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Public perception of forest fires: The role of knowledge, socio-demographic factors, and implications for fire management

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Abstract: Forest fires are becoming an increasingly serious environmental and social problem, driven by climate change and growing anthropogenic pressure. While their ecological aspects have been widely studied, less attention has been paid to social perception and its impact on fire management. The aim of this study is to analyse the social perception of forest fires among respondents residing in Poland, with particular emphasis on levels of knowledge, attitudes, and perceived risk. A quantitative (Computer-Assisted Web Interview, CAWI) survey was conducted between November 2025 and February 2026, involving 246 participants. Statistical analyses included non-parametric tests, correlation analysis, and the Relative Importance Index. The results indicate a moderate level of knowledge combined with predominantly negative attitudes toward forest fires. Significant differences were observed between socio-demographic and professional groups, with higher levels of knowledge recorded among respondents associated with forestry. A discrepancy was identified between perceived and actual knowledge, as well as a tendency to prioritise direct and visible effects of fires over long-term climatic consequences. Although some respondents recognised fire as a natural ecological process, the level of acceptance and understanding of management practices, such as controlled burning, remained limited. The findings highlight the importance of strengthening environmental education, improving risk communication, and increasing public awareness of integrated fire management methods. Given the non-probability and forestry-skewed sample, the findings should be interpreted as exploratory and cannot be generalised to the Polish population. Nevertheless, they provide insight into patterns of forest-fire perception that may inform further representative studies.

Keywords: environmental disaster; forestry problems; social survey; society

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In recent decades, the frequency, intensity, and spatial extent of forest fires have increased globally, driven by climate change, land-use transformations, and growing anthropogenic pressure (Keane et al.02008; Ślązak 2019; Bowman, Perry 2017; Jain et al. 2022; Yin et al. 2024; Kelley et al. 2025). Forest fires are therefore no longer solely an ecological phenomenon, but a complex socio-environmental issue affecting biodiversity, ecosystem functioning, climate regulation, and human safety. Forest fires are also increasingly recognised as an important component of the Earth system (Moazeni, Cerdà 2025; Bowman et al. 2009).

While the ecological drivers and consequences of forest fires have been widely studied, significantly less attention has been given to the social dimension of fire, particularly in terms of how knowledge, perceptions, and attitudes influence public responses and acceptance of fire management strategies (McCaffrey 2006; Oliveira et al. 2020; Palaiologou et al. 2021). This gap is critical, as societal perceptions can directly affect the effectiveness of fire prevention policies, risk communication, and the implementation of adaptive management practices such as prescribed burning.

Fire is often perceived predominantly as a destructive force, associated with biodiversity loss (Pausas, Keeley 2019; Żmihorski et al. 2019; Smith et al. 2000), atmospheric pollution, and economic damage (Pellegrini et al. 2018; Walker et al. 2019; Brown et al. 2000; Smith et al. 2000). However, in many ecosystems, fire also plays an essential ecological role, contributing to nutrient cycling, vegetation regeneration, and the maintenance of biodiversity (Agee 1993; Certini 2005; Bond, van Wilgen 1996; Stephens et al. 2016; Kobziar et al. 2024). This duality creates a fundamental challenge for forest management: balancing public risk perception with ecological realities.

Recent studies indicate that public understanding of fire ecology is often limited and fragmented, with a tendency to emphasise immediate and visible impacts (e.g. damage to forests and wildlife) while underestimating long-term climatic and ecological processes (Palaiologou et al. 2021). Moreover, acceptance of fire-related management strategies-particularly prescribed burning-varies significantly across demographic and professional groups (McCaffrey 2006; Oliveira et al. 2020).

Despite growing recognition of these issues, empirical data on the social perception of forest fires in Central and Eastern Europe remain scarce, especially in a comparative or cross-regional context. Furthermore, few studies explicitly link perception patterns with implications for fire risk management and policy design.

In Europe, including Central and Eastern regions, fire regimes are also undergoing significant changes due to increasing temperatures, prolonged droughts, and land-use transformations. Despite historically lower fire activity compared to Mediterranean regions, the growing vulnerability of forest ecosystems highlights the need for improved fire risk management strategies adapted to local environmental and social conditions.

In Poland, most publicly owned forests are administered by the State Forests National Forest Holding, which is responsible for forest management, fire-danger monitoring, fire-detection systems, patrols, and preventive infrastructure. The State Forests operates largely on a self-financing basis, using revenues from forest management and the Forest Fund. Fire-suppression operations are conducted primarily by the State Fire Service and volunteer fire brigades operating within the national rescue and firefighting system. These services are financed mainly from state and local-government budgets, whereas the State Forests finances fire monitoring and preventive measures within the forests under its administration.

This study addresses these gaps by providing a quantitative assessment of public knowledge, attitudes, and risk perception related to forest fires, with particular focus on differences across socio-demographic and professional groups, the relationship between perceived and actual knowledge, and the level of acceptance of fire as both a natural ecological process and a management tool. Importantly, the study goes beyond a purely descriptive approach by linking patterns of social perception with their practical implications for fire management, including the role of environmental education, the effectiveness of risk communication strategies, and the societal acceptance of preventive measures such as prescribed burning. By integrating the social dimension with a management-oriented perspective, this paper contributes to a more comprehensive understanding of human–fire interactions and supports the development of more effective and socially informed fire management strategies.

The main objective of this study is to analyse the social perception of forest fires among adult re-

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spondents from Poland with particular emphasis on levels of knowledge, attitudes, and perceived risks. The study examines how socio-demographic characteristics and levels of environmental knowledge influence public perception, attitudes, and understanding of forest fires, including their causes, impacts, and management strategies.

MATERIAL AND METHODS

Study design and data collection. The study was conducted using a quantitative approach based on a structured online survey (Computer-Assisted Web Interview, CAWI). Data were collected between November 1, 2025, and February 1, 2026. Participation was voluntary and anonymous, and the study was approved by the Ethics Committee of the University of Agriculture in Kraków (Approval No. 336/2025).

The survey questionnaire was developed by the authors and consisted of 21 questions, including single-choice and multiple-choice items. It was designed to capture respondents' socio-demographic characteristics, fire-related familiarity and experience, attitudes toward forest fires, perception of fire-related risks, and opinions on fire-management practices, including prescribed burning. In the questionnaire, the term 'forest services' referred to employees and organisational units of the Polish State Forests, whereas 'fire services' referred to the State Fire Service and volunteer fire brigades.

The survey used non-probability snowball sampling (Naderifar et al. 2017). The link was initially distributed through the authors' academic and professional networks, mainly among forestry students and early-career employees of the Polish State Forests, and was subsequently shared by respondents. Because the link could be forwarded freely, the number of people reached and the response rate could not be determined. The resulting sample was dominated by young respondents connected with forestry and should therefore be treated as exploratory and non-representative of the Polish population. (Naderifar et al. 2017).

Fire-related familiarity and experience index. To characterise respondents' familiarity with forest-fire issues and their previous fire-related experience, an exploratory composite score was developed and termed the fire-related familiarity and experience index. The index combined four questionnaire items concerning personal experience of witnessing a forest fire, self-reported familiarity with the main causes of forest fires, and awareness of controlled or prescribed burning. The index therefore reflects declared familiarity, awareness, and experience rather than objectively verified factual knowledge.

Responses were assigned scores ranging from 0 to 7, with higher scores indicating greater declared familiarity and fire-related experience. The scoring procedure is presented in Table 1. Because the index was developed specifically for this exploratory study and was not subjected to external validation, it should not be interpreted as a comprehensive measure of forestry or fire-ecology knowledge.

Statistical analysis. Statistical analyses were performed using SPSS Statistics (Version 29, 2024) and Microsoft Excel (Version Standard, 2024).

Table 1. Scoring system used to calculate the fire-related familiarity and experience index

Question	Answer	Score
Have you ever witnessed a forest fire in person?	Yes, many times	2
	Yes, once or several times	1
	No, never	0
Do you have knowledge of the main causes of forest fires in your region?	Yes, detailed knowledge	2
	Yes, partial knowledge	1
	No, I do not have such knowledge	0
Do you know what controlled burning in forests is?	Yes	1
	No	0
Have you heard about controlled burning, also known as prescribed burning, used in some regions as a forest management and wildfire prevention measure?	Yes, I know what it involves	2
	I have heard something about it, but I do not know the details	1
	No, I have never heard of it	0

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The normality of data distribution was assessed using the Shapiro–Wilk test. Due to deviations from normality, non-parametric tests were applied.

Differences between two groups were analysed using the Mann–Whitney *U* test, while comparisons across multiple groups were conducted using the Kruskal–Wallis test. Spearman's rank correlation coefficient was used to examine relationships between variables. For categorical data, chi-square (χ^2) tests of independence were performed.

To evaluate the perceived importance of selected fire-related impacts, the Relative Importance Index (*RII*) was calculated based on Likert-scale responses (1–5), allowing for ranking of factors according to their perceived significance. Statistical significance was assumed at $P < 0.05$.

RESULTS

Characteristics of respondents. All results presented below refer exclusively to the final sample of 246 respondents residing in Poland. The sample was dominated by men (58.1%), while women accounted for 41.9%. The age structure was strongly skewed toward younger participants, with respondents aged 18–24 years forming the largest group. In terms of place of residence, 47.6% of respondents lived in rural areas, while the remainder represented urban populations of varying sizes. A substantial proportion of respondents declared an educational or professional connection with forests, with students of forestry or related disciplines constituting 58.1% of the sample (Table 2). This sample structure reflects the recruitment strategy, which was initiated mainly within forestry-related academic and professional networks.

General attitudes toward forest fires. Respondents most commonly perceived forest fires negatively. More than half of the sample declared a negative attitude, while approximately one-third reported a neutral position. Positive attitudes were relatively rare (Figure 1).

The analysis of socio-demographic factors revealed that age significantly influenced attitudes toward forest fires (Table 3). Younger respondents more frequently expressed negative attitudes, whereas no significant effects were observed for sex, place of residence, or professional connection with forestry.

Knowledge and experience related to forest fires. The mean score on the fire-related familiarity and experience index was 3.61 (SD = 1.81) out of a maximum of 7 (Table 4). The distribution differed significantly from normality, as indicated by the Shapiro–Wilk test.

Table 2. Structure of respondents by sociodemographic and professional variables (n = 246)

Variables	Response	*n* (%)
Sociodemographic factors		
Gender	Women	103 (41.9)
	Men	143 (58.1)
Age	< 18	15 (6.1)
	18–24	145 (58.9)
	25–34	26 (10.6)
	35–44	29 (11.8)
	> 45	31 (12.6)
Place of residence	Rural areas	116 (47.6)
	A small town of up to 20 000 inhabitants	32 (13.0)
	City with up to 100 000 inhabitants	42 (17.1)
	City with over 100 000 inhabitants	56 (22.8)
Professional status		
Professional involvement with forests	Work in forestry	39 (15.9)
	Student of forestry or related studies	143 (58.1)
	No professional involvement with forests	64 (26.0)

n – sample size

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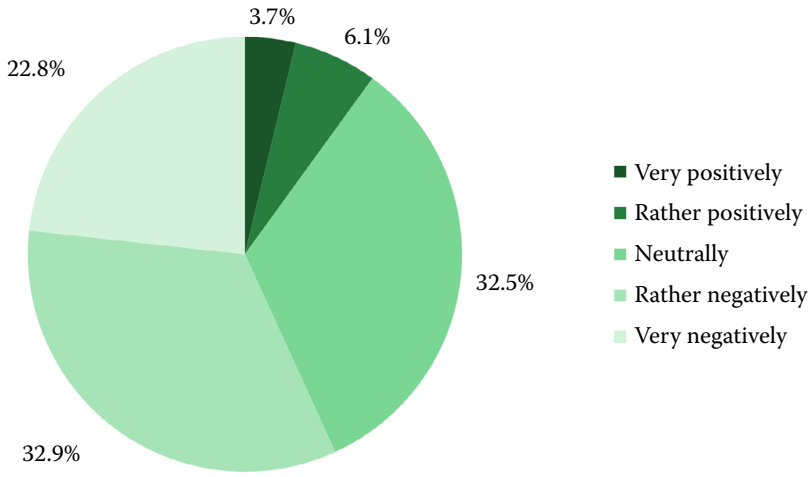

Figure 1. Respondents' overall attitudes toward forest fires in forests, plantations and other green areas

Knowledge levels differed significantly according to sex, age, and professional connection with forestry (Table 5). Men demonstrated higher levels of knowledge than women. Older respondents, particularly those above 45 years of age, showed higher knowledge levels compared to younger participants. The strongest differences were observed in relation to professional background, with respondents working in forestry achieving the highest knowledge scores.

Table 3. Association between sociodemographic and professional variables and respondents' overall attitudes toward forest fires – Chi-square test of independence statistics

Sociodemographic and professional variables	Response	Overall attitudes toward forest fires *n* (%)			Statistical test results			
		positive	neutral	negative	Chi^2	*df*	*P*	V_k
Gender	Women	7 (2.8)	37 (15.0)	59 (24.0)	1.768	2	0.413	0.085
	Men	17 (6.9)	48 (19.5)	78 (31.7)				
Age	< 24	11 (4.5)	60 (24.4)	89 (36.2)	13.620	6	0.034*	0.166
	25–34	6 (2.4)	11 (4.5)	9 (3.7)				
	35–44	3 (1.2)	5 (2.0)	21 (8.5)				
	> 45	4 (1.6)	9 (3.7)	18 (7.3)				
Place of residence	Rural areas	13 (5.3)	38 (15.4)	65 (26.4)	5.112	6	0.530	0.102
	A small town of up to 20 000 inhabitants	3 (1.2)	16 (6.5)	13 (5.3)				
	City with up to 100 000 inhabitants	4 (1.6)	12 (4.9)	26 (10.6)				
	City with over 100 000 inhabitants	4 (1.6)	19 (7.7)	33 (13.4)				
Professional involvement with forests	Work in forestry	6 (2.4)	13 (5.3)	20 (8.1)	7.458	4	0.114	0.123
	Student of forestry or related studies	10 (4.1)	57 (23.2)	76 (30.9)				
	No professional involvement with forests	8 (3.3)	15 (6.1)	41 (16.7)				

*$P < 0.05$; *n* – sample size; Chi^2 – chi-square statistic; *df* – degrees of freedom; *P* – *P*-value; V_k – Cramér's *V*

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Table 4. Descriptive statistics for the fire-related familiarity and experience index

Fire-related familiarity and experience index	*M*	SD	*Me* (Q1–Q3)	Min–Max	*Sk.*	*Kurtz.*	W–S	
							W	*P*
	3.61	1.81	4.00 (2.00–5.00)	0.00–7.00	–0.046	–0.578	0.960	< 0.001

M – mean; SD – standard deviation; *Me* – median; Min–Max – minimum and maximum values; *Sk.* – skewness; *Kurt.* – kurtosis; W–S – Shapiro–Wilk test; *W* – Shapiro–Wilk test statistic

More than half of the respondents assessed their own knowledge as high or very high, while approximately one-third considered it average (Figure 2). A significant positive correlation was found between self-assessed and actual knowledge levels (Table 6).

Perception of fire risk and ecological role of forest fires. Among the respondents included in the final Polish sample, more than half assessed the fire risk in Polish forests as high or very high (Figure 3). Age significantly influenced this perception, with younger respondents more likely to rate the risk as high (Table 7).

More than half of the respondents agreed that forest fires may, under certain conditions, constitute a natural and necessary element of forest ecosystems (Figure 4). This perception varied significantly by sex and age (Table 8).

Despite this, forest fires were generally perceived as having a negative impact on the environment, although a substantial proportion of respondents acknowledged their potential ecological benefits under specific conditions (Figure 5). Age significantly influenced these assessments (Table 9).

Perceived impact of forest fires on climate and ecosystems. The perceived importance of fire-re-

Table 5. Fire-related familiarity and experience index according to sociodemographic characteristics and professional involvement with forests

Sociodemographic factors and professional status	*Me*	Mann–Whitney *U*		
		25–75% *IQR*	*Z*	*P*
Gender				
Women	3.00	2.00–4.00	–3.989	< 0.001*
Men	4.00	3.00–5.00		
		Kruskal–Wallis		
		25–75% *IQR*	*H*	*P*
Age				
< 18	3.00	3.00–4.00		
18–24	3.00	2.00–4.00		
25–34	4.00	3.00–6.00	17.275	0.002*
35–44	3.00	2.00–6.00		
> 45	5.00	2.00–6.00		
Place of residence				
Rural areas	4.00	2.00–5.00		
A small town of up to 20 000 inhabitants	3.50	2.00–5.00	1.251	0.742
City with up to 100 000 inhabitants	3.00	3.00–5.00		
City with over 100 000 inhabitants	4.00	2.25–5.00		
Professional involvement with forests				
Work in forests	6.00	3.00–6.00		
Forestry or related studies student	3.00	2.00–5.00	22.595	< 0.001*
No professional involvement with forests	3.00	2.00–4.75		

Mann–Whitney *U* – Mann–Whitney *U* statistic; *Me* – median; *IQR* – interquartile range; *Z* – *Z* statistic; *H* – Kruskal–Wallis *H* statistic

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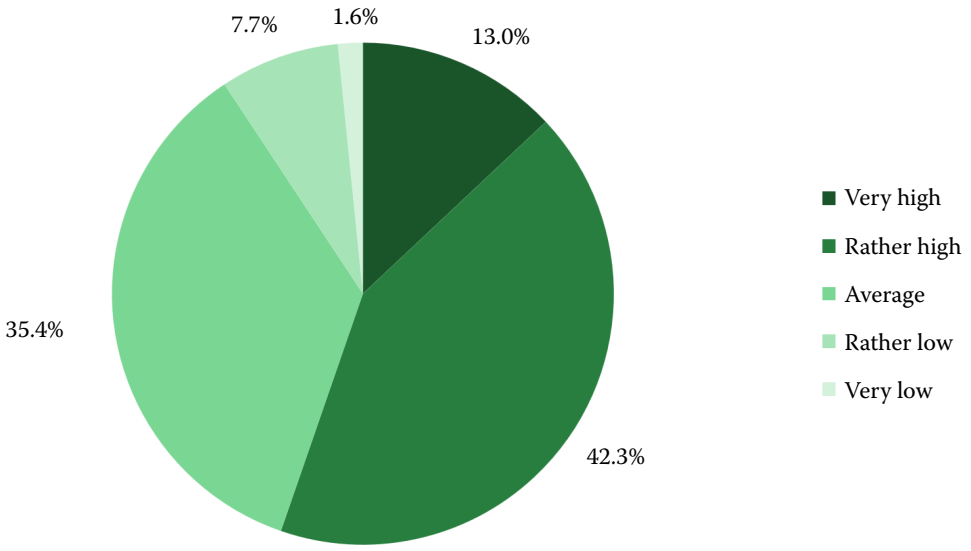

Figure 2. Relationship between self-assessed knowledge and the fire-related familiarity and experience index

lated impacts varied across categories (Table 10). Respondents assigned the highest importance to the negative impact on forest animals, followed by forest loss. Lower importance was attributed to climate-related impacts, including CO_2 emissions and regional climate change.

Significant differences in perception were observed across socio-demographic groups (Table 11). Women generally rated the impacts of fires as more severe than men. Age and professional background also influenced selected perceptions, particularly regarding the impact of fires on regional climate.

Table 6. Relationship between self-assessed knowledge and the actual level of knowledge about forests and environmental issues

Fire-related familiarity and experience index	*n*	Significance	Spearman's correlation
Self-assessed knowledge	246	< 0.001	0.577**

**$P < 0.001$; n – sample size

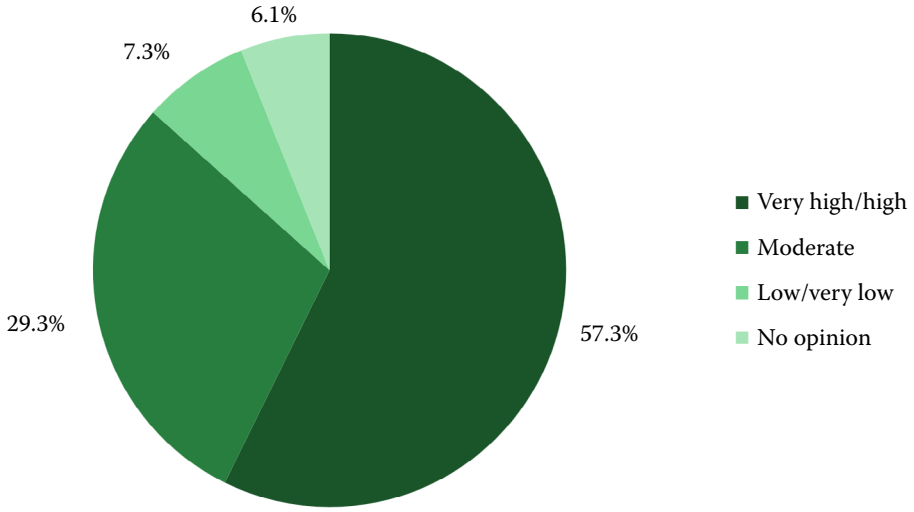

Figure 3. Respondents' self-assessment of fire risk in Polish forests

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Table 7. Association between respondents' sociodemographic and professional characteristics and their assessment of fire risk in Polish forests – Chi-square test of independence statistics

Sociodemographic and professional variables	Response	Assessment of fire risk in Polish forests *n* (%)				Statistical test results			
		Very high/ high	Moderate	Low/ very low	No opinion	Chi^2	*df*	*P**	V_k
Gender	Women	57 (23.2)	34 (13.8)	7 (2.8)	5 (2.0)	4.239	5	0.516	0.131
	Men	84 (34.1)	38 (15.4)	11 (4.5)	10 (4.1)				
Age	< 18	5 (2.0)	7 (2.8)	3 (1.2)	0 (0.0)	51.049	20	< 0.001*	0.228
	18–24	87 (35.4)	45 (18.3)	10 (4.1)	3 (1.2)				
	25–34	10 (4.1)	6 (2.4)	3 (1.2)	7 (2.8)				
	35–44	17 (6.9)	9 (3.7)	1 (0.4)	2 (0.8)				
	> 45	22 (8.9)	5 (2.0)	1 (0.4)	3 (1.2)				
Place of residence	Rural areas	70 (28.5)	33 (13.4)	6 (2.4)	7 (2.8)	28.276	20	0.103	0.170
	A small town of up to 20 000 inhabitants	16 (6.5)	12 (4.9)	2 (0.8)	2 (0.8)				
	City with up to 100 000 inhabitants	24 (9.8)	11 (4.5)	6 (2.4)	1 (0.4)				
	City with over 100 000 inhabitants	31 (12.6)	16 (6.5)	4 (1.6)	5 (2.0)				
Professional involvement with forests	Work in forests	26 (10.6)	8 (3.3)	2 (0.8)	3 (1.2)	12.667	15	0.628	0.131
	Forestry or related studies student	83 (33.7)	44 (17.9)	7 (2.8)	9 (3.7)				
	No professional involvement with forests	32 (13.0)	20 (8.1)	9 (3.7)	3 (1.2)				

*$P < 0.05$; *n* – sample size; Chi^2 – chi-square statistic; *df* – degrees of freedom; *P* – *P*-value; V_k – Cramér's *V*

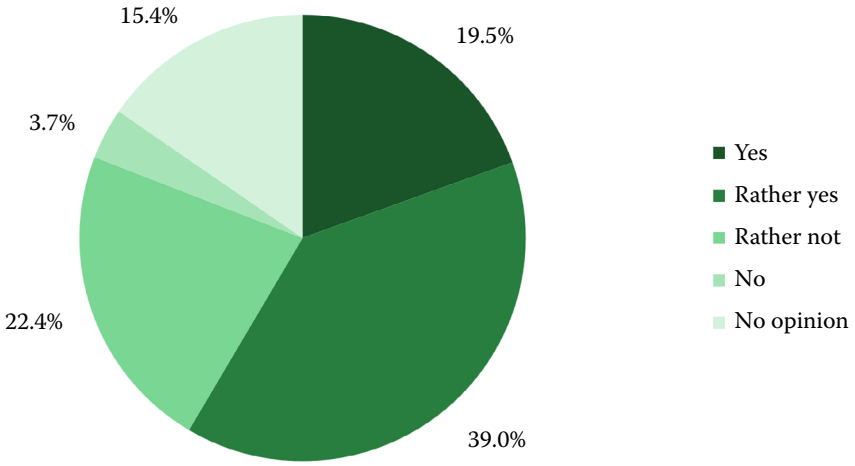

Figure 4. Respondents' opinions on the role of forest fires as a natural component of the forest ecosystem

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Table 8. Association between respondents' sociodemographic and professional characteristics and their opinions on the role of forest fires as a natural element of the forest ecosystem – Chi-square test of independence statistics

Sociodemographic and professional variables	Response	Do you believe that, under certain conditions, forest fires are a natural and necessary element of the forest ecosystem? *n* (%)					Statistical test results			
		Yes	Rather yes	No opinion	Rather not	No	Chi^2	*df*	*P**	V_k
Gender	Women	25 (10.2)	5 (2.0)	21 (8.5)	38 (15.4)	14 (5.7)	13.321	4	0.010*	0.233
	Men	13 (5.3)	4 (1.6)	34 (13.8)	58 (23.6)	34 (13.8)				
Age	< 18	1 (0.4)	0 (0.0)	4 (1.6)	9 (3.7)	1 (0.4)	30.233	16	0.017*	0.175
	18–24	24 (9.8)	7 (2.8)	29 (11.8)	66 (26.8)	19 (7.7)				
	25–34	3 (1.2)	1 (0.4)	3 (1.2)	9 (3.7)	10 (4.1)				
	35–44	5 (2.0)	0 (0.0)	11 (4.5)	5 (2.0)	8 (3.3)				
	> 45	5 (2.0)	1 (0.4)	8 (3.3)	7 (2.8)	10 (4.1)				
Place of residence	Rural areas	18 (7.3)	7 (2.8)	26 (10.6)	49 (19.9)	16 (6.5)	10.831	12	0.543	0.121
	A small town of up to 20 000 inhabitants	3 (1.2)	1 (0.4)	7 (2.8)	14 (5.7)	7 (2.8)				
	City with up to 100 000 inhabitants	7 (2.8)	1 (0.4)	11 (4.5)	13 (5.3)	10 (4.1)				
	City with over 100 000 inhabitants	10 (4.1)	0 (0.0)	11 (4.5)	20 (8.1)	15 (6.1)				
Professional involvement with forests	Work in forests	2 (0.8)	2 (0.8)	8 (3.3)	16 (6.5)	11 (4.5)	12.551	8	0.128	0.160
	Forestry or related studies student	21 (8.5)	7 (2.8)	32 (13.0)	60 (24.4)	23 (9.3)				
	No professional involvement with forests	15 (6.1)	0 (0.0)	15 (6.1)	20 (8.1)	14 (5.7)				

*$P < 0.05$; *n* – sample size; Chi^2 – chi-square statistic; *df* – degrees of freedom; *P* – *P*-value; V_k – Cramér's *V*

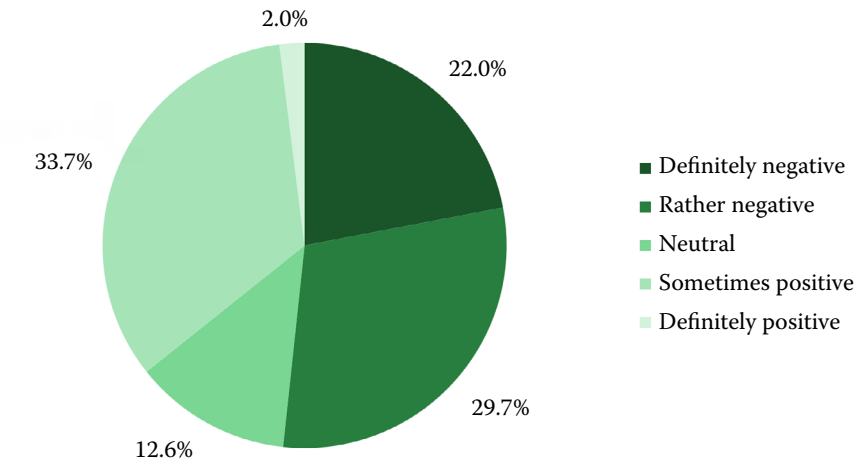

Figure 5. Respondents' opinions on the impact of forest fires on the natural environment

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Table 9. Association between respondents' sociodemographic and professional characteristics and their assessment of the impact of forest fires on the natural environment – Chi-square test of independence statistics

Sociodemographic and professional variables	Response	How would you assess the impact of forest fires on the natural environment? *n* (%)					Statistical test results			
		Definitely positive	Sometimes positive	Neutral	Rather negative	Definitely negative	Chi^2	*df*	*P**	V_k
Gender	Women	2 (0.8)	27 (11.0)	15 (6.1)	34 (13.8)	25 (10.2)	4.622	4	0.328	0.137
	Men	3 (1.2)	56 (22.8)	16 (6.5)	39 (15.9)	29 (11.8)				
Age	< 18	1 (0.4)	6 (2.4)	4 (1.6)	4 (1.6)	0 (0.0)	34.946	16	0.004*	0.188
	18–24	1 (0.4)	39 (15.9)	20 (8.1)	45 (18.3)	40 (16.3)				
	25–34	1 (0.4)	15 (6.1)	5 (2.0)	3 (1.2)	2 (0.8)				
	35–44	0 (0.0)	9 (3.7)	1 (0.4)	12 (4.9)	7 (2.8)				
	> 45	2 (0.8)	14 (5.7)	1 (0.4)	9 (3.7)	5 (2.0)				
Place of residence	Rural areas	1 (0.4)	42 (17.1)	14 (5.7)	29 (11.8)	30 (12.2)	11.218	12	0.510	0.123
	A small town of up to 20 000 inhabitants	0 (0.0)	12 (4.9)	3 (1.2)	9 (3.7)	8 (3.3)				
	City with up to 100 000 inhabitants	2 (0.8)	11 (4.5)	7 (2.8)	17 (6.9)	5 (2.0)				
	City with over 100 000 inhabitants	2 (0.8)	18 (7.3)	7 (2.8)	18 (7.3)	11 (4.5)				
Professional involvement with forests	Work in forests	2 (0.8)	19 (7.7)	2 (0.8)	8 (3.3)	8 (3.3)	11.147	8	0.194	0.151
	Forestry or related studies student	1 (0.4)	46 (18.7)	19 (7.7)	43 (17.5)	34 (13.8)				
	No professional involvement with forests	2 (0.8)	18 (7.3)	10 (4.1)	22 (8.9)	12 (4.9)				

*$P < 0.05$; *n* – sample size; Chi^2 – chi-square statistic; *df* – degrees of freedom; *P* – *P*-value; V_k – Cramér's *V*

Perceived causes of forest fires. Human activity was identified as the primary cause of forest fires by the majority of respondents, followed by climate change, while natural factors were less frequently indicated (Figure 6).

Fire prevention and management preferences. Respondents generally assessed public knowledge of fire prevention as insufficient (Figure 7).

The most commonly indicated methods for reducing fire occurrence included environmental

Table 10. Relative impact of forest fires on the environment in the study group of respondents (*n* = 246)

Impact of forest fires on the climate	Relative Importance Index (*RII*)	*Me*	Rank
Significant worsening of the climate situation through CO_2 emissions	0.680	3.00	3
Negative impact on forest animals	0.846	5.00	1
Significant contribution to forest loss	0.715	4.00	2
Changes in the regional climate	0.611	3.00	4

n – sample size; *Me* – median

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Table 11. Sociodemographic and professional variables in relation to the perceived significance of forest fires in the context of climate change

Sociodemographic and professional variables	Forest fires significantly worsen the climate situation through CO_2 emissions				Forest fires have a negative impact on animals living in forests				Forest fires significantly contribute to forest loss				Forest fires change the climate in the region			
	Me	*M*	*IQR*	*P*	*Me*	*M*	*IQR*	*P*	*Me*	*M*	*IQR*	*P*	*Me*	*M*	*IQR*	*P*
U Mann-Whitney																
Gender																
Women	4.00	3.67	2.00	0.003*	5.00	4.47	1.00	< 0.001*	4.00	3.90	2.00	< 0.001*	3.00	3.40	2.00	< 0.001*
Men	3.00	3.20	2.00		4.00	4.06	2.00		3.00	3.34	2.00		3.00	2.80	2.00	
Kruskal-Wallis																
Age																
< 18	3.00	3.53	1.00		5.00	4.47	1.00		4.00	4.13	2.00		4.00	3.60	1.00	
18–24	3.00	3.35	1.00		5.00	4.34	1.00		4.00	3.63	2.00		3.00	3.14	2.00	
25–34	3.00	3.31	3.00	0.906	4.00	4.00	2.00	0.176	3.00	3.15	2.00	0.092	2.00	2.46	3.00	0.030*
35–44	4.00	3.48	1.00		4.00	4.10	1.00		3.00	3.28	3.00		3.00	3.10	2.00	
> 45	3.00	3.55	1.00		4.00	3.87	2.00		4.00	3.65	2.00		3.00	2.84	2.00	
Place of residence																
Rural areas	3.00	3.33	2.00		5.00	4.22	1.00		4.00	3.53	1.00		3.00	3.06	2.00	
A small town of up to 20 000 inhabitants	3.00	3.38	1.00		4.00	4.03	2.00		4.00	3.69	2.00		3.00	3.00	2.00	
City with up to 100 000 inhabitants	3.00	3.45	1.00	0.849	5.00	4.40	1.00	0.431	4.00	3.55	3.00	0.924	3.00	2.95	2.00	0.859
City with over 100 000 inhabitants	3.00	3.52	2.00		5.00	4.23	1.00		4.00	3.61	2.00		3.00	3.14	2.00	
Professional involvement with forests																
Work in forests	3.00	3.10	2.00		4.00	3.87	2.00		4.00	3.36	3.00		3.00	2.74	2.00	
Forestry or related studies student	3.00	3.39	1.00	0.136	5.00	4.29	1.00	0.107	4.00	3.55	2.00	0.239	3.00	3.00	2.00	0.039*
No professional involvement with forests	4.00	3.59	2.00		5.00	4.31	1.00		4.00	3.77	2.00		3.00	3.36	2.00	

*$P < 0.05$; *Me* – median; *M* – mean; *IQR* – interquartile range

education and stricter law enforcement (Figure 8). Fewer respondents pointed to forest management practices or technological solutions.

Most respondents supported active fire management strategies, including early detection and rapid suppression, either alone or in combination with natural processes (Figure 9).

Assessment of forest and fire services. The activities of forest services and fire brigades were generally evaluated positively. The majority of re-

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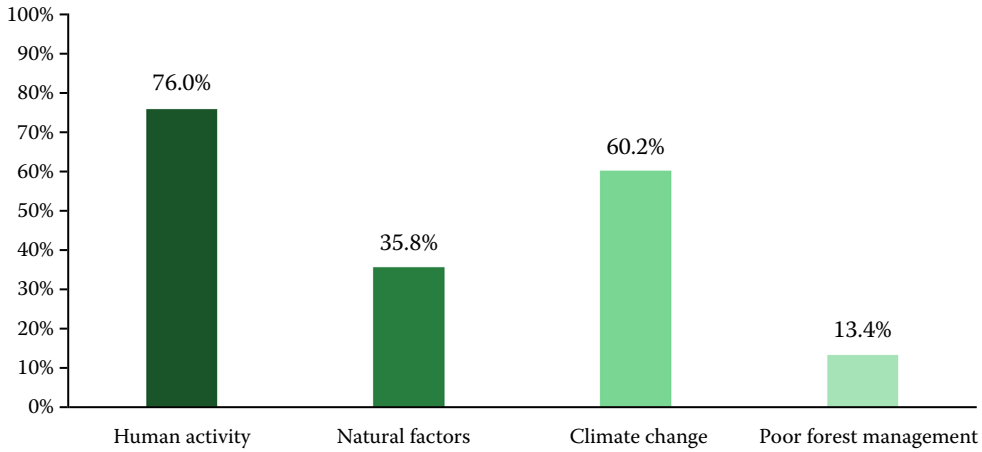

Figure 6. Perceived main causes of forest fires according to respondents

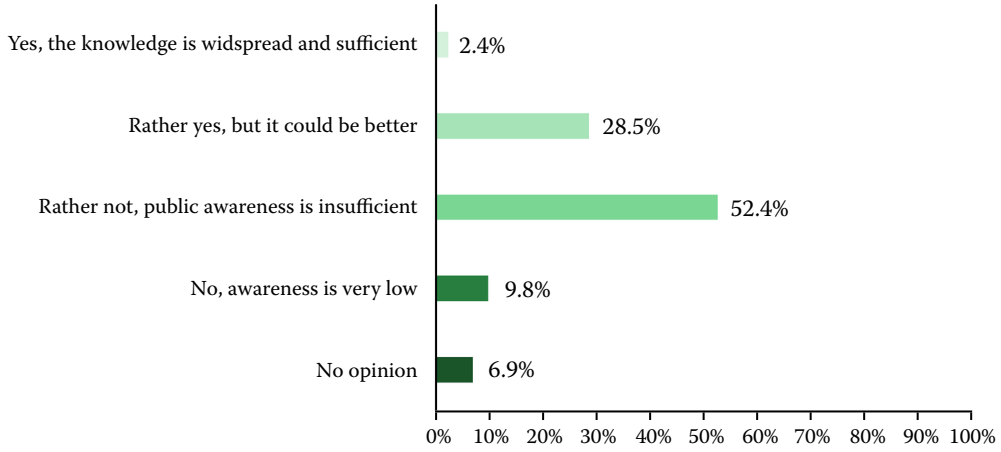

Figure 7. Assessment of the level of public knowledge about forest fire prevention

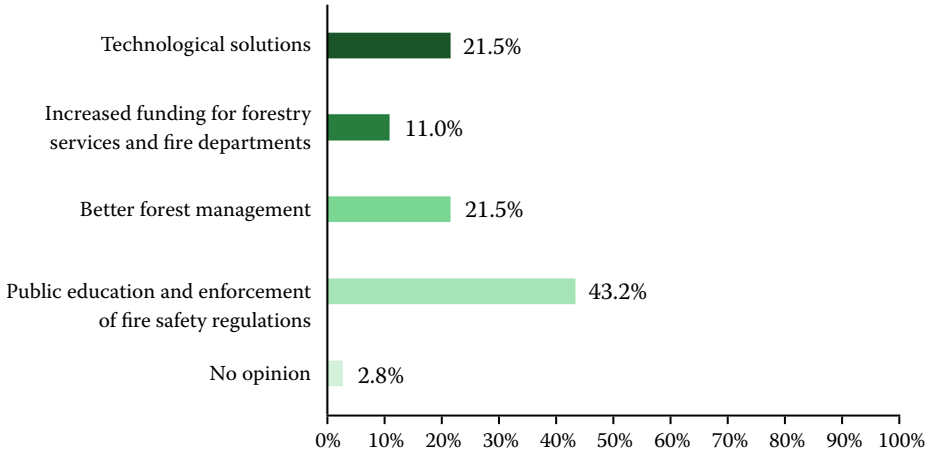

Figure 8. Respondents' perceived effectiveness of forest fire prevention methods

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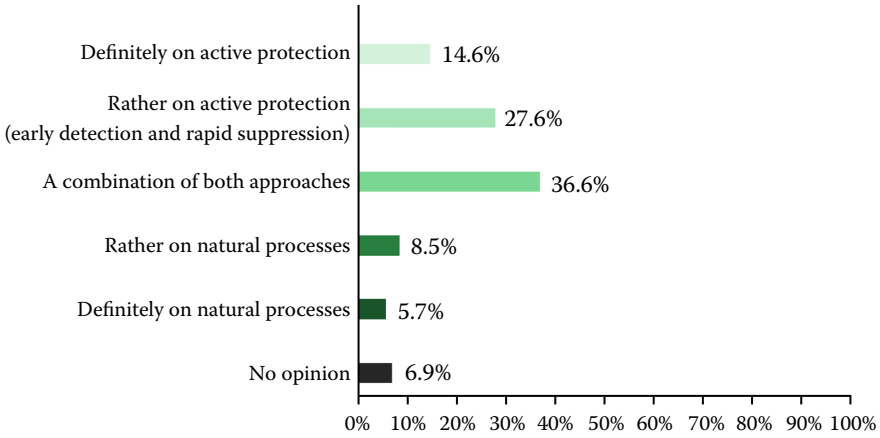

Figure 9. Preferred approach to forest fire management as perceived by respondents

spondents rated their effectiveness in fire prevention and suppression as good or very good (Figure 10).

Respondents perceived controlled burns mainly as a tool for preventing large-scale fires and removing dead vegetation. Their importance for restoring ecological balance and protecting ecosystems was indicated less frequently (Table 12), suggesting that controlled burns are more often viewed as a component of fire prevention than as part of natural ecological processes.

Assessments differed depending on age and professional connection with forestry (Table 13). The youngest respondents more frequently em-

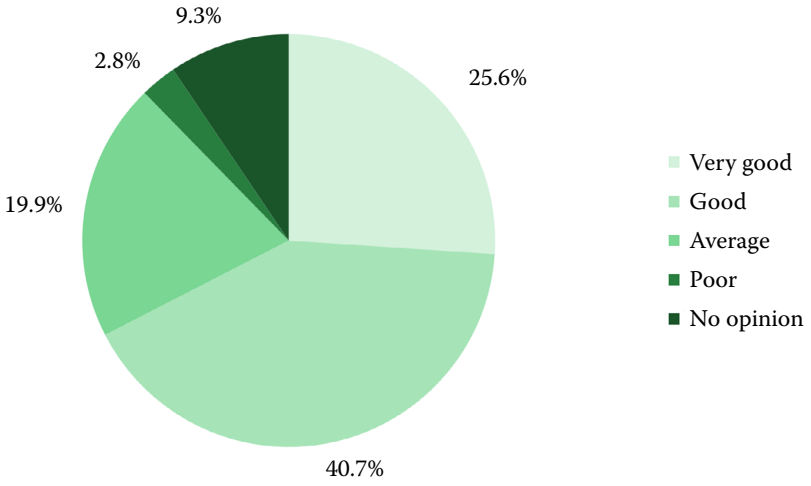

Figure 10. Assessment of the efforts of forestry services and fire departments in preventing and combating forest fires

Table 12. Relative importance of controlled burns for the functioning of forest ecosystems in the study group of respondents (n = 246)

Importance of controlled burns for forest ecosystem functioning	Relative Importance Index (*RII*)	*Me*	Rank
Preventing larger fires	0.722	4.00	1
Ecosystem protection	0.666	3.00	4
Removal of dead plants and branches	0.693	4.00	2
Restoration of ecological balance	0.668	3.00	3

n – sample size; *Me* – median

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Table 13. Sociodemographic and professional variables in relation to the perceived role of controlled fires in the functioning of forest ecosystems

Sociodemographic and professional variables	Prevention of larger fires				Ecosystem protection				Removal of dead plants and branches				Restoration of ecological balance			
	Me	*M*	*IQR*	*P*	*Me*	*M*	*IQR*	*P*	*Me*	*M*	*IQR*	*P*	*Me*	*M*	*IQR*	*P*
U Mann-Whitney																
Gender																
Women	3.00	3.56	2.00	0.631	3.00	3.35	3.00	0.717	4.00	3.54	2.00	0.387	4.00	3.49	2.00	0.127
Men	4.00	3.64	2.00		3.00	3.31	1.00		4.00	3.41	2.00		3.00	3.24	2.00	
Kruskal-Wallis																
Age																
< 18	4.00	2.87	2.00		4.00	3.80	2.00		4.00	3.47	1.00		4.00	4.00	2.00	
18–24	3.00	3.48	1.00		3.00	3.12	2.00		4.00	3.45	1.00		3.00	3.19	2.00	
25–34	4.00	3.88	2.00	0.906	4.00	3.69	2.00	0.176	4.00	3.81	2.00	0.092	4.00	3.92	1.00	0.030*
35–44	3.00	3.24	1.00		3.00	3.10	2.00		3.00	3.07	2.00		3.00	3.07	2.00	
> 45	5.00	4.19	1.00		4.00	4.00	2.00		4.00	3.61	2.00		3.00	3.52	3.00	
Place of residence																
Rural areas	3.00	3.49	2.00		3.00	3.19	2.00		3.50	3.39	2.00		3.00	3.25	1.00	
A small town of up to 20 000 inhabitants	3.00	3.47	1.00		3.00	3.16	3.00		4.00	3.59	1.00		3.00	3.38	3.00	
City with up to 100 000 inhabitants	3.50	3.57	1.00	0.034*	4.00	3.48	2.00	0.123	4.00	3.33	2.00	0.465	3.00	3.31	2.00	0.539
City with over 100 000 inhabitants	4.00	3.96	2.00		4.00	3.61	2.00		4.00	3.64	2.00		4.00	3.54	3.00	
Professional involvement with forests																
Work in forests	3.00	3.49	1.00		4.00	3.69	2.00		4.00	3.56	2.00		3.00	3.31	3.00	
Forestry or related studies student	3.00	3.48	1.00	0.006*	3.00	3.13	2.00	0.016*	4.00	3.47	1.00	0.723	3.00	3.28	2.00	0.576
No professional involvement with forests	4.00	3.98	2.00		3.00	3.55	2.00		4.00	3.39	2.00		3.00	3.50	2.00	

*$P < 0.05$; *Me* – median; *M* – mean; *IQR* – interquartile range

phasised the importance of controlled burns for ecological balance. Individuals not professionally connected with forests more often pointed to their role in reducing the risk of large fires, whereas respondents associated with forestry more frequently emphasised their importance for ecosystem protection.

DISCUSSION

The results of this study indicate that the overall level of knowledge about forest fires among respondents was moderate, while attitudes toward this phenomenon were predominantly negative. At the same time, respondents demonstrated a dif-

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ferentiated perception of fire, recognising both its destructive effects and, to some extent, its ecological role. This pattern suggests that public perception of forest fires is shaped not only by factual knowledge but also by simplified interpretations and subjective judgments, which is consistent with previous findings highlighting the importance of social perception in fire-related decision-making (McCaffrey 2006; Oliveira et al. 2020; Palaiologou et al. 2021).

A key finding of the study is the discrepancy between knowledge and perception. Despite only moderate scores on the fire-related familiarity and experience index, respondents often expressed strong and critical attitudes toward forest fires. This suggests that perceptions may be influenced more by intuitive or emotionally driven interpretations than by a comprehensive understanding of fire ecology. Similar patterns have been reported in previous studies, where public perception tends to emphasise visible and immediate impacts rather than underlying ecological processes (Palaiologou et al. 2021). From a management perspective, this highlights the need for more effective environmental education and risk communication strategies that address not only knowledge deficits but also perception biases.

The analysis also confirmed the significant role of experience in shaping knowledge. Respondents professionally connected with forestry demonstrated substantially higher levels of knowledge compared to students and individuals without such a background. This finding supports earlier observations that direct exposure to forest environments and practical experience are critical for developing a deeper understanding of fire-related processes (McCaffrey 2006). At the same time, younger respondents exhibited lower levels of knowledge despite expressing stronger and more critical attitudes. This discrepancy suggests that knowledge acquisition in this group may be more theoretical or indirect, reinforcing the importance of practical, experience-based education.

Differences in perception were also observed across socio-demographic groups. Women generally assessed the impacts of forest fires as more severe, while younger respondents more frequently expressed strong negative attitudes. These findings indicate that risk perception is not solely determined by objective knowledge but is also shaped by demographic and social factors. Such variability has important implications for communication strategies, suggesting that a uniform approach to fire-related education and awareness may be insufficient and that more targeted, group-specific communication may be required (Moazeni, Cerdà 2025). Forest fires may also induce short-term physicochemical changes in the forest humus layer (Kupka et al. 2022).

Another important finding relates to the perception of fire impacts. Respondents more readily identified direct and observable consequences, such as damage to animals and forest loss, while assigning lower importance to less visible and long-term effects, including climate-related processes. This confirms that public perception is often focused on immediate and tangible outcomes, whereas broader ecological and climatic implications remain less recognised. Similar tendencies have been noted in previous research on environmental risk perception (Oliveira et al. 2020). This gap may limit public understanding of the full consequences of forest fires and reduce support for long-term management strategies. Human-caused fires may also affect soil surface processes and increase rill detachment capacity (Parhizkar, Cerdà 2023).

The identification of human activity as the primary cause of forest fires reflects a relatively high level of awareness of direct anthropogenic drivers. However, the lower recognition of factors related to forest management suggests a limited understanding of more complex determinants of fire risk, such as fuel accumulation or forest structure. This is particularly relevant in the context of adaptive forest management, where such factors play a critical role in shaping fire dynamics.

In this regard, the findings related to the perception of prescribed burning are particularly noteworthy. Although some respondents recognised its potential role, the overall level of awareness and acceptance of this practice appears limited. This suggests that prescribed burning is not yet fully understood as a preventive management tool, despite its documented ecological and practical benefits (Stephens et al. 2016). The gap between partial acceptance and limited knowledge may represent a barrier to the wider implementation of such practices and indicates a need for improved communication of their purpose and effectiveness. Public acceptance of prescribed burning is closely linked to risk perception and prior knowledge (Gerald 2010).

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The findings of this study can be better understood when compared with fire-prone regions such as Southern Europe and parts of Africa, where forest fires constitute a recurrent and well-recognised element of the landscape. In Mediterranean countries, including Spain and Portugal, wildfires are a frequent phenomenon, with large areas affected annually and a strong dominance of human-related ignition sources. In such regions, both experts and stakeholders increasingly recognise the need to move beyond suppression-oriented strategies toward integrated fire management approaches that include fuel management and preventive measures (Tedim et al. 2022).

At the same time, studies from fire-prone regions indicate that public perception and social factors play a crucial role in wildfire mitigation and adaptation. For example, research from Southern Europe highlights that community engagement, trust in institutions, and social capital significantly influence the effectiveness of fire risk reduction strategies (Lecina-Diaz et al. 2023). Similarly, European policy-oriented analyses emphasise the need to develop a 'fire-literate' society capable of understanding and adapting to increasing wildfire risk (Wardropper et al. 2025).

In the surveyed Polish sample, the observed perceptions may partly reflect limited direct exposure to recurrent large wildfires and reliance on indirect information about fire processes. However, owing to the non-representative sampling design, this interpretation should not be generalised to the entire Polish population or to other Central European countries. Compared to fire-prone regions, where exposure to fires and management practices such as prescribed burning is more common, the lower level of familiarity observed in this study may limit public acceptance of such strategies. This highlights the importance of knowledge transfer and experience-based education in building societal readiness to address increasing wildfire risk under changing climatic conditions. Decision-support and multi-criteria approaches are increasingly used in forest fire management (Abedi 2022).

From a practical perspective, the results highlight three key areas relevant to fire management. First, the moderate level of knowledge combined with strong perceptions underscores the importance of strengthening environmental education, particularly in a form that integrates theoretical and practical elements. Second, the observed differences in perception across demographic groups suggest that risk communication strategies should be more targeted and adapted to specific audiences. Third, the limited understanding and acceptance of prescribed burning indicate a need for clearer communication of its role within integrated fire management approaches.

The results should be interpreted with caution due to several limitations. The use of a non-probability snowball sampling method resulted in a non-representative sample, with a strong over-representation of younger respondents and individuals connected with forestry. Consequently, the findings cannot be generalised to the broader population. However, they provide valuable exploratory insights into patterns of knowledge, perception, and attitudes, which may serve as a basis for further, more representative studies. In addition, the unequal sizes of the age and professional groups and the association between young age and forestry-student status require caution when interpreting differences attributed separately to age and professional involvement.

CONCLUSION

This exploratory study provides insight into knowledge, attitudes, and risk perceptions related to forest fires among the surveyed respondents in Poland. The results indicate that perceptions of forest fires are shaped not only by factual understanding but also by socio-demographic factors and individual experience, with professional exposure to forestry emerging as a key determinant of higher knowledge levels.

A clear discrepancy between perceived and actual knowledge, as well as between the recognition of direct and indirect fire impacts, suggests that public understanding of fire-related processes remains incomplete. In particular, respondents tended to focus on immediate and visible consequences, while less attention was given to long-term climatic and ecological effects.

The findings also reveal a limited and uneven acceptance of fire as a natural ecological process and as a management tool. Although some respondents acknowledged the role of fire under certain conditions, the overall level of awareness and understanding of practices such as prescribed burning remains insufficient.

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From a practical perspective, the results emphasise the importance of strengthening environmental education, improving risk communication, and increasing public awareness of integrated fire management approaches. These actions should take into account differences across demographic groups and focus on bridging the gap between knowledge and perception.

Despite the limitations related to the non-representative sample, the study provides valuable exploratory insights that may support the development of more effective and socially informed fire management strategies and serve as a basis for further research in this field.

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