composition of the logs after 15 y differed sharply from the initial concentrations, but there was no clear altitudinal pattern to these differences in concentrations. Burned wood decomposition and nutrient dynamics can vary considerably depending on the specific conditions of each ecosystem and the interaction of various environmental factors, such as humidity and temperature. Our results provide one of the longest time series of wood decomposition in Mediterranean ecosystems, thereby contributing to improve our understanding of burned wood decomposition processes and forest regeneration and restoration.

Keywords: density loss, carbon, nitrogen, phosphorus, decomposition

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The Role of Dehesas in Fire Management in Extremadura, Spain: An Analysis of Forest Fire Evolution and Agroforestry Systems

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Abstract

The dehesas, traditional agroforestry systems characterized by a combination of pastures and scattered forests, play a crucial role in fire management in the Extremadura region of Spain. These systems act as natural barriers and reduce the spread of fire due to their diverse structure. The presence of dehesas in Extremadura has significantly influenced the evolution of fires in the region. The aim of this study was to analyse the evolution of forest fires in Extremadura and to deepen the role of dehesas as an agroforestry system against fires. The data from the European Forest Fire Information System and the Global Wildfire Information Systems (2002-2019) were used, along with cartographic information on fire risk areas and the surface area of pastures and dehesas in Extremadura. The results show that forest fires in Extremadura have decreased by around 26% in the last decade, and the number of hectares burned has been reduced by 94,514 ha. The dehesas act as a natural barrier against forest fires, and most of the large forest fires in Extremadura occur where dehesa spaces cease to exist, and the forest mass without proper management increases exponentially. Although the number of forest fires during the fire season (July to September) is only 1.5% higher than outside the fire season, the number of affected hectares is 60.30% higher. The results reflect that, despite the decrease in the number of forest fires, attention must be paid to the magnitude of existing fires. In summary, the dehesas in Extremadura act as natural barriers and reduce the spread of fire due to their diverse structure. The conservation and restoration of dehesas are essential to ensure the protection of the region against forest fires. The implementation of sustainable management practices and the strengthening of detection and response systems are fundamental to mitigate the effects of fires in Extremadura and preserve its valuable natural heritage.

Keywords: Dehesas, Fire prevention, Agroforestry systems, Forest fire management

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Identification of potential areas to introduce agroforestry systems as a practice to mitigate wildfires risk in Europe

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Abstract

In recent years, the frequency and intensity of wildfires have increased due to climate change, land-use changes, and other factors. Agroforestry systems have been identified as a potential solution to reduce the risk of wildfires while promoting environmental sustainability. Agroforestry is a land-use system that combines trees and crops or livestock on the same land, providing multiple benefits such as soil conservation, biodiversity conservation, and carbon sequestration. The aim of this analysis is to identify potential areas in Europe where the introduction of agroforestry systems can reduce the risk of wildfires while providing environmental benefits and increasing resilience to climate change. The selection of these target areas is based on a spatial approach which consists of four steps: selection of suitable potential areas from the total agricultural area in Europe, excluding nature conservation sites; analysis of environmental risks in the potential areas; evaluation of woody landscape features in the areas under risk and, finally, definition of target areas. The total agricultural area for the EU-27, the United Kingdom and Switzerland was 1,725,041 km2. Land use categories included croplands (61.8%), permanent crops (6.1%), pastures and natural grasslands (32.1%). Once nature conservation sites were subtracted from the total agricultural area, potential areas for introducing agroforestry systems amounted to a total of 1,539,185 km2. A total of 11 environmental indicators were used to determine risks related to soils, biodiversity, water, and climate change. Datasets of these indicators were gathered from cartographic products developed at European or national scales. In order to evaluate the effects of those risks, threshold values were defined for each indicator, identifying the limits above or below which sustainability is compromised in potential areas. After combining the environmental indicators, heat maps were produced to highlight the intensity of environmental risks. Data were analyzed considering the different biogeographical regions present in Europe: Alpine, Atlantic, Black Sea, Boreal, Continental, Mediterranean, Pannonian and Steppe. Areas with a high concentration of risks were determined as target areas to introduce agroforestry systems. In conclusion, the identification of potential areas to introduce agroforestry systems as a practice to reduce wildfires risk in Europe is a crucial step towards promoting environmental sustainability and reducing the risk of wildfires. The spatial approach used in this analysis provides a useful tool for policymakers, land managers, and other stakeholders to identify areas

where agroforestry can be implemented as a sustainable land use option.

Keywords: land use dynamics, agroforestry systems, risks, Europe

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Restoring the sustainability and fire resilience of a forest – a landscape planning approach

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Abstract

Over the last century and particularly since the 1950s, the Portuguese traditional "agro-silvo-pastoral" systems have been subject to disruption leading to the homogenization and degradation of the landscape. Rural depopulation and the consequent abandonment of land management, in addition to systematic afforestation campaigns, converted these traditional systems into continuous monospecific forests, constituted by species with high flammability, such as *Pinus pinaster* and *Eucalyptus globulus*, which culminated in the increase of forest fires that ravage the territory every year.
Besides the drastic consequences of habitat and property destruction, the loss of landscape values has been an accelerator of land abandonment and neglect of natural resources, resulting in a landscape highly vulnerable to rural fires.
The presented case study aims to propose a long-term Landscape Plan for Curvachia do Cabeço do Vento (Curvachia), combining the objectives of fire resilience and ecological sustainability. This work is being developed in the scope of two research projects, SCAPEFIRE and LANDGI-Nexus, both aiming at a sustainable landscape transformation through an integrated approach combining ecological, cultural, and socio-economical components of the landscape (Magalhães et al, 2021). The proposed Landscape Plan integrates fire behaviour and ecological suitability concepts applied to spatial planning, together with close-to-nature forestry and permaculture design framework.
Curvachia is a 75 ha rural property located in Leiria municipality, 150 km from Lisbon city region. This property has a high suitability to silviculture in which some of the original *Quercus suber* and *Quercus faginea* forests remain. On the Ribeiro da Curvachia valley bottom, the more fertile soils were cultivated with horticultural crops, orchards, and vineyards. The cycle of organic matter was completed using the material resulting from pruning and thinning for cattle-bedding and manure production.
Pinus pinaster trees were planted in the beginning of the 20th century, along with alignments of eucalyptus trees, corresponding to the firebreaks. The area of eucalyptus expanded during the 1960s, replacing the agricultural plots which were eventually abandoned, thus eliminating the existing discontinuities in the combustible material. The largest fires occurred in 1985, 1995, and 2005 and a smaller one in 2021.
The proposed Landscape Plan ensures the ecological restoration of Curvachia along with its economic and social viability, namely by promoting Quercus forest's natural regeneration, native broadleaf trees new plantations, edging and swale design, creating a

very diverse and resilient landscape with high ecological, cultural and aesthetical value.

Keywords: rural sustainable landscape, land-use planning, landscape transformation, resilient forest

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A review on the driver of fires and associated biodiversity impacts in Southeast Asia

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Abstract

Peatland ecosystem in Southeast Asia has seen significant deforestation and degradation in recent decades. The clearance of natural forests for agricultural land followed by drainage has become a substantial issue in peatlands. Peat fires are the primary cause of smog or transboundary haze, biodiversity loss, and increased greenhouse gas (GHG) emissions. This review study aims to identify best management practices in managing peatland ecosystems in Southeast Asian countries. Initial findings suggest that excessive draining (via canal construction), fires, logging, and land conversion are the primary sources of peatland degradation. Furthermore, conflict over land as an essential source of livelihood has impacted the peatlands. Peatlands' economic use necessitates planned after-use, such as agriculture, forestry, recreation, wildlife habitat, and biodiversity protection (nature conservation). This will almost certainly require some form of restoration or rehabilitation, such as rewetting to raise water tables. There is a lack of understanding of the function of peatlands, resulting in peatland management that does not align with the ecological functions of peatlands. ASEAN member countries have been conducting peat restoration activities and for them to run effectively, efficiently, and economically, there is a need to understand and apply the required technical principles. Peatland restoration should return degraded peatlands to conditions that are as close to natural as possible within practical constraints and at a reasonable cost. As part of after-use plans, carbon emission reduction and sequestration projects should be assessed for feasibility and options included.

Keywords: Keywords: best practices, peatland, Southeast Asia

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Tourism carrying capacity of Mediterranean natural protected areas based on wildfire safety

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Abstract

Tourism has long been a major contributor to Spanish economy (Drius et al., 2019) and, currently, it plays a keystone role in the development of Mediterranean rural areas. Moreover, the awareness of conservation and the interest in natural protected areas have increased considerably in the last decades (Prévot et al., 2018). Consequently, tourist arrivals, both domestic and inbound, have experienced a significant growth in protected areas, exerting higher pressures on the environment (Pickering et al., 2018). Regarding this constraint, the concept of carrying capacity (Chapman et Byron, 2018) emerged as the maximum sustainable level of human pressure that the area can support without degrading its ecological integrity or exceeding its capacity to maintain biodiversity and ecosystem services, preserving their natural values and avoiding damage.
In addition, due to Global Change, wildfires are becoming more virulent and the effects on ecosystems and population are becoming more devastating (Pausas and Fernández-Muñoz, 2012; Molina et al., 2017). Along with this, the increase in the number of visitors make wildfire risk of natural areas rises meaningfully. As a result, wildfires and their impacts are becoming frequent headlines in relation to tourism. The achievement of sustainable tourism requires the incorporation of wildfire disaster planning. Being adapted and protected from wildfires, allows natural areas visited by tourist to suffer less impacts and to recover faster from the disturbance of fire. Therefore, managers should be able to effectively protect natural areas from wildfires and preserve visitor safety. For this purpose, it is necessary to estimate the number of people who can safely visit the space, that is to say, the tourism carrying capacity based on wildfire safety.
The goal of this research is to develop this new approach and propose a methodology to adjust the optimum number of visitors admitted daily to a natural protected area according to wildfire safety. The tourism carrying capacity is modeled and calculated statically based on the physical carrying capacity, the structural building risk and the fire suppression difficulty, and it is adjusted dynamically with daily weather conditions and the derived potential fire hazard of vegetation. Under the most unfavorable wildfire scenario, the physical carrying capacity of natural protected areas could be reduced between 28% and 34% because of the recommended safety distance depending on the radiation heat flux. The results of this study will assist decision making to manage natural protected areas integrating rural development and the tourist fire safety.

Keywords: wildfire protection, physical carrying capacity, fire management, potential fire hazard,

structural building risk, fire suppression difficulty, radiation heat flux

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