Not my responsibility

Progress report 1 (12-2022 – 09-2025)

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FIRE SAFETY ENGINEERING | LUND UNIVERSITY

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Abstract

This progress report presents the results from the first phase of the research project *Not my responsibility* (NoMR), running from December 2022 to September 2024. The project investigates how Swedish communities can strengthen preparedness and resilience to wildfires by developing a shared understanding of hazard, exposure, vulnerability, and responsibility across stakeholders. During this period, empirical work has been carried out across several domains, including analysis of the 2021 Finsjö wildfire, extensive stakeholder mapping, national-scale assessment of social and physical vulnerability, and experimental studies of wildfire emissions from typical Swedish forest fuels. Findings highlight the complexity of responsibility in wildfire management, the importance of informal networks, and the central role of adaptive community capacity. The project has also piloted a household vulnerability assessment tool and conducted an international research exchange with Australia to learn from established community preparedness practices. Together, these activities provide early evidence and tools to support improved collaboration, shared responsibility, and risk reduction strategies for wildland–urban interface communities in Sweden. Further work will develop and operationalise these insights into guidance and stakeholder engagement frameworks during the next phase of the project.

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Preface

This report is an annual report of the project Not my responsibility (NoMR). The project is a collaboration between the Division of Fire Safety Engineering and Division of Risk Management and Societal Safety at Lund University and the Department of Fire and Safety at RISE Research Institutes of Sweden. The project is funded by FORMAS (contractnr: 2022-01843_3), under the call Cross-Cutting Climate Adaptation – challenges and measures.

The project is comprised of seven work packages (WP): WP0 Project management; WP1 Stakeholder dialogue; WP2 Wildfire and Wildland Urban Interface (WUI) fuels behaviour; WP3 Mapping of formal and informal stakeholder interactions – Stakeholder identification; WP4 Hazard, exposure and vulnerability assessment; WP5 Wildfire Safe Communities; WP6 Outreach and Education.

The summary of work to date has been written by the project team

- Professor Margaret McNamee (LU, Project leader (PL) until June 2025)
- Dr Tove Frykmer (LU, PL from June 2025)
- Lucas Hovart (LU, PhD-student)
- Dr Per Blomqvist (RISE)
- Dr Johan Sjöström (RISE, Deputy PL)
- Dr Frida Vermina Plathner (RISE)
- Dr Kerstin Eriksson (RISE)
- Robert Svensson (RISE, PhD-student).

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1 Introduction

This is the first progress report in the project "NoMR - Not my responsibility" financed by Formas.

NoMR is a research project that aims to describe how to adapt Swedish communities to be better prepared for wildfires in Sweden through the development of a common view of wildfire hazard, exposure and vulnerability, as well as stakeholder responsibilities. With a description and a common view of the vulnerability and the distribution of responsibilities for climate adaptation strategies, we can improve this adaptation work on different levels and among different stakeholders in society. This will ensure that the important work presently underway concerning adaptation due to climate change, and its impact on increased wildfire hazard, from falling into the cracks between stakeholders that do not share the same view of their respective responsibilities.

NoMR runs nominally for four years (over five calendar years) and is a collaboration between Lund University and RISE Research Institutes of Sweden.

2 Work package 0 Project management

The project began 1st December 2022. Work package 0 has been on-going for the whole of the project thus far and is expected to continue until the end of the project.

2.1 Management

This WP includes technical and administrative management of the project. Professor Margaret McNamee (Lund University) was the Project Leader (PL) at the outset of the project until June 2025, supported by Dr Johan Sjöström (RISE) as deputy PL. From June 2025, Dr Tove Frykmer has taken over as PL. This WP ensures that all relevant national and international regulations are met (e.g. concerning GDPR, worker conditions etc), coordinates with ongoing national and international collaborations and organises quarterly project meetings.

A project Teams space was established in the first months, with the following folders for sharing project documents with all participants:

- Approved Application
- WP0 Project Management
- WP1 Stakeholder dialogue
- WP2 Wildfire and Wildland Urban Interface (WUI) fuels behaviour
- WP3 Mapping of formal and informal stakeholder interactions – Stakeholder identification
- WP4 Hazard, exposure and vulnerability assessment
- WP5 Wildfire Safe Communities
- WP6 Outreach and Education

Additional folders and sub-structure have been developed as needed.

2.2 Meetings

The project has minuted project meetings nominally four times per year, with additional meetings held in between for individual work packages or for PhD-student supervision. Most project meetings are held online with one project meeting per year held in person either in Lund, Göteborg or Borås.

All meeting minutes are stored in the Teams folder for WP0, for easy access by all project participants.

2.3 Funding

Funding sent to Lund University from Formas has been distributed based on the distribution in the application. To date, research has been progressing and funding has been distributed according to plan.

During the second year of the project, FORMAS project officer authorized two minor changes in the budget allocation. Some of the funding for RISE was allocated to support secondment of Dr Frida Vermina Plathner to UPC in Barcelona for a short period. Additionally, some of the Lund University funding was reallocated from personnel funding (i.e. hours of research) to support a research visit to Australia in conjunction with Lucas Hovarts secondment to Australia for six months. More is written about these exchanges under the section on Research Exchange.

Funding was also sought and awarded from Brandforsk to support the travel and expenses for Lucas Hovarts six months in Australia.

3 Work package 1 Stakeholder dialogue

Work package 1 concerns stakeholder dialogue, which is at the core of the project. For the start of the project, the focus has been on definitions of responsibility, identification of relevant stakeholders and analysis of a specific case study of the Finsjö wildfire from the perspective of stakeholder responsibility, with a focus on the Fire and Rescue Service (FRS).

3.1 What is responsibility?

Responsibility as a concept is complex, and gives rise to multiple interpretations and manifestations in different situations, e.g. ethical or legal. Multiple theories offer useful clarification as a starting point for meaningful dialogue (Hamilton, 1978, Fincham and Jaspars, 1980, Heider, 1958, Beck, 1992, Giddens, 1999, Strydom, 1999). Among the various models developed to represent the complexity of the responsibility attribution, we have chosen to apply a modified version of Pellizzoni's typology (Pellizzoni, 2004). Pellizzoni encapsulates the distinction between before and after an event on the x-axis of his typology while certainty and uncertainty are on the y-axis. Within the framework of this model, we have chosen to use the nomenclature of duty and blame on the horizontal axis, and formal and informal on the vertical axis aspects of responsibility. The axes delineate four interpretations of responsibility: care, liability, responsiveness, and accountability, see Figure 1. This is a modification to the Pellizzoni model in that while Pellizzoni sees a cyclic progression from pre-event feelings of responsibility to post-event and back again, we take the approach of Löfmarck et al. (2017) that all types of responsibility in the typology can exist at all times. Löfmarck et al. (2017) have previously applied this model to understand confusion encountered concerning questions of responsibility in Swedish forestry regulations and how they are applied.

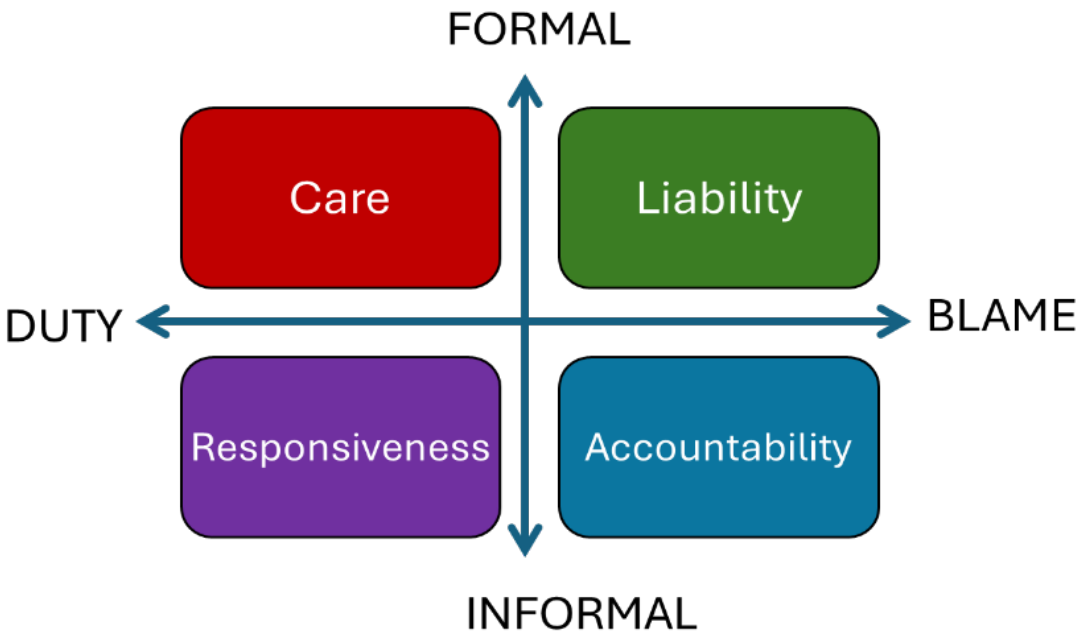

Figure 1: Modified schematic view of typology of responsibility based on Pellizzoni (2004).

Using this nomenclature, *care* means answering normatively to known needs, in a way that is validated and expected morally or legally, *liability* refers to being held legally or morally responsible for fault according to standardized expectations, *accountability* relates to being held responsible by self-binding standards in relation to reasoned (rather than formal) justification, and *responsiveness* refers to acting responsibly due to being sensitive to informal external issues.

To date (exemplified through our application to the analysis of the Finsjö wildfire), our interest lies in the distinction between *care* and *responsiveness*, the two sub-aspects related to duty in the horizontal dimension of the typology, and how their differences can help us consider diverse forms of responsibility division. *Duty* in this context relates to the time frame before and during a given situation. *Care* or *responsiveness* focus on the role taken by an individual or an organization, based on capacity (Vincent, 2011). While *care* manifests from known and codified needs, *responsiveness* designates action taken based on spontaneous perception of needs, a form of readiness-to-act. Nevertheless, the analysis of *care* and *responsiveness* give insights into *liability* and *accountability* as aspects of responsibility which can feed into potential assessment of blame after an event, which will be analysed in the future.

3.2 Description of the Finsjö wildfire

An updated version of the fire risk forecast model (based on the Canadian Forest Fire Weather Index (FWI) System) was implemented in Sweden (San-Miguel-Ayanz et al., 2022). Prior to 2021, only one time step per day (12 UTC) was available to represent an entire 24-hour period. With the new version, it was possible to show the evolution of the fire risk parameters over the course of the day, using hourly output data from the fire risk forecast (MSB, 2024).

In 2021, the grass fire season started in February, as soon as the snow cover has melted away. At this point the greatest outdoor wildland fire risk is for grass fires due to grass that grew during the previous year which can now act as fuel for potential grass fires. Typically (not just 2021), the main focus for grass fire risk is in the south of Sweden at the start of the year. As the temperature increased towards the spring, the area with grass fire risk extended towards the north. As summer approached, new grass began to grow, starting in the south part of Sweden, thereby ending the grass fire season.

The number of dry and warm days has a significant impact on wildfire risks in general. Table 1 shows a summary of the average temperature and precipitation in 2021 relative to typical values (San-Miguel-Ayanz et al., 2022). As shown in the table, anomalously high temperatures and low precipitation were experienced during February, March, June and July. Anomalously low precipitation was experienced during the whole of 2021.

Table 1: Overview of temperature and precipitation in Sweden, reproduced from San-Miguel-Ayanz et al. (2022), p104.

Month	Anomalously high temperatures	Anomalously low precipitation amounts
Feb	Yes. All time high in southern Sweden.	In southern Sweden (10-50%*)
Mar	Yes. All time high along the southern east coast.	Along the northern east coast (25-50%*)
Apr	No	Along the southern east coast and the west coast (25-50%) and (locally) in the north (50%)
May	No	In the eastern central to northern part of Sweden (50%)
June	Yes. 18-19 June: highest June temperature since 1947.	In the south and in the central north (25-50%)
July	Yes. Extensive areas with a +2°C anomaly*.	In the north and along the central east coast (50%)
Aug	No	Along the south part of the border to Norway (50%)
Sept	No	Along the south to central part of the east coast (50%)

The largest wildfire, in terms of spatial extent, started near Finsjö on 18 June, 2021. During 2021, there was an ongoing project at the Swedish Civil Contingencies Agency aimed at investigating the potential to detect wildfires using satellite images. The Finsjö fire was detected by the satellites, but reporting to the local FRS was through traditional channels with local residents calling in an alarm (Idh, 2021). Apart from the on-ground resources, the fire was fought with helicopters and water scooping aircrafts.

At the end of April, dynamic resource management (DRH) was introduced in Mönsterås, which is a new system for alerting the FRS emergency forces. Since "reinforced alarm" cannot be initiated by Internal Commanders (IC) within this system without a certain delay via the Operator at SOS Alarm, a temporary operational routine was developed. Prior to the Finsjö wildfire, the accident type *grass fire* or *fire in forest/land* had not been particularly frequent. A fire ban (step one) had been introduced in the entire Kalmar County as high fire danger ratings had been in force for an extended period. On the day of the reported fire incident, the weather conditions were as summarised in

Table 2.

Table 2: Summary of weather conditions on the day the Finsjö wildfire began. Translated from Idh (2021).

	Extreme conditions (PM)	Interval during 24 hours (18th June)
FWI (day)	5E – Extreme	9,5-43,5
Fuel moisture	5 – Very dry	
Relative humidity	~30%	32,5-94,6%
Windspeed		0,7-5,3 m/s
Temperature	33 °C	11,7-33 °C

It is difficult to say exactly when the fire was reported to the FRS but there are indications that residents called the event into SOS Alarm approximately 1.30 pm on the 18th June.

3.3 Analysis of the Finsjö wildfire with respect to responsibility

Data was collected using 26 semi-structured interviews of forest owners, volunteers, residents, and the FRS within the ClicNord project (Clicnord Project, 2024). Each interview was conducted by at least two interviewers. An interview guide was developed prior to the series of interviews and used as a basis for data collection. All data analyzed for this study was extracted from interviews which were recorded, transcribed, and anonymized before analysis. Out of the 26 interviews, 14 interviews with the FRS were selected for detailed analysis concerning perceptions of responsibility. Of the 14 interviews, a total of 10 were identified which implicitly or explicitly discuss responsibility. This subset of 10 interviews provided the basis for the data and analysis presented here. Therefore, all material that is presented is based on the FRS point of view. While valuable expressions of responsibility were present within interviews conducted with the other participant groups, in this initial study the point of view of the leadership assumed by the FRS has been the focus.

The technique of framework analysis has been applied to identify feelings of responsibility expressed by the interviewees (Patton, 2015), with the 10 interviews being analysed for emergent themes. What we have shown is that responsibilities manifest themselves in different ways, from *dutiful care* to *spontaneous responsiveness,* or by *formal liability* or *informal accountability*. Moreover, these different forms of responsibility, within a wildfire intervention, each present benefits and challenges. Therefore, building shared responsibility within communities is not done best by merely formalising duties and codifying actions. There is potential benefit in recognizing that there are shared responsibilities, as responsibility manifested through several forms, which have the potential to contribute to different layers of need.

This reflection is expected to be the starting point for a practical application if used as a basis for stakeholder dialogue. By recognising the different forms of responsibilities, one can start questioning the expectations they delineate. A systematic comparison of stakeholders' mutual expectations could lead to a structured description of the responsibility landscape into given wildfire management contexts. It would offer a precedent for future applications as a framework for both analysis and engagement building within communities. Overall, the preliminary analysis shows that spontaneous volunteers are perceived as helpful by the FRS, but not without challenges, in agreement with previous work (Eriksson and Danielsson, 2022). They are seen as one benefit of small communities where people know each other and are eager to help and answer the needs of others as they emerge. However, the informal nature of help becomes a source of uncertainty as one cannot guarantee it will manifest in a predictable way in every situation. In addition, as spontaneous volunteers are generally untrained and inexperienced, they can introduce risks leading to perceived concerns of accountability by the FRS. Finally, while the typology used shows usefulness by distinguishing different expressions of responsibility, the data used presents added layers of complexity which the framework fails to encapsulate in its current form. In the future additional empirical analysis of the data should provide input to the elaboration of our theoretical understanding of responsibility as a concept.

The analysis in full has been published in a conference paper by Hovart et al. (2024a). A working version of the analysis was also presented at the Nordic Fire and Safety Days 2024 (Hovart et al., 2024b).

3.4 A consolidated framework for responsibility in disaster risk management

The article develops a consolidated framework for responsibility (CFR) in disaster risk management to address the conceptual vagueness that surrounds the notion of shared responsibility. While the Sendai Framework promotes shared responsibility as a guiding principle, its lack of definition often leads stakeholders into ambiguous situations where roles are assumed but not clearly understood. The article argues that before responsibility can be meaningfully negotiated or distributed, stakeholders must first achieve a common understanding of what responsibility itself entails.

The theoretical foundation of the study draws on both disaster risk management literature and wider philosophical, sociological, and legal perspectives. These bodies of work reveal responsibility as a multi-layered and contested concept that has been variously defined in terms of causality, temporality, formality, capacity, agency, and motivation. The review demonstrates that no single perspective is sufficient on its own, highlighting the need for a framework that integrates diverse insights while remaining adaptable to context.

The consolidated framework is presented as an “onion model” comprising four interdependent dimensions. At its core lies **Definition**, which clarifies the causal link between agents, expectations, and effects, and distinguishes between prospective and retrospective responsibilities as well as formal and informal modes. Surrounding this are the **Conditions,** capacity, agency, and trust, which determine whether responsibility can in fact be assumed or assigned. Beyond these, the dimension of **Motivation** captures the drivers that influence whether actors take on responsibility, including avoidance of blame, attraction of praise, and the embodiment of values. Finally, the outer layer of **Division** concerns the ways responsibility is shared, absorbed, deflected, or collectivised between actors. The layering illustrates not only dependency between levels but also the progression from abstract meaning to applied practice.

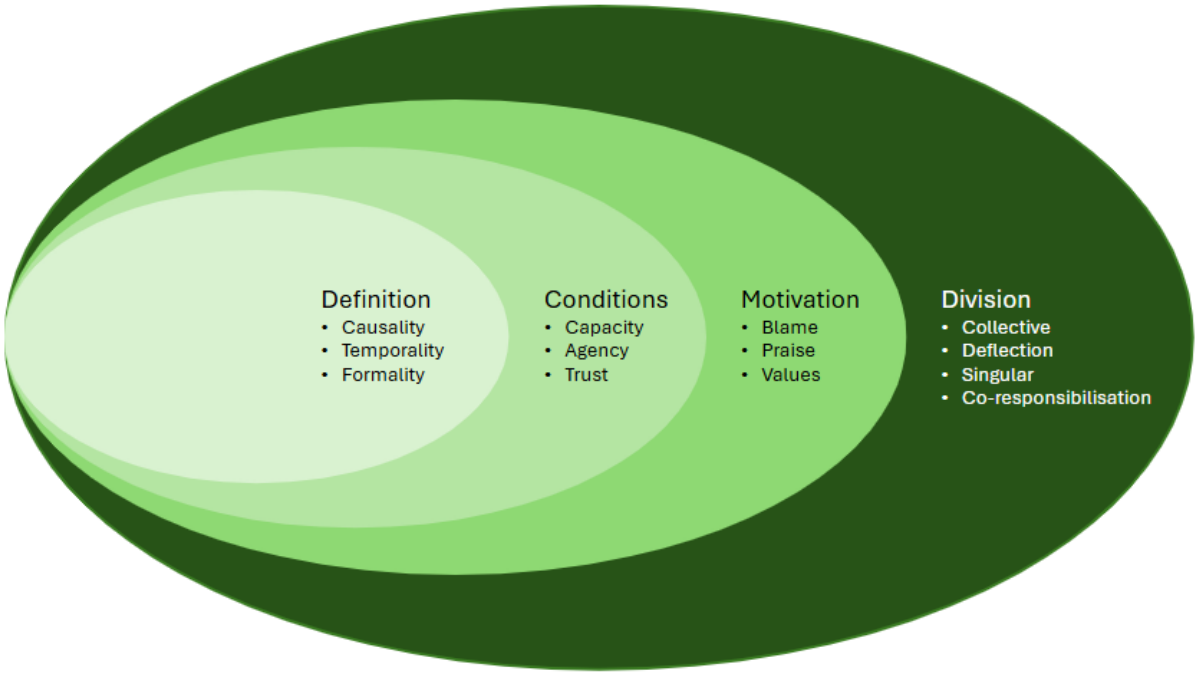

Figure 2 : Schematic illustration of the consolidated framework for responsibility. Each layer refers to a dimension of the framework and is identified as a separate colour. Attributes for each dimension are listed below the title of the layer.

The utility of the framework is then demonstrated through its application to the Sendai Framework. The analysis shows that Sendai emphasizes formalisation, capacity building, and state-led coordination, but leaves gaps in informal dynamics such as trust, moral values, and effective co-responsibility. This illustrates both the strengths and limitations of international agreements in addressing the multi-dimensional nature of responsibility.

In conclusion, the article highlights that the CFR offers both conceptual clarity and analytical structure for navigating shared responsibility. It allows stakeholders to identify where misunderstandings, gaps, or misalignments may occur, and stresses that only once the concept of responsibility is clearly understood can negotiations about its division take place effectively. Importantly, the framework also provides a pathway for future work by identifying which dimensions or attributes are most decisive in enabling community engagement. In areas where preparedness culture remains underdeveloped, particular attention to key dimensions and attributes may prove especially influential to support development. In this way, the CFR not only clarifies the language of responsibility but also opens avenues for more targeted strategies to foster engagement and resilience in contexts where it is most needed.

4 Work package 2 Wildfire and Wildland Urban Interface (WUI) fuels behaviour

WP2 will focus on understanding the fire behaviour on forest and WUI fuels and their emissions.

4.1 Wildfire emissions

It has been noted that there is a lack of published emission data from typical forest fuels that exists in Sweden. There have been studies of emission from other boreal forest around the world. But the Swedish forest differs from the rest of the world by being mainly production forest. The fuel involved in the fires are mainly surface fuels in pine and spruce stands and containing mostly mosses and litter. Within the project we have conducted over 100 small scale combustion tests in the Cone calorimeter (ISO 5660-1) where particle size of the smoke was measured with an ELPI and gas composition of the emissions with an FTIR. The tests were focusing on the upper 5 cm of the surface. The tested moisture content of the samples was spanning approximately 7 – 35 %, which is the span from the driest measured Swedish MC to the limit a fire could sustain.

Table 3: All detected gas yields from the cone calorimeter study in October 2024.

Sample type	Spec.	MC (%)	CO_2	CO	CH_4	C_2H_4	NO	NH_3	HCHO
Pine									
Moss	*Pleurozium*	10	1390 ± 100	74.1 ± 5	6.37 ± 1.5	0.361 ± 0.06	0.122 ± 0.21	2.55 ± 0.43	-
		16	1510 ± 69	89.7 ± 7.9	7.13 ± 0.81	1.05 ± 0.8	0.13 ± 0.23	2.46 ± 0.17	0.455 ± 0.79
		29	1370 ± 150	86 ± 3	7.3 ± 1.2	1.15 ± 0.59	-	2.52 ± 0.14	-
	Hylocomium	9	1480 ± 130	79.2 ± 6.8	5.68 ± 0.79	0.316 ± 0.25	0.359 ± 0.33	2.1 ± 0.16	-
		16	1460 ± 70	85.4 ± 4.9	7.43 ± 0.94	0.406 ± 0.08	-	2.46 ± 0.43	-
		31	1440 ± 57	98.5 ± 11	6.08 ± 0.83	1.04 ± 0.34	-	2.41 ± 0.18	-
Lichen	*Cladonia*	10	1480 ± 3	36.8 ± 2.1	0.687 ± 0.045	0.12 ± 0.028	-	0.41 ± 0.075	-
		15	1520 ± 19	39.4 ± 3.4	0.792 ± 0.36	0.121 ± 0.13	0.168 ± 0.29	0.302 ± 0.068	-
		34	1520 ± 48	33.8 ± 2.3	1.29 ± 0.27	0.095 ± 0.1	-	0.408 ± 0.032	-
1-h litter	Needles	7	1580 ± 9	41.7 ± 2.9	0.297 ± 0.063	-	2.68 ± 0.61	0.161 ± 0.099	-
		12	1690 ± 28	43 ± 4.5	0.146 ± 0.089	-	2.31 ± 0.87	0.132 ± 0.16	-
		18	1660 ± 42	51.9 ± 4.6	0.378 ± 0.019	-	2.74 ± 0.23	0.511 ± 0.16	-
	Twigs	8	1630 ± 12	37.9 ± 2.6	0.0705 ± 0.04	-	1.69 ± 0.29	-	-
		11	1640 ± 23	37.3 ± 2.8	0.0245 ± 0.042	-	1.85 ± 0.5	0.0045 ± 0.0078	0.11 ± 0.19
		18	1660 ± 17	33.2 ± 1.8	-	-	1.44 ± 0.93	-	-
	Bark	9	1590 ± 17	50.5 ± 1.7	0.0162 ± 0.028	-	-	-	-
		13	1620 ± 67	59.4 ± 7.6	-	-	-	-	0.17 ± 0.29
		22	1590 ± 51	52.3 ± 5.7	0.201 ± 0.35	-	-	-	-
10-h litter	Deadwood	13	1580 ± 27	26.5 ± 0.54	0.369 ± 0.24	-	-	-	0.0223 ± 0.039
	Cones	13	1580 ± 9	47.7 ± 3.9	0.592 ± 0.19	-	-	0.0017 ± 0.003	-
Spruce									
Moss	*Pleurozium*	10	1490 ± 32	79.7 ± 7	4.41 ± 0.2	0.331 ± 0.023	-	2.8 ± 0.24	-
		15	1430 ± 86	88.3 ± 12	5.91 ± 1	0.254 ± 0.079	-	2.79 ± 0.63	-
		32	1040 ± 220	133 ± 24	10 ± 4	1.45 ± 0.24	-	5.05 ± 1.3	3.62 ± 2.1
	Hylocomium	11	1550 ± 9	84.6 ± 2	3.51 ± 0.18	0.521 ± 0.14	0.365 ± 0.63	1.98 ± 0.067	-
		17	1370 ± 68	63.9 ± 13	3.31 ± 0.58	0.679 ± 0.28	0.62 ± 0.54	1.1 ± 0.36	-
		31	1060 ± 390	101 ± 9.3	6.34 ± 2.2	1.28 ± 0.79	-	2.72 ± 0.54	2.62 ± 2.4
	Dicranum	17	1270 ± 58	57.5 ± 7.9	5.13 ± 1.5	0.599 ± 0.33	-	2.07 ± 0.69	-
		35	980 ± 170	92.1 ± 23	10.4 ± 3.4	0.966 ± 0.4	-	3.94 ± 1.8	1.08 ± 1.9
1-h litter	Needles	13	1670 ± 4	62.5 ± 5	0.315 ± 0.14	-	2.96 ± 0.11	0.229 ± 0.18	-
Birch									
1-h litter	Leaves	11	1740 ± 21	67.9 ± 1	2.19 ± 0.11	0.628 ± 0.053	1.64 ± 0.62	2.31 ± 0.22	-
		14	1760 ± 40	64.2 ± 1.4	2.08 ± 0.19	0.625 ± 0.12	1.89 ± 0.88	1.76 ± 0.2	-
		23	1720 ± 40	56.7 ± 7.3	1.63 ± 0.38	0.282 ± 0.13	1.3 ± 0.087	1.72 ± 0.34	-

Table 4: All detected particle yields from the cone calorimeter study in October 2024.

Sample type	Spec.	MC (%)	$PM_{0.1}$	$PM_{0.25}$	PM_1	$PM_{2.5}$	PM_{10}
Pine							
Moss	*Pleurozium*	10	2.09 ± 0.42	13.5 ± 2	22.2 ± 2.8	23.3 ± 2.7	54.7 ± 5.4
		16	2.05 ± 0.11	13.1 ± 3.8	24.1 ± 15	25.8 ± 16	62.2 ± 28
		29	3.43 ± 0.46	16.6 ± 2.3	21.8 ± 2.6	22.8 ± 2.7	52.2 ± 5.4
	Hylocomium	9	1.73 ± 0.17	13.5 ± 2	27.6 ± 15	28.7 ± 14	58.5 ± 14
		16	2.33 ± 0.3	11.2 ± 0.18	15.7 ± 1.2	16.4 ± 1.1	46.9 ± 6.9
		31	2.97 ± 0.55	10.9 ± 2.8	13.1 ± 3.4	14.5 ± 3.3	51.4 ± 1.2
Lichen	*Cladonia*	10	1.84 ± 0.17	16.4 ± 0.48	29.2 ± 0.68	30.9 ± 1.2	65.5 ± 6.7
		15	1.65 ± 0.076	12.3 ± 1.7	21.7 ± 3.7	23.1 ± 3.8	56.3 ± 6.9
		34	2.25 ± 0.064	10.8 ± 1.5	15.5 ± 2.6	17.2 ± 2.9	56.4 ± 6.8
1-h litter	Needles	7	0.921 ± 0.04	31.8 ± 0.3	111 ± 1.1	114 ± 1.5	168 ± 3.2
		12	0.758 ± 0.078	35.5 ± 0.02	113.8 ±4.55	118.2 ± 6.08	170.5 ± 17.0
		25	0.90 ± 0.098	33.4 ±1.59	90.0 ± 5.76	96.7 ± 7.69	127.9 ± 10.6

Sample type	Spec.	MC (%)	$PM_{0.1}$	$PM_{0.25}$	PM_{1}	$PM_{2.5}$	PM_{10}
Pine							
	Twigs	8	0.681 ± 0.082	24.9 ± 1.8	89.1 ± 12	92.1 ± 13	117 ± 13
		11	0.56 ± 0.003	23.6 ± 0.19	78.9 ± 5.9	83.1 ± 3.7	110.6 ± 2.1
		18	0.65 ± 0.08	24.0 ± 0.44	78.4 ±3.4	83.5 ± 1.8	105.8 ± 5.1
	Bark	9	0.554 ± 0.12	6.78 ± 1.8	15.7 ± 5.5	18.2 ± 6.5	53.5 ± 11
Spruce							
Moss	*Pleurozium*	10	2.4 ± 0.3	20.7 ± 0.45	35.1 ± 2	36.8 ± 2	81.2 ± 5
		15	2.88 ± 0.19	18.6 ± 1.7	27 ± 3.3	28.3 ± 3.3	65.6 ± 7.3
		32	3.48 ± 0.27	27.4 ± 3.9	55 ± 18	56.1 ± 17	89.7 ± 11
	Hylocomium	11	2.39 ± 0.032	19.2 ± 2.3	31.7 ± 7.1	33.9 ± 7.5	86.8 ± 13
		17	2.67 ± 0.21	18 ± 0.49	26.9 ± 0.91	28.9 ± 0.83	83.4 ± 1.1
		31	3.48 ± 0.29	20 ± 1.6	31.3 ± 7.5	33 ± 7.6	81.6 ± 7.7
	Dicranum	17	2.33 ± 0.27	15.9 ± 0.91	23.7 ± 3	25.2 ± 3.1	63.8 ± 8.4
		35	3.09 ± 0.45	18.8 ± 0.52	27.9 ± 5.7	28.7 ± 5.8	50.4 ± 7.3
Birch							
1-h litter	Leaves	11	2.79 ± 0.45	23.8 ± 0.53	44.5 ± 1.9	47.3 ± 1.4	116 ± 7.4

The results are presented in a conference paper by Svensson et al. (2025) and will be presented in a Fire and Materials paper.

The total particle productions from the two last test days in October 2024 were giving much lower particle emission factors than what we could explain. So three extra test days in the cone was conducted in August 2025 to redo some of the tests to see if the results could be reproduced. As expected, the new tests showed other values than the ones from October 2024. The old particle results from the last two days were removed from the Fire and Materials article, and partly.

A new test series of slightly larger samples will be made in Lund during October 2025. In this series the area will be approximately 0.3 m x 0.3 m and 10+ cm thick. The main difference from the cone tests will be that we don't have a constant external heat source and that the increased thickness of the samples will make us able to continue the test through a "natural" smouldering phase.

5 Work package 3 Mapping of formal and informal stakeholder interactions – Stakeholder identification

WP3 aims to establish an understanding of the networks (and associated capabilities) that surround wildfire preparedness and response in Sweden. This requires mapping of the stakeholder structure from national to local level, starting with the legal framework for the FRS and progressing through the network layers to local implementation. In addition, to capture the formal networks which have manifested historically, this WP will also investigate networks that developed during a number of historical large-scale wildfires. Initial mapping was started at the outset of the project and will be developed as the project planning for stakeholder outreach approaches. Figure 3 contains a snapshot of the stakeholder mapping shared between partners through Padlet.

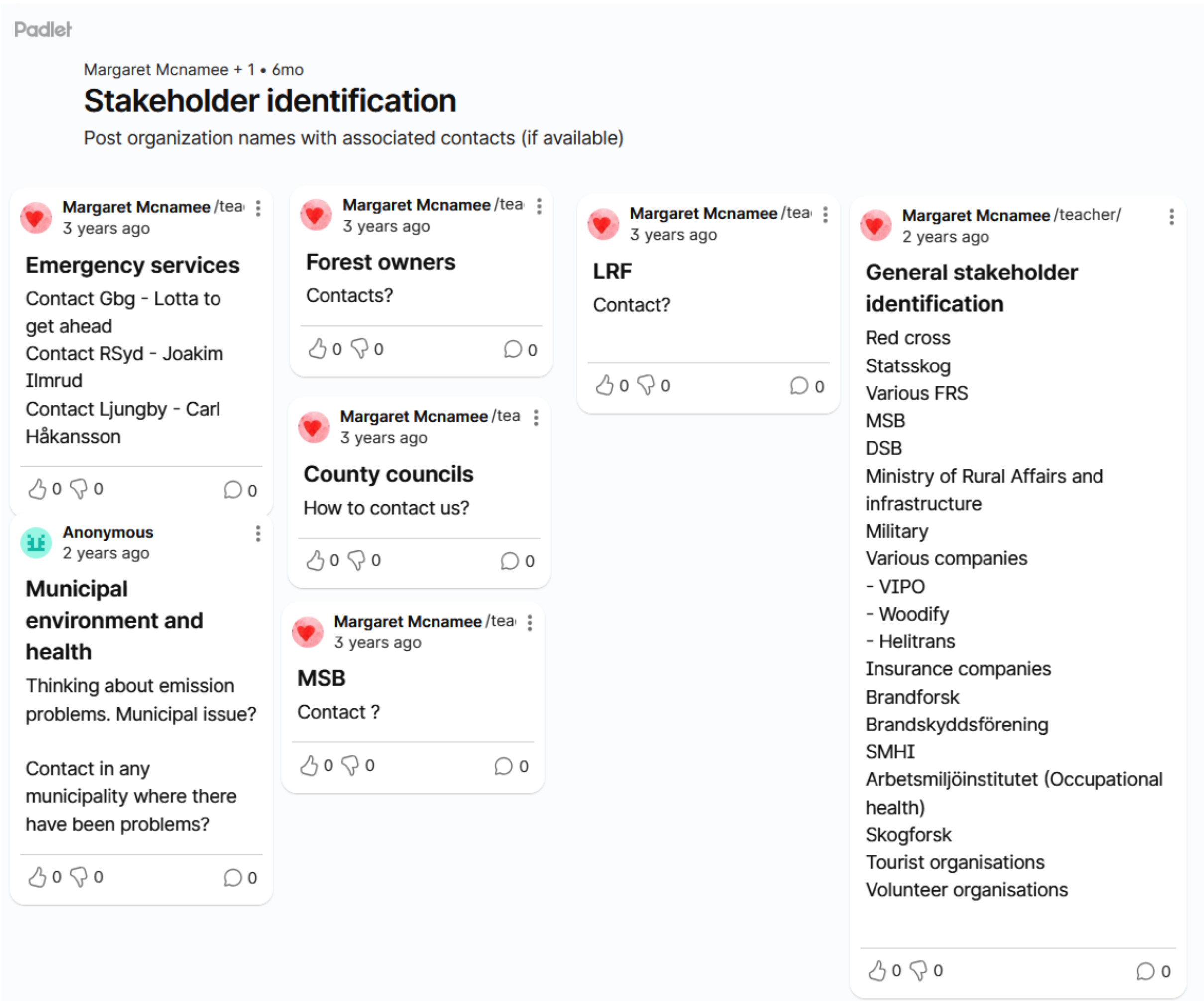

Figure 3: Padlet overview of initial stakeholder mapping.

6 Work package 4 Hazard, exposure and vulnerability assessment

Work Package 4 (WP4) addresses wildfire risk in the Swedish Wildland–Urban Interface (WUI) by assessing hazard, exposure, and vulnerability. The objective is to assess how community vulnerability is shaped by the structure, location, surroundings, and available resources of settlements at risk.

6.1 Vulnerability

In scientific literature, vulnerability is commonly described as a multidimensional concept that includes physical, social, ecological, and institutional dimensions (Birkmann et al., 2013, Fischer et al., 2013). In the context of wildfire, social vulnerability is defined as the degree to which individuals or groups are exposed to, susceptible to, and able to cope with or adapt to wildfire risks. This means that vulnerability is shaped not only by environmental and structural factors, but also by social and demographic conditions, varying by both context and scale (Cutter et al., 2003, McNeeley et al., 2017).

Social vulnerability to wildfire in Sweden was evaluated through two complementary approaches (Vermina Plathner, 2024):

1. National-scale demographic analysis
   Wildfire incidents that either threatened or damaged buildings (n = 3257, between 1996 and

2022) were matched with demographic data at the census tract level. Results show that sparsely populated areas are disproportionately exposed to wildfire. Factors associated with higher exposure include low population density, older building stock, longer distances to firefighting resources, and a higher proportion of older adults. Contrary to previous international findings, Swedish wildfire exposure was higher in areas with fewer foreign-born residents and more owner-occupied homes, likely partly reflecting the spatial distribution of tenure and demography in rural areas as well as the fact that building ignitions are often caused by Swedish fire-use traditions.

2. Qualitative content analysis of incident reports
   A directed content analysis of event reports was conducted to identify themes of exposure, susceptibility, and coping capacity at the household level. Key findings include that traditional fire use (e.g., spring grass burning) significantly increases exposure, particularly among older residents. Age, poor mobility, and emotional attachment to property contributed to increased susceptibility, while long arrival times for emergency services due to rural remoteness exacerbated impacts. Conversely, neighbouring residents and community involvement were found to play an important role in coping, often acting before responders arrived.

These findings highlight that social vulnerability in the Swedish WUI is not easily generalized from international models and must be understood within the context of Nordic settlement patterns, cultural practices, and service accessibility.

To complement this work, WP4 also addresses physical vulnerability, which refers to how the design and maintenance of homes and gardens influence the likelihood of fire-related damage. Research conducted in related projects has shown that the physical vulnerability of buildings is primarily determined by micro-scale features. These include the presence of flammable materials near façades, un-mowed lawns, and the use of coniferous hedges. Importantly, the study found that fires that damage buildings are usually small and ignited close to the structure, making local-scale features more relevant than regional fuel loads (Vermina Plathner et al., 2023, Vermina Plathner et al., 2025).

Because such features are difficult to assess through satellite imagery, a homeowner-based survey tool was developed to capture local physical vulnerability, jointly through the NoMR and FirePrime projects (grant agreements 2022-01843 and 10114038-1). The tool evaluates factors such as building material, vegetation type and proximity, and garden maintenance. It was piloted in the village of Berga through a collaboration between RISE, UPC, and BOKU. Following a first round of evaluation, the tool is now under further development.

The spatial delineation of the WUI in Sweden has been handled in Formas project Skötsel av den bebyggelsenära naturmiljön (2021-02396) and H2020 project FirEUrisk (101003890).

6.2 Hazard

Wildfire hazard is evaluated in related projects (e.g. Formas 2021-02396). Wildfire hazard relates to the potential fire behavior of a particular fuel. As input to wildfire models, fuel properties of similar forest types (groupings may e.g. be described by the stand type and maturity) are commonly averaged in so-called fuel models. Wildfire predictions with identical weather conditions for these fuel models are then used to compare fuel hazard.

A paper draft on wildfire hazard in Sweden was submitted to the IAFSS 2026 conference. The study presents the results of a fuel inventory conducted 2021-2025. Although fuel properties vary, there is a significantly higher potential spread rate in forest floors under mature pine than in spruce, which, in turn, has a higher fire hazard than deciduous species.

7 Work package 5 Wildfire Safe Communities

This WP will build on the findings of WP2 and WP4 to create a Swedish equivalent of the FireWise program, a community preparedness program for wildfires developed in the US.

In 2024, funding was sought and awarded from the Swedish Fire Research Board (Brandforsk) for an exchange with Australia with the express aim to learn from wildfire experience in a country with a greater history of wildfires. This outreach is on-going during the first half of 2025. As part of this exchange, data will be collected concerning community programs and information with a focus on Victoria (the state which historically has had the most fatal wildfires).

7.1 Learning from Australia

In order to reach this goal, Lucas Hovart was sent to Australia to spend six months learning from the Australian bushfire safety culture. The goal of this trip was to gain knowledge from a country with a large experience with wildfires and with extended work realised on community resilience. The trip was funded by Brandforsk, allowing for this trip to happen from December 2024 to June 2025. Lucas Spent two months collaborating with the University of Melbourne at their countryside campus in Creswick. This first experience allowed him to experience the life in an environment exposed to bushfire risk and to practice preparedness first hand as a resident. Being on site during the peak of the fire season, he experienced a bushfire and was able to observe people's behaviour during the event. After these two months, he went to Sydney for a month to collaborate with partners at the University of New South Wales. This exchange allowed him to compare data and to gain knowledge on organisations collaboration during large scale bushfires. The last three month were spent at RMIT University in Melbourne. Lucas spent this period working on a large set of interview data relating the experience of a community heavily impacted by a large bushfire which occurred early 2024. The analysis of these data lead to a paper project in collaboration with RMIT researchers which will be submitted to the IAFSS conference. The entire project was reported to Brandforsk in the form of a webinar hosted in June 2025.

7.2 Results of research in Australia

The article emerging from this collaboration draws on 37 interviews with residents, firefighters, and disaster managers. Out of this dataset, 28 interviews were kept, focusing on members of the affected community, whether part of the local fire brigade or not. The study explores how preparedness and response were constructed and how decisions were made during the event.

The results show that while the community was generally well-prepared, as most residents reported awareness of the risk and some degree of practical, strategic, or relational preparation, few had engaged in preparedness at what could be considered an "optimal" level in regards to recommendations. Practical measures included property maintenance, sprinklers, and water tanks, the first one being highly encouraged, the others falling outside of officially recommended practices; strategic measures involved household fire plans and pre-packed evacuation bags; relational measures centred on staying connected with others, supporting neighbours and vulnerable individuals. However, during the response phase, strict compliance with official recommendations, particularly the directive to leave early on extreme or catastrophic fire danger days, was absent.

Instead, residents consistently relied on their assessment of their own situated agency. This meant balancing formal guidance with personal judgement, prior experiences, and local circumstances. In practice, participants described triangulating information from three main sources: digital alerts (e.g. VicEmergency app, weather radars, social media), environmental signals (changes in wind, smoke, or thunderstorms), and social communication (neighbours, friends, and relatives). These cues were cross-validated and combined in real time to inform decision-making.

The study highlights a tension between institutional expectations and community practices. Official communication regarding the fire danger rating functioned effectively as a trigger for alertness, and was efficient in that purpose, but did not directly prompt early evacuation. Instead, it was integrated into a broader risk assessment process, with protective actions implemented only once the fire's threat was confirmed locally. This tendency to assess risk before implementing protective actions is supported by theories in human behaviours in fire. In this light, noncompliance should not be seen as a lack of preparedness, but rather as a reflection of adaptive capacity, trust in personal and collective judgement, and the exercise of community disaster risk literacy, the ability to interpret and integrate multiple signals to assess situated agency. Such ability can be associated with the model of conditions required for the assumption of responsible actions. The model suggests that, in order to be able to assume responsibility, one needs to have appropriate capacity, a sufficient degree of agency, and trust in their ability to activate their capacity. The results show a case where the capacity to read and triangulate several signals allowed for the construction of a trusted picture of people situated agency, demonstrating how the three conditions for responsibility assumption were reunited.

The findings carry important implications for fire safety science and disaster risk management. First, preparedness frameworks can move beyond strict compliance as the benchmark for resilience. Second, variability in community preparedness and response strategies can be understood as both a constraint and a potential strength, depending on local capacity and context. Third, developing disaster risk literacy may be a productive way to enhance resilience in communities where resources are limited.

Overall, the study argues for a larger understanding of community resilience development: from a deficit-based view focused on what residents fail to do, toward a capacity-based view that recognises how people adapt, compensate, and act responsibly under complex fire conditions. Results and insights from this study will serve to inform future reflections in the Swedish context.

8 Work package 6 Outreach and Education

WP6 concerns the project's publication and outreach plan.

8.1 Publications and presentations

Publications to date are summarised below per year:

2025

- R. Svensson, J. Sjöström, F. Vermina Plathner, A. Sandinge, P. Blomqvist, E. Arinaitwe, M. McNamee (2025) "Wildfire emissions from european boreal fuels: Effects of fuel type and moisture content" Interflam 2025.
- Vermina Plathner, F., Sjöström, J. & Granström, A. (2025) Surface fuel variability in Boreal forests: Implications for fire hazard assessment. Manuscript submitted for publication to Fire Safety Journal.
- Hovart, L., Eriksson, K., Frykmer, T., & McNamee, M. (xxxx). Reframing responsibility: towards a consolidated framework for responsibility (CFR) in disaster risk management. *International Journal of Disaster Risk Reduction*. (under review)
- Hovart, L., McNamee, M. (2025, June). Lära av erfarenheter från skogsbränder i Australien [Webinar]. Brandforsk. Youtube. https://www.youtube.com/watch?v=cZUPa1taIEs&t=1s
- Van Kerkhof, F. & Correia de Almeida Serranito, F. (2025). *Burning Questions: Community Engagement and Wildfire Management in a Changing Climate: A case study of Kamloops, British Columbia, Canada*. Lund University (master thesis)
- Pucher. R. (2025). *Contributions of participatory land use planning approaches to enhance disaster resilience in the Wildland Urban Interface (WUI)*. Lund University (master thesis)

2024

- Nordic Fire and Safety Days
    - L. Hovart, K. Eriksson, T. Frykmer, M. McNamee, "Citizen responsive contributions in wildfire crisis Lessons about Shared Responsibility from the 2021 Finsjö fire", ESFSS, Barcelona, Spain, *Journal of Physics Conference Series,* DOI: 10.1088/1742-6596/2885/1/012070 (2024)
- ESFSS
    - F. Vermina Plathner, Who is exposed to Nordic WUI Fires? *J. Phys.: Conf. Ser. 2885 012068*. https://doi.org/10.1088/1742-6596/2885/1/012068
    - L. Hovart, K. Eriksson, T. Frykmer, M. McNamee, "Citizen responsive contributions in wildfire crisis Lessons about Shared Responsibility from the 2021 Finsjö fire", ESFSS, Barcelona, Spain, *Journal of Physics Conference Series,* DOI: 10.1088/1742-6596/2885/1/012070 (2024)

Related publications:

- FirEUrisk:
  Sjöström, J., Vermina Plathner, F. & Granström, A. (2025) 70 Years of observational weather data show increasing fire danger for boreal Europe and reveal bias of ERA5 reanalysed data. Scientific reports 15:20111. https://doi.org/10.1038/s41598-025-04200-3

- Clicnord:
  Eriksson, K., Sjöström, J., & Vermina Plathner, F. (2024). "This community will grow"—little concern for future wildfires in a dry and increasingly hotter Swedish rural community. Regional Environmental Change, 24(2), 69. https://doi.org/10.1007/s10113-024-02227-2

- Vermina Plathner, F. (2024). Hur brinner skogen? Initial kalibrering av den kanadensiska brandspridningsmodellen (MSB2355). Swedish Civil Contingencies Agency: Karlstad.

- Vermina Plathner, F., Sjöström, J. & Granström, A. (2022). Influence of tree species on surface fuel structure in Swedish forests. In D.X. Viegas & Ribeiro, L. M (Eds.) Advances in Forest Fire Research 2022 (pp. 1157-1166). Coimbra: University of Coimbra Press. DOI: 10.14195/978-989-26-2298-9_176.

- Formas bebyggelsenära:
  Elio Medina, J., Plathner, F. V., Pastor, E., & Fernandez-Anez, N. (2025). How to Approach the Definition of WUI in Northern Europe. Fire and Materials. https://doi.org/10.1002/fam.3264

- Plathner, F. V., Sjöström, J., & Granström, A. (2025). Early season wildfires pose the highest threat to buildings and people in Sweden. Fire Safety Journal, 104457. https://doi.org/10.1016/j.firesaf.2025.104457

- Plathner, F. V., Sjöström, J., & Granström, A. (2023). Garden structure is critical for building survival in northern forest fires–An analysis using large Swedish wildfires. Safety science, 157, 105928. https://doi.org/10.1016/j.ssci.2022.105928

2023:

- Website for outreach

2022: The project started December 2022 and no publications occurred that year.

Teaching: Emissions from wildfires added to the course VBRF55/VBRA20

8.2 Research exchange

In 2024-2025, Lucas Hovart was awarded a Brandforsk scholarship to Australia. He spent six months in Australia to study bushfire safety culture and community resilience. From December 2024 to June 2025, he worked with three universities: two months at the University of Melbourne’s Creswick campus, where he lived in a high-risk bushfire area and observed community behaviour during an actual fire; one month at the University of New South Wales in Sydney, focusing on organisational collaboration during large-scale bushfires; and three months at RMIT University in Melbourne, analysing interviews from a community affected by a major 2024 bushfire. This work led to a joint paper for the IAFSS conference, and the project was presented to Brandforsk in a June 2025 webinar.

In 2025, Tove Frykmer travelled to Australia to visit collaboration partners and Lucas in Melbourne. The purpose of the trip was to connect with research groups at University of New South Wales (UNSW) in Sydney, at University of Canberra and Royal Melbourne Institute of Technology (RMIT) in Melbourne. At UNSW, Tove connected with Dr Jaco Fourie, part of a research group involved in *Collective Action and Collaborative Governance in Crisis Situations* (https://www.cacgcs.unsw.edu.au) where focus was on understanding respective countries' crisis preparedness systems and the core of the two research groups. In Canberra, Tove and Lucas presented the research project and work so far (Tove was present and Lucas joined virtually through Teams) for approximately 15 researchers at the Centre for Environmental Governance (https://www.canberra.edu.au/research/centres/ceg). In Melbourne, Tove connected with researchers at RMIT, who were already collaborating with Lucas to find potential joint publications.

In 2025, Frida Vermina Plathner visited the Center for Technological Risk Studies (CERTEC) research group at the Universitat Politècnica de Catalunya (UPC), Barcelona. Frida introduced the research project for the research team led by Eulalias Planas and Elsa Pastor, who also lead the EU-funded project *FirePrime*, in which a harmonized FireSmart programme for Europe is developed. During her stay, she collaborated with Elsa Pastor and Pascal Vacca on the development of a microscale physical vulnerability tool for wildfire.

In 2024, Alexandre Paul Molina visited RISE (Lund) and Lund University for 2 months as part of the PyroLife PhD student exchange. His topic of research was community engagement with regards to wildfires. During his stay, he identified and interviewed a number of relevant stakeholders to obtain the Swedish perspective of engagement.

9 Key Findings

Key findings from project activities 2022–2025:

Empirical analysis of the 2021 Finsjö wildfire shows that responsibility during wildfire response is expressed in multiple forms, and that spontaneous volunteers are perceived as valuable but introduce uncertainty and accountability challenges for responders.

Initial stakeholder mapping across national, regional, and local levels indicates that wildfire preparedness and response rely on extensive informal networks and dependencies that are not fully reflected in formal organisational structures.

More than 100 small-scale combustion tests of Swedish boreal forest fuels have produced new emission data for fuel types and moisture conditions typical for Swedish production forests, generating knowledge previously unavailable in Sweden.

National-scale analysis of 3,257 wildfire incidents shows that exposure is highest in rural and sparsely populated areas, often involving older building stock, long emergency response times, and a larger proportion of elderly residents.

Qualitative analysis of incident reports and interviews highlights that traditional fire-use practices, physical limitations, and emotional attachment to property shape household vulnerability, while neighbour support is a critical factor in coping capacity.

A pilot homeowner-based vulnerability assessment tool has demonstrated that micro-scale building and garden features strongly influence building survival and will be used to inform Swedish guidance for community-level wildfire risk reduction.

A six-month research exchange in Australia has provided empirical insight showing that community preparedness and response are adaptive and context-based, relying on multiple information sources rather than strict compliance with official warnings.

Development and testing of a consolidated framework for responsibility has shown that unclear responsibility expectations hinder collaboration and that structured dialogue is needed to align roles and capabilities.

10 Other activities

The project has worked closely together with master students during 2025. Two groups of students from the program Disaster Risk Management and Climate Change Adaptation at the Division of Risk Management and Societal Safety were supervised by Tove Frykmer and Lucas Hovart. Their research questions were related to NoMR and knowledge could be exchanged and developed in collaboration. One student group finalised their thesis, *Burning Questions: Community Engagement and Wildfire Management in a Changing Climate - A case study of Kamloops, British Columbia, Canada*, in June 2025. In September 2025, the second student presented his thesis called *Contributions of participatory land use planning approaches to enhance disaster resilience in the Wildland Urban Interface (WUI)*.

Moreover, the project received a master student during May-July 2025, Ingrid Veen from Wageningen University in The Netherlands. Ingrid was based at the Division of Risk Management and Societal Safety, supported by Tove Frykmer and Kerstin Eriksson. She also visited RISE and Johan Sjöström and received assistance from Frida Vermina Plathner and Robert Svensson in her data collection. Ingrid plans to present her master thesis in November 2025, focusing on the research question: How can environmental, social and practical limitations to current preparation efforts for wildfires in Sweden, be factored in into preparation in disaster management?

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