

Public perceptions of forests in Italy: ecosystem services, emotional meanings, and post-pandemic needs

Davide Clemente⁽¹⁾,
Antonio Brunori⁽²⁾,
Giuseppe Carrus⁽³⁾,
Giuseppina Spano⁽⁴⁾,
Angelo Panno⁽¹⁾,
Giovanni Sanesi⁽⁵⁾

Forests are increasingly recognized not only for their ecological and productive roles but also for their social, cultural, and psychological importance. In Italy, the last national-scale assessment of public perceptions of forests was conducted before the COVID-19 pandemic, leaving open questions about how citizens currently perceive forests, their functions, and their value for everyday life. Building on previous national evidence, this study provides an updated overview of Italians' perceptions of forests in a post-pandemic context. A national online survey was conducted between May and July 2025 with a large, geographically diverse sample of Italian adults ($n = 2,193$), covering all 20 regions and five macro-areas. The questionnaire assessed perceptions of forest cover, the importance attributed to environmental issues and forest ecosystem services, perceived threats to forests, emotional responses to familiar and unfamiliar forest environments, post-pandemic need for nature, forest visitation frequency, and information needs and sources. Results indicate that Italians attribute high importance to forests for biodiversity conservation, climate regulation, hydrogeological protection, and human well-being, with non-material and regulatory services consistently rated higher than strictly productive ones. Participants showed a marked tendency to overestimate forest cover, replicating patterns observed in pre-pandemic studies. Forests were widely perceived as threatened by multiple pressures, particularly wildfires, climate change, illegal activities, and drought, with both nationally shared concerns and region-specific differences. Emotional responses to forest environments were predominantly positive, with high levels of interest, enthusiasm, and inspiration and very low levels of fear, even in unfamiliar forests. The post-pandemic need for nature emerged as a salient dimension across the country, with only modest geographical variation. Information demand was substantial, especially regarding biodiversity, health-related benefits, and forest management, and respondents primarily relied on institutional and science-based sources. Overall, the findings highlight a strong and multifaceted public engagement with forests in Italy, combining cognitive, emotional, and behavioral dimensions. By updating pre-pandemic evidence and incorporating emotional and experiential aspects at a national scale, this study provides insights relevant for forest communication, governance, and the integration of social values into sustainable forest management strategies.

□ (1) Department of Human Science, Experimental and Applied Psychology Laboratory, European University of Rome, Rome (Italy); (2) Programme for the Endorsement of Forest Certification (PEFC) Schemes, Via Pietro Cestellini, 17, 06135 Perugia (Italy); (3) Department of Education Science, Roma Tre University, Rome, Lazio (Italy); (4) Department of Psychology and Health Science, Pegaso Telematic University, Naples (Italy); (5) Department of Soil, Plant and Food Sciences, University of Bari, Bari (Italy)

@ Davide Clemente
(dott.davideclemente@gmail.com)

Received: Feb 03, 2026 - Accepted: Mar 14, 2026

Citation: Clemente D, Brunori A, Carrus G, Spano G, Panno A, Sanesi G (2026). Public perceptions of forests in Italy: ecosystem services, emotional meanings, and post-pandemic needs. *iForest* 19: 130-140. - doi: [10.3832/ifor5149-019](https://doi.org/10.3832/ifor5149-019) [online 2026-04-11]

Communicated by: Marco Borghetti

Keywords: Forests, Urban Forest, Forest Access, Ecosystem Services, Public Perception

Introduction

Forests have assumed a central role in contemporary strategies for sustainability, climate adaptation, and human well-being. No longer perceived solely as providers of timber and ecological functions, forests are increasingly understood as complex socio-ecological systems that deliver a wide range of ecosystem services, including provisioning, regulating, and cultural benefits (Millennium Ecosystem Assessment 2005, United Nations 2015). The ecosystem services framework has facilitated a shift in perspective toward a more integrated understanding of forests as multifunctional landscapes that support biodiversity conservation, climate regulation, hydrogeological protection, and human well-being (Führer 2000, Paletto et al. 2014). Among these services, cultural ecosystem services – such

as recreation, aesthetic appreciation, sense of place, and symbolic meaning – have gained growing attention in both forest research and environmental psychology. These non-material benefits play a crucial role in shaping public attitudes, emotional responses, and expectations regarding forest management (De Meo et al. 2018, Carrus et al. 2020). Rather than being perceived as neutral ecological spaces, forests are interpreted through personal and collective memories, values, and emotions, becoming lived landscapes embedded in social experience (Coles et al. 2013, Spano et al. 2021). Empirical studies show that forests characterized by structural complexity, species diversity, and a balance between naturalness and maintenance tend to evoke restorative emotions such as calmness and serenity, fostering psycho-

logical well-being and pro-environmental orientations (Paletto et al. 2017). The emotional and experiential dimensions of forest perception are therefore closely intertwined with cognitive evaluations of ecosystem services. Preferences for forest attributes vary according to socio-demographic characteristics, territorial contexts, and levels of environmental knowledge (Purwestri et al. 2023). Research across different European countries shows that laypeople often prioritize aesthetic diversity, naturalness, and cultural meanings, whereas forest professionals tend to emphasize management indicators and infrastructure (Pastorella et al. 2016). These discrepancies underscore the importance of understanding how different social groups perceive forest functions, especially in contexts where sustainable forest management increasingly depends on public support and participation. In parallel, urban forestry has gained prominence as a response to the growing demand for green infrastructure in densely populated, climate-vulnerable cities. Urban and peri-urban forests are now widely recognized not only for their role in mitigating air pollution and heat stress, but also for their contributions to psychological restoration and social cohesion. However, reviews of international literature suggest that studies on public perception of urban forests often rely on local case studies and convenience samples, and tend to emphasize perceived benefits without adequately addressing socio-demographic diversity and contextual variation (Barona et al. 2022). There is therefore a need for broader, nationally representative investigations that integrate ecological, emotional, and social dimensions.

The COVID-19 pandemic further intensified the salience of forests in everyday life. During periods of mobility restriction and social distancing, contact with nature emerged as a critical resource for coping with stress, uncertainty, and social isolation (Soga et al. 2021). Urban, peri-urban, and rural forests were increasingly experienced as spaces of psychological refuge and renewal (Smith & Turner 2023). At the same time, interest in forest-based well-being practices, including Forest Therapy and Urban Forest Therapy, expanded significantly. In Italy, Riviaccio et al. (2024) proposed a standardized framework to identify and validate sites suitable for therapeutic forest experiences, highlighting a growing institutional attention to the health-related functions of forest landscapes. Despite this expanding body of evidence, the specific pathways through which forests contribute to well-being remain only partially understood. Multiple mechanisms, ranging from stress reduction and attention restoration to social interaction and cultural identity, likely interact in shaping perceived benefits. Moreover, while increasing recognition has been given to cultural ecosystem services, these

dimensions are often underrepresented in formal environmental decision-making processes (Van Den Brink et al. 2018). Symbolic and experiential meanings, such as beauty, spirituality, and attachment, may influence attitudes toward forest conservation and management, yet are not systematically captured in large-scale empirical assessments.

In the Italian context, forests occupy a particularly significant position, both ecologically and culturally. Previous research indicates that Italian citizens place high importance on environmental issues related to forests, including biodiversity conservation and climate regulation, and exhibit strong connectedness to nature (Carrus et al. 2020). At the same time, studies conducted in peri-urban and mountain areas reveal that forest expansion and management interventions can evoke ambivalent reactions, shaped by local identities, educational level, and gender differences (De Meo et al. 2015, Paletto et al. 2017). These findings suggest that public perceptions of forests are neither homogeneous nor merely utilitarian, but reflect a complex interplay of ecological awareness, emotional attachment, and socio-cultural context. The national survey conducted by Carrus et al. (2020) represents a landmark investigation into Italians' perceptions of forests, providing robust evidence on environmental concerns, connectedness to nature, and the perceived importance of forest-related issues. Notably, that study documented a tendency among respondents to overestimate forest cover and to prioritize regulatory and non-material services over strictly productive functions. However, the study was conducted before the COVID-19 pandemic and did not systematically integrate emotional responses to forest environments, post-pandemic need for nature, visitation frequency, and information sources into a unified analytical framework. Consequently, it remains unclear whether and how public perceptions of forests have evolved in the post-pandemic context, and how cognitive evaluations of ecosystem services interact with emotional engagement and experiential behaviors. Understanding these dimensions is particularly relevant for contemporary forest governance, as policies aimed at climate adaptation, biodiversity conservation, and sustainable resource use increasingly depend on societal support and awareness.

To address these gaps, the present study provides an updated national-scale quantitative survey of Italian adults, covering all 20 regions and multiple macro-areas. The study integrates cognitive assessments (perceived forest cover, importance of ecosystem services, perceived threats), emotional responses to familiar and unfamiliar forest environments, behavioral indicators (visitation frequency), and post-pandemic need for nature, together with information sources and perceived knowledge.

The present study set out to update and

expand previous national evidence on Italians' perceptions of forests, taking as a reference the study by Carrus et al. (2020), which provided the last comprehensive pre-pandemic overview of public attitudes toward forests in Italy. Since that study, the social and psychological relevance of nature has undergone significant changes, especially in the aftermath of the COVID-19 pandemic, when forests and natural spaces gained renewed meaning as environments associated with well-being, safety, and personal restoration. Despite this shift, no new nationwide data were available to document how citizens currently perceive forests, their functions, and their value for everyday life. Drawing inspiration from the structure of the 2020 survey, the present investigation replicated its core components – such as socio-demographic information, perceived forest cover, evaluations of environmental issues, perceived relevance of forest functions and products, and attitudes toward forest management – while broadening the conceptual focus to include additional dimensions that reflect contemporary sensibilities and public discourse surrounding forests. In particular, the survey incorporated variables concerning emotional reactions to forests, experiential and symbolic ways of engaging with woodland environments, preferences for specific forest characteristics, perceived threats, land-use orientations, and informational needs. These elements were introduced to capture aspects of the human-forest relationship that have gained prominence in recent years but were not previously examined at the national scale. Through a large, geographically diverse sample spanning all 20 Italian regions, the study aimed to provide a more nuanced and up-to-date representation of how Italians relate to forests today. By combining replication and conceptual expansion, this research allows for comparison with pre-pandemic evidence while simultaneously documenting new trends in emotional engagement, post-pandemic need for nature, and experiential interaction with forest environments.

Building on the ecosystem services framework and on previous national findings, this study addresses the following research questions: (i) To what extent do Italian citizens overestimate forest cover at national and regional levels in the post-pandemic period? (ii) How are different ecosystem services and forest functions evaluated in the contemporary Italian context? (iii) How salient is the post-pandemic need for nature, and does it vary across territorial macro-areas? (iv) What emotional responses characterize perceptions of familiar and unfamiliar forest environments? (v) How are forest visitation frequency, emotional engagement, and perceived forest-related wellbeing interrelated?

Overall, the goal of the present study is to provide an updated and analytically

structured account of public perceptions of forests in Italy, integrating cognitive evaluations, emotional dimensions, and behavioral indicators. This updated insight can support forest communication strategies, public policy development, nature-based well-being programs, and ongoing debates on sustainable land management and the social value of forest ecosystems.

Materials and methods

The study involved a sample of adult residents in Italy, recruited through voluntary, anonymous participation in an online questionnaire distributed via Google Forms. Prior to participation, informed consent was obtained digitally, and no sensitive personal data was collected, in compliance with the GDPR (EU Regulation 2016/679). Data collection took place between May and July 2025. A total of 2193 individuals completed the survey. Participants ranged in age from 18 to 89 years (mean \pm standard deviation = 50.98 \pm 14.68). When categorized by UNESCO adult age groups, 4.6% of respondents were aged 18-24, 11.9% were 25-34, 15.7% were 35-44, 22.9% were 45-54, and 25.6% were 55-64. Older adults aged 65 years and above represented 19.2% of the sample. Gender distribution was balanced, with 45.6% identifying as women and 54.4% as men. Participants were residents of all 20 Italian regions and all major macro-areas of the country, ensuring broad national coverage. Approximately one-third of the sample lived in the North-West (32.7%), followed by the Center (23.8%), the South (22.1%), and the North-East (15.7%). Residents of the Islands represented 5.7% of participants. Region-level analyses indicated that the highest participation rates were in Lombardy (16.4%), Piedmont (14.1%), Lazio (9.3%), Puglia (9.1%), Tuscany (8.9%), and Emilia-Romagna (5.1%). Less represented regions included Valle d'Aosta (0.5%), Molise (1.2%), and Basilicata (1.5%). Regarding educational attainment, the sample was generally well educated. Nearly 40% of participants held a university degree (39.9%), while 35.8% had completed secondary school. An additional 19.3% reported postgraduate qualifications, including master's degrees, specialization courses, or doctoral training. Lower educational levels were less represented, with 4.8% completing middle school and 0.2% primary school.

Marital status was diverse. Nearly half of the respondents were married (49.2%), while 23.5% identified as single. Additionally, 11.0% were cohabiting with a partner, 8.5% were divorced or separated, and 5.7% were in a relationship without cohabitation. A minority of 2.0% identified as widowed.

Regarding employment status, nearly half of the sample worked full-time (48.5%). Self-employed professionals represented 15.0% of respondents, retirees 17.6%, part-time workers 6.7%, students and academic trainees 6.3%, homemakers 1.6%, unem-

ployed individuals 1.6%, and apprentices/trainees 1.0%. All other professional roles occurred at frequencies below 0.1% and were grouped as "Other professions". Students, including university students, doctoral candidates, and research fellows, accounted for 6.4% of the sample. Smaller proportions identified as unemployed (1.6%), homemakers (1.6%), or enrolled in training or apprenticeship programs (1.0%). Less frequent professions collectively accounted for under 1% of the sample. Descriptive statistics for all sociodemographic variables are reported in Tab. S1 (Supplementary material).

Participation was voluntary and anonymous, and no personally identifiable or sensitive information was collected, in accordance with European GDPR regulations and ethical standards for survey-based research. The survey was designed to be completed in approximately 10-15 minutes and was promoted via academic networks, social media, and partner institutions. The questionnaire was structured into four thematic sections to capture socio-demographic characteristics, quantitative perceptions of Italian woodlands and urban green areas, and psychological responses associated with forest environments.

The first section collected socio-demographic information, including age, gender, region of residence, education level, marital status, and professional status. These variables were used to describe the sample composition and examine potential differences across subgroups.

A second section focused on participants' quantitative knowledge and perceptions of Italian woodlands. Respondents were asked to estimate the percentage of forest cover in Italy, in their own region, and across Europe, providing values ranging from 0% to 100%. They also evaluated the perceived relevance of forests in addressing several environmental issues – such as hydrogeological risk, climate change, desertification, and biodiversity loss – using Likert-type scales ranging from "not important at all" to "very important". In this section, participants also assessed the importance of different material and immaterial forest-related goods and services, including timber production, wild edible products, medicines and nutraceuticals, tourism opportunities, environmental education, health and well-being, and social cohesion. Views on forest management were explored through items assessing agreement with statements concerning the necessity of human intervention in forest ecosystems versus the desirability of leaving forests unmanaged. Finally, participants reported how frequently they visit woodlands and urban green areas, choosing among response options that ranged from "never" to "several times a week".

A third section examined psychological perceptions associated with forests. Participants rated the extent to which they perceive forests as sources of well-being, such

as relaxation, stress reduction, psychological restoration, health promotion, and social connection, using Likert-type importance scales. A composite score was computed by averaging the items, with higher scores indicating stronger perceived benefits of forests for well-being. Positive emotional responses were also assessed separately for familiar and unfamiliar forest contexts using parallel 4-item scales (e.g., interest, inspiration, enthusiasm, activation), rated on a 5-point Likert scale ranging from "not at all" to "extremely". Given the strong intercorrelation between the two scales ($r = 0.82$, $p < 0.001$), their excellent internal consistency ($\alpha = 0.87$ and $\alpha = 0.90$), and their shared theoretical focus on positive affective engagement with forest environments, a composite index of positive emotional engagement was computed by averaging all eight items. This approach reduced multicollinearity and provided a parsimonious predictor for regression analyses. Negative emotions were analyzed descriptively and were not included as predictors in regression models, as their variance was markedly restricted and mean scores indicated floor effects. The questionnaire also included items assessing individuals' perceived need to spend time in nature during the post-pandemic period, reflecting renewed motivation to seek contact with natural environments as a way to restore balance and psychological well-being. Higher composite scores reflect a greater post-pandemic need for direct experience in natural settings.

Sampling considerations

The survey relied on voluntary participation through an online questionnaire distributed via mailing lists, social media, and partner networks. Consequently, the sampling strategy was non-probabilistic and based on self-selection. Although the study achieved broad territorial coverage across all 20 Italian regions, the sample cannot be considered statistically representative of the Italian population.

The socio-demographic profile of respondents indicates a relatively high proportion of individuals with tertiary education compared to national population statistics. This overrepresentation may reflect greater interest in environmental topics among highly educated individuals, as well as differential familiarity with online survey tools. Given the voluntary and digital nature of recruitment, potential self-selection bias cannot be excluded. Individuals with stronger pro-environmental attitudes or higher engagement with forest-related issues may have been more likely to participate. Similarly, digital access bias may have limited participation among segments of the population with lower internet access or lower digital literacy.

These aspects should be taken into account when interpreting the findings and assessing their generalizability. Nevertheless, the large sample size and extensive

geographical distribution enable robust internal comparisons across regions and socio-demographic groups.

Statistical analysis

Descriptive statistics, ANOVA models were computed using IBM SPSS Statistics v. 23.0 (IBM Corp., Armonk, NY, USA). Descriptive analyses were used to examine the distribution of socio-demographic characteristics and to explore general trends in participants' perceptions, beliefs, and psychological responses related to Italian woodlands. These analyses allowed us to obtain an initial overview of how respondents evaluated forest cover in Italy, Europe, and their own region, their perceptions of the extent of protected areas, and their beliefs regarding the role of forests in addressing major environmental challenges such as climate change, hydrogeological risk, desertification, and biodiversity loss. In addition, descriptive statistics were used to summarize participants' judgments on the importance of a wide range of forest-related goods and services, including tourism, environmental education, health and well-being, social cohesion, non-timber forest products, and timber production. Additionally, participants shared their opinions on forest management and indicated how frequently they visit woodland environments.

ANOVA models and chi-square tests were then employed to investigate whether the main survey variables varied by participants' socio-demographic characteristics, including gender, age, educational level, marital status, professional status, and geographical area. These analyses made it possible to detect potential differences across population groups in their perceptions of forests, their views on forest management, and the value attributed to forest-related environmental, social, and economic functions.

To extend the analytical depth beyond descriptive and group-comparison approaches, two multiple regression models were estimated. The first model examined predictors of post-pandemic need for nature, including socio-demographic variables, visitation frequency, and perceived forest-related well-being. The second model examined the predictors of perceived forest-related well-being. This latter model was specified as hierarchical to test the in-

cremental contribution of positive emotional engagement beyond socio-demographic characteristics and visitation frequency. Standardized beta coefficients (β) are reported. Statistical significance was set at $p < 0.05$.

Results

Perceptions of forest surface extension

Participants were asked to estimate the percentage of forest cover in Italy, in Europe, and in their own region, as well as the percentage of protected areas in Italy. Descriptive statistics show a clear pattern of overestimation, consistent with previous literature.

On average, respondents estimated that 42.24% of the Italian territory is covered by forests (standard deviation, $SD = 17.58$), with responses ranging from 0% to 100%. The median value (40%) confirms that the central tendency reflects a moderate overestimation relative to the actual national forest cover, as reported in official statistics (approximately 36% – ISPRA 2023). Estimates of forest cover at the European scale were slightly higher, with a mean value (M) of 44.92% ($SD = 17.84$; median = 40%).

Participants also provided estimates for the percentage of forested area in their own region. The distribution of responses was wide (0-100%), with a modal value of 30%, indicating strong variability in regional perceptions and a tendency toward approximate or heuristic judgments rather than precise knowledge.

Regarding the estimated percentage of protected areas in Italy, responses ranged again from 0% to 100%, with a modal value of 10%, showing that, although participants display a tendency to overestimate forest cover, they tend to underestimate the extension of protected areas, which in Italy exceeds 20% when considering all protection categories.

This pattern parallels the findings reported by Carrus et al. (2020), who observed a generalized tendency among Italians to substantially overestimate forest extension while holding less accurate perceptions of land protection levels.

We explored whether perceptions of forest extension varied across the five Italian macro-areas (North-West, North-East, Center, South, Islands). Four one-way ANOVAs

were conducted on the estimated percentage of forest cover in Italy, in the respondent's region, in Europe, and on the estimated percentage of protected areas. Results showed significant differences in all four indices across geographical areas.

For the perceived forest cover in Italy, the effect of macro-area was significant ($F_{[4, 2188]} = 4.73, p = 0.001$). Participants living in the Islands reported the lowest estimates ($M = 37.22$), significantly lower than those reported by respondents from the Center ($M = 43.52$) and the South ($M = 43.81$). No other pairwise comparisons reached significance.

A similar pattern emerged for the perceived percentage of protected areas, with significant differences across macro-areas ($F_{[4, 2188]} = 8.16, p < 0.001$). Respondents from the South provided the highest estimates ($M = 28.37$), which were significantly higher than those provided by residents of the North-West, North-East, Center, and Islands.

Perceptions of forest cover in one's own region also varied significantly across macro-areas ($F_{[4, 2188]} = 9.13, p < 0.001$). Participants from the Center reported the highest values ($M = 41.01$), significantly higher than those from the North-West ($M = 34.93$), South ($M = 35.61$), and Islands ($M = 33.48$). No significant differences emerged between the Center and the North-East.

Finally, for perceived forest cover in Europe, the effect of macro-area was significant ($F_{[4, 2188]} = 3.37, p = 0.009$). Post-hoc tests indicated that respondents from the South ($M = 47.07$) reported significantly higher estimates than those from the North-East ($M = 42.98$). No other contrasts were significant.

Overall, the pattern of results indicates that participants from the Center and South tended to overestimate forest extension, whereas respondents from the Islands consistently provided the lowest estimates. All the means are reported in Tab. 1.

Importance of environmental issues and forest functions

Participants evaluated the importance of a set of environmental issues and forest-related goods and services. Descriptive statistics indicated uniformly high ratings across all variables, with mean scores consistently above 4 on a 1-5 scale, confirming that Italians perceive forests as highly relevant for environmental protection, public health, and socio-economic functions.

At the national level, the most highly rated issues were the prevention of hydrogeological instability ($M = 4.80, SD = 0.52$), climate change mitigation ($M = 4.73, SD = 0.61$), desertification control ($M = 4.71, SD = 0.62$), and biodiversity conservation ($M = 4.74, SD = 0.60$). Forest-related services showed similarly high evaluations, particularly for health improvement ($M = 4.71, SD = 0.62$) and the production of wild forest foods ($M = 4.25, SD = 0.93$). By contrast, wood and biomass production received

Tab. 1 - Mean estimates of forest-related indicators across the five Italian macro-areas.

Macro-areas	% Forest in Italy	% Protected areas	% Forest in own region	% Forest in Europe
North-West	41.51	23.25	34.93	44.51
North-East	41.42	22.33	38.11	42.98
Center	43.52	24.23	41.01	45.28
South	43.81	28.37	35.61	47.07
Islands	37.22	23.12	33.48	42.82
Total	42.24	24.46	36.94	44.92

comparatively lower scores ($M = 4.14$, $SD = 1.00$), in line with previous findings (Carrus et al. 2020), suggesting a stable preference for non-material and ecosystem services over strictly productive ones.

It was examined whether these evaluations varied across the five Italian macro-areas (North-West, North-East, Center, South, Islands). Ten one-way ANOVAs were performed on the importance attributed to environmental issues and forest-related services. Several significant effects of the geographical area emerged.

For soil erosion control, the effect of macro-area was significant ($F_{[4, 2188]} = 4.08$, $p = 0.003$). Post-hoc comparisons showed that respondents from the Islands attributed significantly greater importance to this issue ($M = 4.83$) than respondents in the North-West ($M = 4.59$), Center ($M = 4.60$), and South ($M = 4.64$). A similar pattern was observed for desertification control ($F_{[4, 2188]} = 3.67$, $p = 0.006$), with higher scores in the Islands ($M = 4.86$) than in the North-West ($M = 4.66$), Center ($M = 4.73$), and South ($M = 4.74$).

Landscape preservation also varied significantly across areas ($F_{[4, 2188]} = 2.88$, $p = 0.022$), with slightly higher evaluations in the South ($M = 4.68$) compared to the North-West and Center, although post-hoc comparisons did not yield widespread significant differences.

Larger geographical differences emerged for forest-related services. The importance of wood, cellulose, and biomass production showed a significant effect of macro-area ($F_{[4, 2188]} = 3.06$, $p = 0.016$). Participants from the Center ($M = 4.24$) rated this service significantly higher than those from the South ($M = 4.05$). The importance given to wild berries, mushrooms, and similar products also varied significantly ($F_{[4, 2188]} = 3.17$, $p = 0.013$), with respondents from the Center ($M = 4.34$) attributing greater importance than those from the North-East ($M = 4.16$).

The clearest geographical differences concerned support for tourism ($F_{[4, 2188]} = 6.09$, $p < 0.001$). Respondents from the South ($M = 4.15$) and Islands ($M = 4.30$) reported significantly higher scores than those from the North-West ($M = 3.97$) and North-East ($M = 3.94$), reflecting regional contexts in which nature-based tourism represents a key economic and cultural asset. By contrast, the importance attributed to the health benefits of forests did not differ significantly across macro-areas ($F_{[4, 2188]} = 1.12$, $p = 0.345$), suggesting a broad national consensus on this aspect.

Overall, these results show that while Italians uniformly attribute high importance to forests for environmental protection and human well-being, regional differences emerge for issues more closely linked to local ecological vulnerabilities (e.g., soil degradation, desertification) and for services with strong territorial relevance, such as tourism and non-timber forest products. A complete overview of means and stan-

Tab. 2 - Mean importance ratings of environmental issues and forest-related services across macro-areas.

Variable	North-West	North-East	Centre	South	Islands
Prevention of hydrogeological risk	4.80	4.82	4.79	4.77	4.90
Climate change mitigation	4.70	4.73	4.74	4.75	4.79
Soil erosion control	4.59	4.68	4.60	4.64	4.83
Desertification control	4.66	4.68	4.73	4.74	4.86
Landscape preservation	4.58	4.56	4.57	4.68	4.70
Biodiversity conservation	4.72	4.72	4.72	4.76	4.79
Wood/cellulose/biomass production	4.14	4.06	4.24	4.05	4.23
Wild products (berries, mushrooms)	4.23	4.16	4.34	4.23	4.41
Support to tourism	3.97	3.94	4.05	4.15	4.30
Health improvement	4.68	4.69	4.71	4.73	4.78

dard deviations for each macro-area is reported in Tab. 2.

Perceived threats to forests

Participants indicated which issues they perceived as major threats to Italian woodlands. Overall, the most frequently cited threats were forest fires (73.7% of respondents), illegal waste dumping (68.1%), and the climate crisis (60.7%). About half of the sample mentioned drought (48.6%), illegal logging (49.3%), hydrogeological instability (46.3%), biodiversity loss (45.7%), and excessive harvesting (43.2%). Fewer respondents identified storms and insect outbreaks (24.7%) or invasive alien species (34.7%) as relevant threats. On average, participants selected about five threats from the eleven listed, confirming a generally high level of concern about the multiple pressures affecting Italian forests.

We examined whether the salience of these threats varied across the five Italian macro-areas (North-West, North-East, Center, South, Islands) using chi-square tests on the cross-tabulations between macro-areas and each binary threat indicator. For some threats, no significant geographical differences emerged: this was the case for the climate crisis ($\chi^2_{[4, 2193]} = 4.23$, $p = 0.375$), drought ($\chi^2_{[4, 2193]} = 8.34$, $p = 0.080$), biodiversity loss ($\chi^2_{[4, 2193]} = 1.25$, $p = 0.870$), and hydrogeological instability ($\chi^2_{[4, 2193]} = 7.37$, $p = 0.118$). These results suggest a broadly shared national perception of these issues as relevant threats, independent of macro-area.

For other threats, however, the association with macro-area was statistically significant, although effect sizes were generally small (Cramer's V between 0.07 and 0.13). Excessive logging showed significant geographical variation ($\chi^2_{[4, 2193]} = 10.34$, $p = 0.035$, $V = 0.07$). Respondents from the Centre were more likely to indicate this threat (48.8%) compared with those in the North-West (41.4%), North-East (39.4%), South (43.7%), and Islands (39.2%). Perceptions of illegal logging also differed across macro-areas ($\chi^2_{[4, 2193]} = 18.22$, $p = 0.001$, $V = 0.09$), with the South exhibiting the high-

est proportion of respondents mentioning this threat (56.5%), while the Islands showed the lowest (39.2%), and the remaining macro-areas falling in between (around 45-49%).

Illegal dumping of waste exhibited one of the strongest geographical gradients ($\chi^2_{[4, 2193]} = 31.66$, $p < 0.001$, $V = 0.12$). While 73.8% of respondents in the South and 70.0% in the North-West reported this as a threat, the proportion dropped to 68.9% in the Center, 64.8% in the Islands, and 56.2% in the North-East. Forest fires also showed marked spatial differences ($\chi^2_{[4, 2193]} = 37.70$, $p < 0.001$, $V = 0.13$). Concern about wildfires was highest in the Islands (89.6%) and in the South (77.5%), followed by the Centre (76.8%), and was comparatively lower in the North-West (69.3%) and North-East (67.0%), in line with the different fire regimes characterizing these territories.

Smaller but significant geographical effects were observed for storms and insect damage ($\chi^2_{[4, 2193]} = 10.82$, $p = 0.029$, $V = 0.07$), and for invasive alien species ($\chi^2_{[4, 2193]} = 15.29$, $p = 0.004$, $V = 0.08$). Storms and insect outbreaks were mentioned somewhat more frequently in the North-East (29.3%) and North-West (25.9%) than in the South (20.2%) and Islands (20.8%), whereas invasive species were most frequently reported in the North-West (39.9%) and Islands (35.2%), and less so in the South (29.5%), with the Centre and North-East in an intermediate position (around one third of respondents).

Overall, these findings indicate a dual pattern: some threats (notably climate crisis, drought, biodiversity loss, and hydrogeological risk) are perceived as nationally shared problems, while others, particularly wildfires, waste dumping, illegal and excessive logging, storms/insects, and invasive species, show meaningful geographical differentiation, reflecting the specific ecological vulnerabilities and disturbance histories of the different Italian macro-areas. All frequencies and percentages by macro-area are reported in Tab. S2 (Supplementary material).

Information needs about forests

Participants indicated the topics they would like more information about regarding Italian forests. Overall, the most frequently selected themes concerned biodiversity and protected areas (60.0%), forests and health (57.3%), and forest management (53.2%). Interest was also high for information on the role of forests in climate crisis mitigation (51.1%) and on the geographical distribution of forests (44.5%). Fewer respondents requested information about wildfire prevention (40.0%) or environmental crimes and forest damage (32.1%). On average, participants selected 3.39 topics (SD = 1.76), indicating substantial curiosity and a diverse range of knowledge demands regarding forests.

We then examined whether these information needs varied across the five Italian macro-areas (North-West, North-East, Center, South, Islands) through chi-square tests on each binary indicator. For several topics, no significant geographical differences emerged, suggesting a national consensus regarding their relevance. This was the case for requests concerning forests and health ($\chi^2_{[4, 2193]} = 4.55, p = 0.336$), forest-related crimes and damage ($\chi^2_{[4, 2193]} = 9.02, p = 0.061$), climate crisis mitigation ($\chi^2_{[4, 2193]} = 4.74, p = 0.315$), forest management ($\chi^2_{[4, 2193]} = 2.19, p = 0.700$), and biodiversity and protected areas ($\chi^2_{[4, 2193]} = 4.34, p = 0.362$).

However, some informational needs showed significant variation across macro-areas. Interest in wildfire prevention differed markedly ($\chi^2_{[4, 2193]} = 31.15, p < 0.001, V = 0.12$): respondents from the Islands (58.4%) and the Center (43.0%) expressed greater demand for information than those from the North-West and North-East (35.3%). Requests for information on where forests are located also varied significantly ($\chi^2_{[4, 2193]} = 10.54, p = 0.032, V = 0.07$), with higher interest in the North-East (60.0%) and the Islands (38.4%) than in other areas. These differences likely reflect geographical variations in forest distribution and exposure to wildfire risk.

Overall, these findings suggest that while most information needs are shared across the country, topics linked to spatial forest distribution and wildfire prevention exhibit meaningful territorial patterns. Full frequencies and percentages are reported in Tab. S3 (Supplementary material).

Information sources about forests

Participants were also asked to indicate which sources they usually rely on to obtain information about forests. At the national level, the most frequently cited channels were scientific journals or scientifically oriented media (68.9%), documentaries (65.0%), and communication by national and regional parks (66.6%). Environmental organizations also played a visible role, with 44.9% of respondents citing environmental NGOs as a source of information, and 44.6% mentioning the forest police or

Carabinieri. Popular magazines were used by about two out of five respondents (41.8%).

By contrast, generalist mass media and digital platforms were much less central. Only 9.5% of participants reported obtaining forest-related information from TV news, 8.4% from social media such as Instagram, and 6.7% from online forums. Weekly or monthly magazines were cited by 5.6% of the sample. Private-sector actors were rarely mentioned: 3.1% cited the wood industry and 2.5% cited energy companies as sources of information on forests.

We also tested whether the use of these sources varied across the five macro-areas. Chi-square tests revealed significant but small geographical effects for documentaries ($\chi^2_{[4, 2193]} = 12.94, p = 0.012, V = 0.08$), park authorities ($\chi^2_{[4, 2193]} = 22.39, p < 0.001, V = 0.10$), and forest police/Carabinieri ($\chi^2_{[4, 2193]} = 10.70, p = 0.030, V = 0.07$). Documentaries were somewhat less frequently cited in the Islands (55.2%) than in the North-West, Centre and South (around 65-67%). Communication from national and regional parks was widely used in all areas, but especially in the North-West (71.3%), the Center (68.3%), and the North-East (67.2%), compared to the South (59.0%) and Islands (60.8%). Information from the forest police and Carabinieri was most frequently mentioned in the Islands (51.2%) and in the North-East (49.6%), and less so in the South (39.8%). For all other sources, including TV news, scientific journals, popular magazines, social media, online forums, NGOs, and private-sector organizations, no significant differences across macro-areas emerged. Full frequencies and percentages are reported in Tab. S4 (Supplementary material).

These patterns suggest that Italians primarily rely on institutional and science-based channels, rather than on generalist media or corporate communication, when seeking information about forests. At the same time, modest regional variations indicate that territorial institutions such as parks and forest police play a somewhat more prominent role in some areas than in others.

Post-pandemic need for nature

Participants reported a moderately high need to spend time in nature in the post-COVID period. On a 0-100 scale, the overall mean score was 58.05 (SD = 34.39), with the full range of responses (0-100) represented. The lowest mean value was observed in the North-West (M = 55.15, SD = 34.80), followed by the North-East (M = 55.94, SD = 33.95) and the Islands (M = 57.50, SD = 36.20), whereas higher scores were found in the Center (M = 59.54, SD = 34.07) and in particular in the South (M = 62.37, SD = 33.55). The ANOVA revealed a significant, though small, effect of geographical macro-area on the post-pandemic need for nature ($F_{[4, 2188]} = 3.79, p = 0.005$). *Post-hoc* Bonferroni tests showed

that only the contrast between the South and the North-West reached statistical significance, with respondents from the South reporting a stronger need to spend time in nature than those living in the North-West (mean difference = 7.22, $p = 0.003$). No other pairwise comparison was significant, indicating that the post-COVID need for nature is widely shared across the country, with only a slight accentuation in Southern regions.

Emotions in familiar and unfamiliar forests

Emotional responses were measured separately for familiar and unfamiliar forest environments using a 5-point Likert scale ranging from 1 ("not at all") to 5 ("extremely"). Fear-related items (e.g., feeling scared, agitated, afraid) were reverse-coded prior to analysis so that higher scores consistently reflected lower perceived fear.

Participants reported highly positive emotional responses when imagining themselves in a forest environment, whether in a familiar woodland or in a new, previously unknown forest. Fear-related emotions (feeling scared, feeling agitated, feeling afraid) received high scores on a 1-5 scale, indicating that participants generally felt safe and at ease in wooded settings. In familiar forests, mean scores for these fear-related items ranged from 4.54 to 4.68, whereas in unfamiliar forests the values were slightly lower but still very high (4.28 to 4.41). These results suggest that new forest environments evoke only minimal additional tension compared to settings that respondents already know.

A series of ANOVAs revealed small but statistically significant geographical differences. Feeling scared and afraid in familiar forests varied across macro-areas, with respondents from the South reporting slightly higher levels of fear than those from the North-West. A similar pattern emerged for feeling scared in unfamiliar forests. For all remaining negative emotions, geographical differences were not significant.

Positive activating emotions showed a similarly strong pattern. In familiar forests, participants reported high levels of interest, enthusiasm, inspiration, and feeling active (mean scores ranging from 3.62 to 4.00). These positive emotions were slightly stronger in unfamiliar forests (means ranging from 3.71 to 4.33), suggesting that novelty may enhance emotional engagement. Significant geographical differences emerged only for enthusiasm and inspiration in familiar forests: respondents from the Center and South reported higher enthusiasm than those from the North-West, and participants from the South also reported higher inspiration. No macro-area effects were observed for positive emotions in unfamiliar forests (see Tab. 3 for more details).

Overall, these findings depict both famil-

iar and unfamiliar forests as emotionally safe, pleasant, and engaging environments, eliciting strong positive reactions and very low fear among Italian respondents.

Forest visitation frequency

Participants reported how often they visit woodlands on a scale from 0 (“never”) to 4 (“several times a week”). Overall, the mean frequency across the full sample was moderate ($M = 2.20$, $SD = 0.91$), indicating that Italians typically visit forests between “a few times a year” and “a few times a month”. Descriptive statistics by macro-area show modest geographical variation. Respondents from the North-East ($M = 2.30$) and North-West ($M = 2.29$) reported the highest visitation frequency, followed closely by residents of the Islands ($M = 2.25$). Participants from the Center ($M = 2.15$) and especially the South ($M = 2.05$) reported comparatively lower frequencies.

A one-way ANOVA revealed a significant effect of geographical macro-area on the frequency of forest visits ($F_{[4, 2188]} = 6.65$, $p < 0.001$). Bonferroni-corrected post-hoc tests showed that respondents from the South visited forests significantly less often than those from the North-West ($p < 0.001$) and North-East ($p = 0.001$). No other pairwise comparisons were statistically significant after correction.

These findings suggest that northern regions, characterized by greater forest cover and easier access to wooded areas, tend to report more frequent engagement with forest environments than southern regions. All descriptive statistics are reported in Tab. 4.

Regression analyses

Predictors of post-pandemic need for nature

A multiple linear regression analysis was conducted to examine predictors of post-pandemic need for nature. The overall model was statistically significant ($F_{[5, 2187]} = 22.96$, $p < 0.001$), explaining 5.0% of the variance ($R^2 = 0.050$, adjusted $R^2 = 0.048$).

Perceived forest-related well-being was the strongest predictor ($\beta = 0.156$, $t = 7.39$, $p < 0.001$), indicating that individuals who attributed greater well-being benefits to forests reported a stronger post-pandemic need for nature.

Gender was also a significant predictor ($\beta = -0.124$, $t = -5.87$, $p < 0.001$). Given the variable’s coding (1 = female, 2 = male), the negative coefficient indicates that women reported significantly higher levels of post-pandemic need for nature than men.

Educational level was negatively associated with post-pandemic need ($\beta = -0.085$, $t = -4.02$, $p < .001$), suggesting that respondents with lower educational attainment reported a slightly stronger need for nature following the pandemic.

Age was not a significant predictor ($\beta = -0.027$, $p = 0.196$), nor was forest visitation

Tab. 3 - Mean scores for post-pandemic need for nature and emotional responses across Italian macro-areas.

Group	Variable	North-West	North-East	Centre	South	Islands	Total
Negative emotions - familiar forests (1-5)	Feeling scared	4.59	4.56	4.55	4.43	4.60	4.54
	Feeling agitated	4.68	4.63	4.68	4.60	4.74	4.65
	Feeling afraid	4.73	4.66	4.71	4.59	4.77	4.68
Negative emotions - unfamiliar forests (1-5)	Feeling scared	4.35	4.29	4.23	4.19	4.42	4.28
	Feeling afraid	4.46	4.41	4.39	4.35	4.52	4.41
	Feeling agitated	4.34	4.31	4.33	4.28	4.53	4.33
Positive emotions - familiar forests (1-5)	Feeling interested	3.96	3.97	4.05	4.02	4.14	4.00
	Feeling enthusiastic	3.79	3.86	3.97	3.98	4.00	3.90
	Feeling inspired	3.53	3.56	3.64	3.72	3.76	3.62
Positive emotions - unfamiliar forests (1-5)	Feeling active	3.90	3.90	3.95	3.92	3.98	3.92
	Feeling interested	4.32	4.35	4.36	4.28	4.45	4.33
	Feeling enthusiastic	4.09	4.14	4.17	4.15	4.26	4.14
	Feeling inspired	3.66	3.69	3.72	3.76	3.85	3.71
	Feeling active	3.91	3.93	3.91	3.93	4.04	3.92

frequency ($\beta = 0.020$, $p = 0.338$).

These findings suggest that post-pandemic motivation for contact with nature is more strongly associated with psychological evaluations and certain socio-demographic characteristics than with behavioral exposure.

Emotional engagement and perceived forest-related well-being

A hierarchical multiple regression analysis was performed to test whether positive emotional engagement predicted perceived forest-related well-being beyond socio-demographic characteristics and visitation frequency.

In Step 1, age, gender, and educational level explained 2.3% of the variance in well-being ($F_{[3, 2189]} = 17.14$, $p < 0.001$, $R^2 = 0.023$). In Step 2, visitation frequency was added and accounted for a small but significant increase in explained variance ($\Delta R^2 = 0.003$; $\Delta F_{[1, 2188]} = 5.91$, $p = 0.015$).

In Step 3, positive emotional engagement was entered, resulting in a substantial increase in explained variance ($\Delta R^2 = 0.054$; $\Delta F_{[1, 2187]} = 129.27$, $p < 0.001$). The final model explained 8.0% of the variance in perceived well-being ($R^2 = 0.080$, adjusted $R^2 = 0.078$; $F_{[5, 2187]} = 38.02$, $p < 0.001$).

In the final model, positive emotional en-

gagement emerged as the strongest predictor ($\beta = 0.239$, $t = 11.37$, $p < 0.001$). Age was positively associated with perceived wellbeing ($\beta = 0.093$, $t = 4.51$, $p < 0.001$), indicating that older respondents reported slightly higher levels of forest-related wellbeing. Gender was also significant ($\beta = -0.110$, $t = -5.31$, $p < 0.001$); given the variable’s coding (1 = female, 2 = male), this coefficient indicates that women reported higher levels of perceived well-being than men. Educational level and visitation frequency were not significant in the final model.

These findings highlight the central role of emotional engagement in shaping perceived forest-related well-being, beyond socio-demographic characteristics and behavioral exposure.

Perceived importance of specific forest goods and social functions

Participants also evaluated the importance of several specific goods and social functions provided by forests, including wood and timber production, biomass for energy, wild forest foods, health-related products, psychological well-being, social cohesion, and environmental education. Overall, mean ratings were clearly above the midpoint of the scale for all items

Tab. 4 - Frequency of forest visits (0-4 scale) across macro-areas.

Macro-area	Mean	SD	Min	Max
North-West	2.29	0.88	0	4
North-East	2.30	0.92	0	4
Centre	2.15	0.92	0	4
South	2.05	0.90	0	4
Islands	2.25	0.97	0	4
Total	2.20	0.91	0	4

Tab. 5 - Mean importance ratings of specific forest goods and social functions across macro-areas.

Forest good / function	North-West	North-East	Centre	South	Islands	Total
Firewood production	3.53	3.54	3.57	3.40	3.63	3.52
Timber production	3.78	3.77	3.72	3.61	3.74	3.72
Biomass for energy	3.71	3.59	3.62	3.57	3.67	3.64
Wild forest foods (mushrooms, berries, etc.)	4.22	4.06	4.21	4.15	4.26	4.18
Health-related products (medicines, nutraceuticals)	4.04	4.11	4.18	4.19	4.28	4.13
Psychological well-being	4.54	4.49	4.59	4.56	4.60	4.55
Social cohesion	4.18	4.31	4.31	4.32	4.36	4.27
Environmental education	4.66	4.69	4.69	4.73	4.85	4.70

(range 1-5), confirming that respondents attribute substantial value to both material and immaterial forest services. At the national level, the highest scores were observed for environmental education ($M = 4.70$, $SD = 0.61$), psychological well-being ($M = 4.55$, $SD = 0.70$), and social cohesion ($M = 4.27$, $SD = 0.88$), followed by the production of wild forest foods ($M = 4.18$, $SD = 0.93$) and health-related products ($M = 4.13$, $SD = 0.97$). Importance ratings for more strictly productive services, biomass for energy ($M = 3.64$, $SD = 1.11$), timber production ($M = 3.72$, $SD = 1.08$), and firewood production ($M = 3.52$, $SD = 1.14$) were comparatively lower, although still clearly positive.

We examined whether these evaluations varied across the five Italian macro-areas. One-way ANOVAs indicated that macro-area had a statistically significant effect on the perceived importance of wild forest foods ($F_{[4, 2188]} = 2.44$, $p = 0.045$), health-related products ($F_{[4, 2188]} = 3.05$, $p = 0.016$), social cohesion ($F_{[4, 2188]} = 2.84$, $p = 0.023$), and environmental education ($F_{[4, 2188]} = 3.05$, $p = 0.016$). For firewood, timber, and biomass production, and psychological well-being, no significant geographical differences emerged (all p -values ≥ 0.09). However, *post-hoc* Bonferroni tests showed that most pairwise contrasts did not survive correction for multiple comparisons, indicating that effect sizes were generally small. The clearest difference concerned the role of forests in environmental education, for which respondents from the Islands reported significantly higher scores ($M = 4.85$) than those from the North-West ($M = 4.66$), while all other macro-areas clustered around similarly high values. Overall, these findings suggest that the importance attributed to forest goods and social functions is consistently high throughout Italy, with only modest spatial variation and a slightly stronger emphasis on educational functions in the Island regions. Descriptive statistics by macro-area are reported in Tab. 5.

Discussion

The findings of the present study provide an updated and comprehensive overview of how Italian citizens perceive forests, building upon and substantially extending previous research. The findings allow us to address the research questions guiding this study, including forest cover estimation, ecosystem service valuation, the post-pandemic need for nature, emotional responses to forests, and the role of visitation frequency in shaping emotional engagement and well-being. When compared to Carrus et al. (2020), a study based on data collected between 2016 and 2017, our results highlight both areas of strong continuity and meaningful shifts, reflecting an evolving socio-environmental context characterized by intensifying climate impacts and post-pandemic psychological dynamics.

Consistent with Carrus et al. (2020), respondents in our sample attributed high importance to the ecological, cultural, and social functions of forests, particularly biodiversity conservation, hydrogeological risk reduction, and climate regulation. This pattern aligns with global research on ecosystem services, which shows that regulating and protective functions tend to be among the most valued by the public, particularly in regions facing environmental vulnerabilities (Millennium Ecosystem Assessment 2005, Díaz et al. 2018). At the same time, the high importance respondents attributed to well-being, education, and social cohesion echoes findings from studies showing that forests act as restorative and identity-building environments (Ulrich 1983, Kaplan 1995, Hartig et al. 2014). These findings address our second research question, confirming that regulating and cultural ecosystem services are consistently valued more strongly than strictly provisioning functions in the contemporary Italian context.

Compared with Carrus et al. (2020), our results show a noticeable strengthening of the perceived psychological and social value of forests. This shift likely reflects broader post-pandemic tendencies, with

several studies documenting a substantial increase in the perceived necessity of nature contact for emotional regulation and well-being (Pouso et al. 2021, Robinson et al. 2021, Soga et al. 2021). The strong “post-COVID need for nature” observed in our data reinforces these findings and suggests that forests may now play an even more central role in public well-being than before 2020. Importantly, regression analyses showed that this need was more strongly associated with perceived forest-related well-being and with gender and educational level, rather than with age or visitation frequency, suggesting that motivational shifts are primarily psychological rather than behavioral in nature. This finding directly addresses our third research question, showing that the post-pandemic need for nature is widely shared across the country, with only modest territorial variation. The relatively modest explained variance suggests that additional psychological variables (e.g., environmental identity, connectedness to nature) may further contribute to explaining forest-related well-being.

A major point of continuity with Carrus et al. (2020) concerns the overestimation of forest cover. Similar biases were found in both studies, indicating a stable cognitive pattern consistent with research suggesting that people often rely on heuristic impressions rather than quantitative knowledge when estimating environmental parameters (Böhm & Pfister 2017, Fernbach et al. 2019). However, the magnitude of overestimation appears in some cases to be higher in our sample, potentially reflecting increased media coverage of forest landscapes and extreme events over recent years. This finding directly addresses our first research question, confirming that moderate overestimation of forest cover persists in the post-pandemic context.

Perceptions of forest threats were also stronger and more diverse in our sample than in pre-pandemic findings reported by Carrus et al. (2020). While climate change and biodiversity loss were already salient concerns in 2016-2017, the present study reveals heightened concern for drought, fires, invasive species, and illegal logging. These differences parallel real ecological trends documented in southern Europe, where forest disturbances have intensified due to climate change and land-use transformations (Bebi et al. 2017, Seidl et al. 2017, Bowditch et al. 2020). The stronger threat profile observed in our study may therefore reflect a combination of changing environmental conditions and heightened public sensitivity.

Unlike Carrus et al. (2020), our study included an extensive analysis of emotional responses to both familiar and unfamiliar forests. The predominance of positive emotions such as inspiration, interest, and enthusiasm confirms existing evidence on the psychological benefits of nature exposure (Hartig et al. 2014, McMahan & Estes 2015). The relative marginality of negative

emotions, despite their presence, suggests that forests continue to be experienced as safe and supportive environments for most people, consistent with studies in environmental psychology and landscape perception (Gatersleben & Andrews 2013). These results address our research question on emotional patterns in familiar versus unfamiliar forest environments, showing that novelty slightly increases activation but does not substantially elevate fear.

Another significant contribution of the present study lies in its assessment of forest-related knowledge and information needs, a dimension not fully addressed in Carrus et al. (2020). Respondents reported uneven knowledge across key themes, including biodiversity, fire prevention, and forest management, echoing research showing that public understanding of forest processes is often limited or fragmented (Riedl 2025). Importantly, perceived knowledge was positively related to perceived threats, suggesting that increased awareness may heighten sensitivity to ecological risks rather than reduce it, an effect previously observed in studies of climate risk perception (van der Linden 2015).

Finally, behavioral data on woodland visits offer a new perspective compared with Carrus et al. (2020). While visitation frequency showed a small positive association with perceived forest-related wellbeing, this effect became non-significant when positive emotional engagement was included in the regression model. This pattern suggests that the psychological benefits associated with forest visits are primarily mediated by the quality of emotional experience rather than by mere behavioral exposure. In other words, frequency of contact alone does not appear sufficient to explain well-being outcomes; rather, the emotional meaning attributed to forest environments plays a central role. This finding aligns with research indicating that subjective emotional engagement is a key mechanism linking exposure to nature to well-being (Lumber et al. 2017, Rosa & Collado 2019). This pattern addresses our fifth research question, indicating that emotional engagement represents a more central predictor of perceived forest-related well-being than mere visitation frequency.

While the uniformly high ratings attributed to environmental issues and forest functions confirm the strong perceived relevance of forests in Italian society, the concentration of responses toward the upper end of the scale (with several mean values exceeding 4.7 on a 1-5 scale) suggests the possibility of ceiling effects. Such clustering may reduce variability and limit the instrument's sensitivity to capturing more nuanced distinctions among respondents.

Moreover, as commonly observed in surveys addressing environmental topics, social desirability bias may have contributed to particularly strong pro-environmental responses. Although the anonymous and

voluntary format of the questionnaire may have mitigated this tendency, it cannot be entirely excluded. These considerations do not invalidate the overall pattern of findings but should be taken into account when interpreting the magnitude of the reported effects.

Taken together, this study reveals that Italians continue to value forests highly, perceive them as essential for environmental sustainability and psychological well-being, and simultaneously recognize the urgency of addressing the threats they face. Compared with Carrus et al. (2020), these perceptions appear more emotionally charged, more threat-oriented, and more influenced by the post-pandemic context. Strengthening communication, participatory governance, and educational strategies may therefore be key to aligning public expectations with sustainable forest management and to reinforcing the role of forests as essential socio-ecological infrastructures in contemporary Italy.

Limitations

Despite the strengths of a large and geographically diverse national sample, several limitations should be acknowledged.

First, the study relied on a non-probabilistic online sampling strategy. Participation was voluntary, which may have introduced self-selection bias, potentially leading to an overrepresentation of individuals already interested in environmental issues. In addition, the sample shows a relatively high proportion of highly educated respondents, which may limit the generalizability of the findings to the Italian population as a whole. Second, the cross-sectional design prevents any causal inference. Although comparisons with pre-pandemic data provide valuable contextual insight, the present study cannot establish temporal changes at the individual level. Third, all measures were based on self-reports. While appropriate for assessing perceptions and emotional responses, self-report instruments may be subject to social desirability bias, particularly when addressing environmentally relevant topics. In addition, although the regression models were statistically significant, the proportion of explained variance was modest, which is common in large-scale attitudinal surveys but suggests that additional psychological and contextual variables may contribute to explaining perceptions and well-being. Finally, several environmental importance ratings approached the upper end of the response scale, suggesting potential ceiling effects. This compression of variance may have limited the ability to detect stronger differences across socio-demographic or territorial groups.

Future research could address these limitations by adopting longitudinal designs, probability-based sampling strategies, and complementary behavioral or experimental measures.

Conclusions

The present study provides one of the most comprehensive assessments to date of how Italian citizens perceive forests, their functions, associated risks, and the emotional and psychological meanings attached to forest environments. Based on a large and geographically diverse sample, the findings indicate that forests are widely regarded as multifunctional systems with substantial ecological, social, and psychological value. Respondents consistently attributed high importance to forest functions related to landscape protection, biodiversity conservation, climate regulation, hydrogeological stability, and, to a growing extent, to health, well-being, environmental education, and social cohesion. These results confirm and extend previous evidence on the positive societal value attributed to forests in Italy (Paletto et al. 2013) and highlight a heightened sensitivity to their protective and regenerative roles (Sergiacomi et al. 2024).

At the same time, the study shows that Italians perceive forests as increasingly threatened by a broad range of pressures, particularly climate change, drought, biodiversity loss, illegal logging, and forest fires. These perceptions appear relatively consistent across regions, suggesting a shared national environmental concern. The coexistence of strong appreciation and elevated perception of threats indicates that forests are viewed not only as ecological assets but also as vulnerable systems requiring proactive stewardship and long-term policy attention.

The emotional findings deepen this picture. Forest environments, both familiar and unfamiliar, evoked predominantly positive affective responses, including feelings of interest, inspiration, enthusiasm, and activation. Negative emotions such as fear or agitation were present but less central, supporting the idea that forests constitute emotionally meaningful and generally restorative environments for most citizens. Crucially, the post-pandemic need for nature emerged as a salient attitudinal dimension: many respondents reported an intensified desire for contact with natural environments, reflecting broader societal trends observed internationally. Regression analyses further indicated that post-pandemic need for nature was more strongly associated with perceived forest-related well-being than with visitation frequency, underscoring the central role of psychological evaluations in shaping this motivational dimension (Anderson et al. 2018).

Despite this strong affective and cognitive engagement, the study also revealed considerable heterogeneity in objective and self-perceived knowledge about forests and forest management. Although most respondents expressed interest in topics such as health benefits, biodiversity, protected areas, and climate-change mitigation, a substantial share reported limited

or only partial knowledge. Information demand was particularly high among groups that also expressed stronger environmental concern and higher perceived threats, indicating a need for clearer, more accessible, and more targeted communication strategies.

Together, these findings point to several implications for forest governance, communication, and planning in Italy. First, the high value placed on ecological and social forest functions suggests that policies integrating conservation, recreation, health promotion, and cultural dimensions may resonate strongly with the public. Second, the widespread perception of threats underscores the need for improved public communication based on trusted, transparent, and scientifically sound information. Third, the strong emotional and psychological engagement revealed by the data, particularly the post-pandemic desire for nature, suggests that urban and peri-urban forests, proximity green spaces, and accessible woodland networks may become increasingly important for public well-being, especially in densely populated or socio-economically vulnerable areas.

Overall, this study shows that Italian citizens recognize forests as essential components of environmental protection, climate resilience, and public well-being. At the same time, they call for greater knowledge, more accessible information, and clearer forest governance. Strengthening communication, education, and participatory approaches may therefore be crucial for aligning public expectations with sustainable forest management and for reinforcing the role of forests as key ecological and social infrastructures in contemporary Italy.

Ethics declarations

The study was approved by the institutional ethics committee of the Università Europea di Roma (Protocol no. 10/2025). All methods were performed in accordance with the Declaration of Helsinki for studies involving human participants.

Data statement

Data are available upon request to the Authors.

Funding details

This study was carried out under the 2025 research contract between Sorgenia S.p.A. and the University of Bari "Aldo Moro", Bari, Italy.

Disclosure statement

The authors report no competing interests.

References

Anderson N, Ford RM, Bennett LT, Nitschke C, Williams KJ (2018). Core values underpin the attributes of forests that matter to people. *Forestry* 91 (5): 629-640. - doi: [10.1093/forestry/cpy022](https://doi.org/10.1093/forestry/cpy022)

Barona CO, Wolf K, Kowalski JM, Kendal D, Byrne JA, Conway TM (2022). Diversity in public perceptions of urban forests and urban trees: A critical review. *Landscape and Urban Planning* 226: 104466. - doi: [10.1016/j.landurbplan.2022.104466](https://doi.org/10.1016/j.landurbplan.2022.104466)

Bebi P, Seidl R, Motta R, Fuhr M, Firm D, Krumm F, Conedera M, Ginzler C, Wohlgemuth T, Kulakowski D (2017). Changes of forest cover and disturbance regimes in the mountain forests of the Alps. *Forest Ecology and Management* 388 (9): 43-56. - doi: [10.1016/j.foreco.2016.10.028](https://doi.org/10.1016/j.foreco.2016.10.028)

Böhm G, Pfister HR (2017). The perceiver's social role and a risk's causal structure as determinants of environmental risk evaluation. *Journal of Risk Research* 20 (6): 732-759. [10.1080/13669877.2015.1118148](https://doi.org/10.1080/13669877.2015.1118148)

Bowditch E, Santopuoli G, Binder F, Del Río M, La Porta N, Klůvankova T, Lesinski J, Motta R, Pach M, Panzacchi P, Pretzsch H, Temperli C, Tonon G, Smith M, Velikova V, Weatherall A, Tognetti R (2020). What is climate-smart forestry? A definition from a multinational collaborative process focused on mountain regions of Europe. *Ecosystem Services* 43: 101113. - doi: [10.1016/j.ecoser.2020.101113](https://doi.org/10.1016/j.ecoser.2020.101113)

Carrus G, Panno A, Aragones JI, Marchetti M, Motta R, Tonon G, Sanesi G (2020). Public perceptions of forests across Italy: An exploratory national survey. *iForest - Biogeosciences and Forestry* 13 (4): 323-328. - doi: [10.3832/iferor3394-013](https://doi.org/10.3832/iferor3394-013)

Coles R, Millman Z, Flannigan J (2013). Urban landscapes-everyday environmental encounters, their meaning and importance for the individual. *Urban Ecosystems* 16 (4): 819-839. - doi: [10.1007/s11252-013-0327-y](https://doi.org/10.1007/s11252-013-0327-y)

De Meo I, Paletto A, Cantiani MG (2015). The attractiveness of forests: preferences and perceptions in a mountain community in Italy. *Annals of Forest Research* 58 (1): 145-156. - doi: [10.15287/afr.2015.308](https://doi.org/10.15287/afr.2015.308)

De Meo I, Cantiani MG, Ferretti F, Paletto A (2018). Qualitative assessment of forest ecosystem services: the stakeholders' point of view in support of landscape planning. *Forests* 9 (8): 465. - doi: [10.3390/f9080465](https://doi.org/10.3390/f9080465)

Díaz S, Pascual U, Stenseke M, Martín-López B, Watson RT, Molnár Z, Hill R, Chan KM, Baste IA, Brauman KA, Polasky S, Church A, Lonsdale M, Larigauderie A, Leadley PW, van Oudenhoven AP, van der Plaats F, Schröter M, Lavorel S, Aumeeruddy-Thomas Y, Bukvareva E, Davies K, Demissew S, Erpul G, Failler P, Guerra CA, Hewitt CL, Keune H, Lindley S, Shirayama Y (2018). Assessing nature's contributions to people. *Science* 359 (6373): 270-272. - doi: [10.1126/science.aap8826](https://doi.org/10.1126/science.aap8826)

Fernbach PM, Light N, Scott SE, Inbar Y, Rozin P (2019). Extreme opponents of genetically modified foods know the least but think they know the most. *Nature Human Behaviour* 3 (3): 251-256. - doi: [10.1038/s41562-018-0520-3](https://doi.org/10.1038/s41562-018-0520-3)

Führer E (2000). Forest functions, ecosystem stability and management. *Forest Ecology and Management* 132: 29-38. - doi: [10.1016/S0378-1127\(00\)00377-7](https://doi.org/10.1016/S0378-1127(00)00377-7)

Gatersleben B, Andrews M (2013). When walking in nature is not restorative. The role of prospect and refuge. *Health and Place* 20: 91-101. - doi: [10.1016/j.healthplace.2013.01.001](https://doi.org/10.1016/j.healthplace.2013.01.001)

Hartig T, Mitchell R, De Vries S, Frumkin H (2014). Nature and health. *Annual Review of Public Health* 35 (1): 207-228. - doi: [10.1146/annurev-publhealth-032013-182443](https://doi.org/10.1146/annurev-publhealth-032013-182443)

ISPRA (2023). Rapporto sullo stato delle foreste e del settore forestale in Italia (RAF Italia) [Report on the State of Forests and the Forestry Sector in Italy (RAF Italia)]. Rete Rurale Nazionale 2014-2020, Ministero dell'Agricoltura, della Sovranità Alimentare e delle Foreste, Roma, Italy, pp- 284. [in Italian] [online] URL: <https://www.reterurale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/19231>

Kaplan S (1995). The restorative benefits of nature: toward an integrative framework. *Journal of Environmental Psychology* 15 (3): 169-182. - doi: [10.1016/0272-4944\(95\)90001-2](https://doi.org/10.1016/0272-4944(95)90001-2)

Lumber R, Richardson M, Sheffield D (2017). Beyond knowing nature: contact, emotion, compassion, meaning, and beauty are pathways to nature connection. *PLoS One* 12 (5): e0177186. - doi: [10.1371/journal.pone.0177186](https://doi.org/10.1371/journal.pone.0177186)

McMahan EA, Estes D (2015). The effect of contact with natural environments on positive and negative affect: a meta-analysis. *The Journal of Positive Psychology* 10 (6): 507-519. - doi: [10.1080/17439760.2014.994224](https://doi.org/10.1080/17439760.2014.994224)

Millennium Ecosystem Assessment (2005). *Ecosystems and human well-being: Synthesis*. Island Press, Washington, DC, USA.

Paletto A, Cantiani MG, De Meo I (2013). Perception of forest values in the Alpine community of Trentino region (Italy). *Environmental Management* 52: 414-422. - doi: [10.1007/s00267-012-9974-7](https://doi.org/10.1007/s00267-012-9974-7)

Paletto A, Giacobelli G, Grilli G, Balest J, De Meo I (2014). Stakeholders' preferences and the assessment of forest ecosystem services: A comparative analysis in Italy. *Journal of Forest Science* 60 (11): 472-483. - doi: [10.17221/85/2014-JFS](https://doi.org/10.17221/85/2014-JFS)

Paletto A, Guerrini S, De Meo I (2017). Exploring visitors' perceptions of silvicultural treatments to increase the destination attractiveness of peri-urban forests: a case study in Tuscany Region (Italy). *Urban Forestry and Urban Greening* 27: 314-323. - doi: [10.1016/j.ufug.2017.06.020](https://doi.org/10.1016/j.ufug.2017.06.020)

Pastorella F, Giacobelli G, Maesano M, Paletto A, Vivona S, Veltri A, Pellicone G, Scarascia Mugnozza G (2016). Social perception of forest multifunctionality in southern Italy: the case of Calabria region. *Journal of Forest Science* 62 (8): 366-379. - doi: [10.17221/45/2016-JFS](https://doi.org/10.17221/45/2016-JFS)

Pouso S, Borja A, Fleming LE, Gómez-Baggethun E, White MP, Uyarra MC (2021). Contact with blue-green spaces during the COVID-19 pandemic lockdown beneficial for mental health. *The Science of the Total Environment* 756: 143984. - doi: [10.1016/j.scitotenv.2020.143984](https://doi.org/10.1016/j.scitotenv.2020.143984)

Purvestri RC, Palátová P, Hájek M, Dudík R, Jarský V, Riedl M (2023). Public perception of the performance of Czech forest ecosystem services. *Environmental Sciences Europe* 35 (1): 89. - doi: [10.1186/s12302-023-00802-8](https://doi.org/10.1186/s12302-023-00802-8)

Riedl M (2025). Forestry communication and public perception: insights from the Czech Republic. *Forests* 16 (5): 818. - doi: [10.3390/f16050818](https://doi.org/10.3390/f16050818)

Rivieccio R, Romano R, Orsini S (2024). Forest therapy in Italy: proposal of a standard procedure for validation of suitable sites. *iForest - Biogeosciences and Forestry* 17 (4): 192-202. -

doi: [10.3832/ifor4543-017](https://doi.org/10.3832/ifor4543-017)

- Robinson JM, Brindley P, Cameron R, MacCarthy D, Jorgensen A (2021). Nature's role in supporting health during the COVID-19 pandemic: a geospatial and socioecological study. *International Journal of Environmental Research and Public Health* 18 (5): 2227. - doi: [10.3390/ijerph18052227](https://doi.org/10.3390/ijerph18052227)
- Rosa CD, Collado S (2019). Experiences in nature and environmental attitudes and behaviors: Setting the ground for future research. *Frontiers in Psychology* 10: 763. - doi: [10.3389/fpsyg.2019.00763](https://doi.org/10.3389/fpsyg.2019.00763)
- Sergiacomi C, Floris A, Clementel F, Paletto A (2024). The economic value of the protective functions of mountain forests: a case study in the Italian Alps. *Journal of Sustainable Forestry* 43 (6-10): 153-173. - doi: [10.1080/10549811.2025.2451438](https://doi.org/10.1080/10549811.2025.2451438)
- Seidl R, Thom D, Kautz M, Martin-Benito D, Peltoniemi M, Vacchiano G, Wild J, Ascoli D, Petr M, Honkaniemi J, Lexer MJ, Trotsiuk V, Mairota P, Svoboda M, Fabrika M, Nagel TA, Reyser CP (2017). Forest disturbances under climate change. *Nature Climate Change* 7 (6): 395-402. - doi: [10.1038/nclimate3303](https://doi.org/10.1038/nclimate3303)
- Smith F, Turner W (2023). What are the psycho-

- logical and cognitive wellbeing benefits as reported by people experiencing green space? A meta-ethnography. *Wellbeing, Space and Society* 5: 100158. - doi: [10.1016/j.wss.2023.100158](https://doi.org/10.1016/j.wss.2023.100158)
- Soga M, Evans MJ, Cox DTC, Gaston KJ (2021). Impacts of the COVID-19 pandemic on human-nature interactions: pathways, evidence and implications. *People and Nature* 3 (3): 518-527. - doi: [10.1002/pan3.10201](https://doi.org/10.1002/pan3.10201)
- Spano G, Dadvand P, Sanesi G (2021). The benefits of nature-based solutions to psychological health. *Frontiers in Psychology* 12: 646627. - doi: [10.3389/fpsyg.2021.646627](https://doi.org/10.3389/fpsyg.2021.646627)
- Ulrich RS (1983). Aesthetic and affective response to natural environment. In: "Behavior and the Natural Environment". Springer, Boston, MA USA, pp. 85-125.
- United Nations (2015). Transforming our world: the 2030 Agenda for Sustainable Development. United Nations General Assembly, Department of Economic and Social Affairs, website. [online] URL: <http://sdgs.un.org/2030agenda>
- Van den Brink PJ, Boxall AB, Maltby L, Brooks BW, Rudd MA, Backhaus T, Van Wensem J (2018). Toward sustainable environmental quality: priority research questions for Europe. *Environmental Toxicology and Chemistry* 37 (9):

2281-2295. - doi: [10.1002/etc.4205](https://doi.org/10.1002/etc.4205)

- Van der Linden S (2015). The social-psychological determinants of climate change risk perceptions: towards a comprehensive model. *Journal of Environmental Psychology* 41: 112-124. - doi: [10.1016/j.jenvp.2014.11.012](https://doi.org/10.1016/j.jenvp.2014.11.012)

Supplementary Material

Tab. S1 - Sociodemographic characteristics of the sample.

Tab. S2 - Perceived threats to forests by macro-area (frequencies and row percentages).

Tab. S3 - Information needs about forests by macro-area (frequencies and row percentages).

Tab. S4 - Information sources about forests by macro-area (frequencies and row percentages).

Link: Clemente_5149@suppl001.pdf