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Social perception of forest multifunctionality in southern Italy: The case of Calabria Region

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ABSTRACT: During the last decades, forest management systems involving multifunctionality were developed and implemented at a local level all over Europe. Recently, the international scientific literature focused on the concept of ecosystem services. The substantial difference between forest functions and ecosystem services is that the former implies the capacity of forest ecosystem to supply goods and services to society, the latter focuses on the benefits that people obtain from the ecosystems. The aim of this paper is to analyse the social perception of the importance of forest functions and threats to forest multifunctionality in four case studies in the south of Italy, in the Calabria Region (Pollino, Sila, Catena Costiera and Serre Calabre). The study was structured in four steps: (*i*) stakeholder analysis, (*ii*) questionnaire survey, (*iii*) statistical analysis of the collected data, (*iv*) development of importance-threat matrices. At the end of the analysis, 71 representative stakeholders were identified and involved in the survey. Besides, the representative stakeholders were classified into four groups of interest according to their characteristics: public administrations, associations-non-governmental organizations, academia and research institutes, professional associations of the forest-wood-energy chain. The stakeholders assigned a level of importance to nine forest functions and to ten threats to multifunctionality using a 5-point Likert scale. The data analysis was elaborated distinguishing between groups of interest and case study areas. The overall results show that the two forest functions perceived as the most important by the involved stakeholders are biodiversity and landscape conservation, while a low importance was assigned to the productive forest functions. Regarding the threats, the overall results show that the most relevant threats are the forest fires that affect all functions followed by illegal cuttings and forest abandonment. The ranking of forest functions is similar in all four case studies, while the threat evaluations are more linked to local contexts.

Keywords: ecosystem services; forest threats; stakeholders; social acceptance; forest functions

In the first half of the 20th century, Prof. Viktor Dieterich in his "Forstwirtschaftspolitik" developed the "Theory of Forest Functions" (Dieterich 1953) and the concept of forest multifunctionality has spread across Europe (Hytönen 1995). According to this theory, the forests are able to perform three main groups of functions (Fernand 1995): utility, protection and recreation. Subsequently,

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many authors have revised the theory of multifunctionality in order to implement it in forest planning and management (Carvalho-Ribeiro et al. 2010; Paletto et al. 2012; Di Salvatore et al. 2013).

From the practical point of view, the multifunctionality is the simultaneous and interrelated provision of different functions from a single land use type such as forest or agricultural area (Mander et al. 2007). According to Knickel and Renting (2000), the multifunctionality is based on the assumption that the uses of forests have always fulfilled more than just their primary aim of producing food, fodder, timber and fuel. Over the years of the debate on forest multifunctionality, many functions have been described and analysed from the scientific and practical point of view. Currently, the main forest functions can be summarized as follows (Führer 2000; Urquhart et al. 2012): forest wood production (timber and fuelwood), non-wood forest product production (fruits and berries, fodder, honey, medicinal plants), protection from natural hazards (landslides, rockfalls, avalanches and floods), air and water quality improvement, provision of wildlife habitats, forest recreation activities (sport and outdoor recreation, game), and conservation of natural and cultural landscapes.

In the last decades, thanks to the theoretical framework elaborated in the "Theory of Forest Functions" (Dieterich 1953) many forest management systems – as multi-objective forest management, multiple-purpose forest management, and multi-functional forest management – were developed and implemented in several parts of Europe (Kangas, Store 2002; Pukkala 2002; Kangas et al. 2006; Nichiforel 2010; Paletto et al. 2012). Therefore, multifunctional management allows forests to provide several goods and services to society.

Recently, in the international literature the concept of ecosystem services has had great success following the definition provided by the Millennium Ecosystem Assessment (MA 2005). Ecosystem services can be defined as the benefits that people obtain from the ecosystems and they can be classified into four main categories based on their functions (MA 2005): (*i*) provisioning services (material or energy outputs from ecosystems such as food production, provision of raw materials, water supply), (*ii*) regulating services (benefits obtained from the regulation of ecosystem processes such as water and climate regulation, pollination, hydrogeological protection, soil erosion control), (*iii*) cultural services (non-material benefits that people obtain from forests through spiritual enrichment, cognitive development, recreation and aesthetic experience), (*iv*) supporting services (necessary for the production of all other ecosystem services such as natural diversity, plant production, soil formation and nutrient cycling). Afterwards, de Groot et al. (2010) reclassified ecosystem services replacing supporting services with habitat services (i.e. nursery habitat, gene pool protection).

The international success of the concept of ecosystem services is due to its capacity to integrate ecological, social and economic approaches in knowledge building and environmental policy development (de Groot et al. 2010; Martínez Pastur et al. 2016). According to Sagoff (2008), the concept of ecosystem services is not a new idea but it is the same concept called by John Locke in 1690 as "natural intrinsic value" of land. Consequently, it is a new name for an old concept.

Synthesizing, the substantial difference between ecosystem functions (e.g. forest functions) and ecosystems services is that the first concept implies the capacity of ecosystems to supply goods and services (de Groot 1992; Barbier 2000), while the second concept focuses on the benefits provided by ecosystem or natural capital (Farber et al. 2002).

In order to better address the multifunctional forest management or the other forest management systems based on multifunctionality, the social valuation is a valuable tool able to consider the social importance assigned to each forest function (Felipe-Lucia et al. 2015). The social valuation is based on the opinions, perceptions and preferences of social actors such as stakeholders, citizens, and groups of interest. In addition, the social valuation is the basis for embarking on a process of public involvement in decisions in order to reduce the conflicts between users, to legitimate the decision-making process and to increase the social acceptance (Kangas et al. 2006; Balest et al. 2016).

Taking into account these considerations, the aim of this paper is to analyse the social perception of the importance of forest functions and threats to multifunctionality in four case studies in the south of Italy, in the Calabria Region (Pollino, Sila, Catena Costiera and Serre Calabre). The study was structured in four steps: (*i*) stakeholder analysis, (*ii*) questionnaire survey, (*iii*) statistical analysis of the collected data, (*iv*) development of importance-threat matrices. The stakeholders' opinions and perceptions were analysed using an importance-threat matrix aimed to highlight the threats to forest multifunctionality at a local level.

MATERIAL AND METHODS

Study area. The social opinions and perceptions of forest multifunctionality were investigated in four study areas located in the Calabria Region, southern Italy (Fig. 1). This region is characterized by 15,222 km^2 of land area and about 2 million inhabitants corresponding to a population density of 129.6 inhabitants per km^2. According to the 2nd Italian National Forest Inventory (Gasparini, Tabacchi 2011) forests cover is 468,151 ha (30.8% of the total regional area) and the main forest types are: European beech (*Fagus sylvatica* Linnaeus) forests (12.6% of forests), chestnut (*Castanea sativa* Miller) forests (11.3%), black (*Pinus nigra* ssp. *nigra* Arnold) and Corsican pine (*Pinus nigra* ssp. *laricio* Arnold) forests (12.2%), downy and common oak (*Quercus pubescens* Willdenow, *Quercus robur* Linnaeus) forests (7.6%). In the Calabria Region, the distribution between private and public forest is almost balanced, 41% are publicly owned (i.e. state, regional and municipal forests) and remaining 59% are privately owned (i.e. individuals and companies). The main category of individual private forests is characterized by an average surface area of less than 2 ha. The forest growing stock is 190 m^3·ha^{-1} with a mean annual volume increment of 5.4 m^3·ha^{-1}·yr^{-1}, while the average annual harvest volume is 1.2 m^3·ha^{-1}·yr^{-1} (22% of the mean annual volume increment).

The stakeholders interviewed are residents in the four sample areas involved in the survey: Pollino, Serre Calabre, Catena Costiera, Sila. The total sample area has a forest surface of about 188,000 ha (40% of the regional forest area) distributed as follows: 35,341 ha in Pollino, 40,009 ha in Serre Calabre, 21,294 ha in Catena Costiera and 91,122 ha in Sila. Forest rates vary from a minimum of 35.6% (Catena Costiera) to a maximum of 65.7% (Sila).

Sample of stakeholders. The sample of stakeholders was identified by stakeholder analysis with the aim to identify and classify the main stakeholders in each study area. According to ODA (1995) the stakeholders are persons, groups or institutions with interests in a project or programme, while the stakeholder analysis is a range of different methodologies and techniques for analysing in a systematic way the stakeholders' roles, relationships, interests, and influence in the decision-making process (Mitchell et al. 1997). The main purposes of stakeholder analysis are as follows (Reed et al. 2009; Grilli et al. 2015): (*i*) defining the aspects of a social and natural phenomenon affected by a decision, (*ii*) identifying the individuals and groups who are affected by or can affect those parts of the phenomenon, (*iii*) prioritizing to these individuals and groups for involvement in the decision-making process.

In this study, the relevant stakeholders have been identified through a brainstorming session between project partners supported by local experts. Subsequently, the preliminary list of stakeholders was integrated using a snowball sampling method. The snowball sampling is a non-random method used whenever some of the required sample characteristics are difficult to accomplish. During the

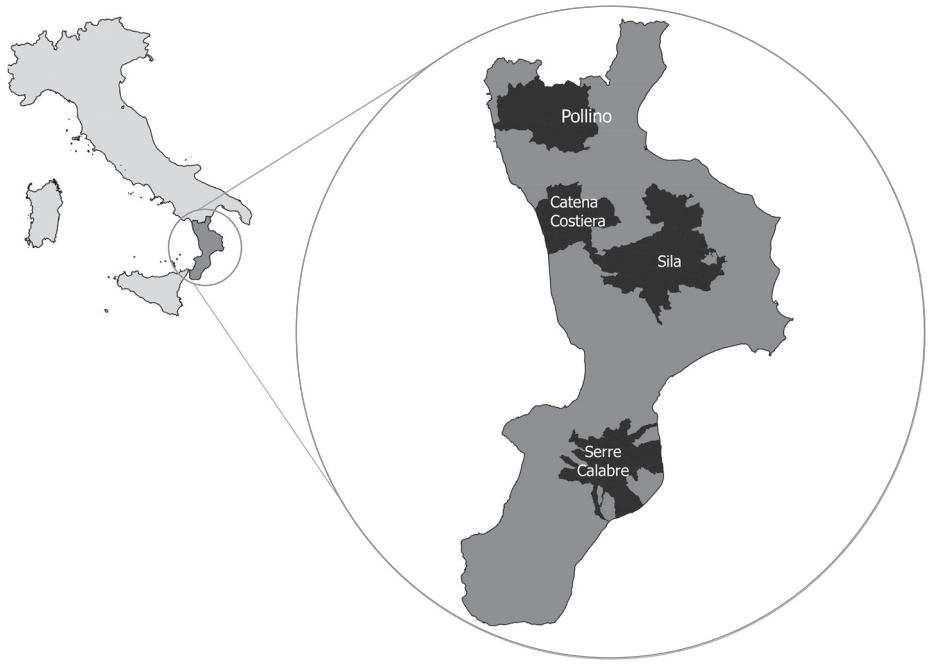

Fig. 1. Location of the Calabria Region in Italy with highlighting the four study areas

interview with the stakeholders, the interviewer asked the name of other stakeholders who could potentially be involved in the survey. In total, at the end of stakeholder analysis, 320 stakeholders have been identified and contacted for the survey.

Questionnaire survey. The stakeholders' opinions and perceptions were collected through face-to-face administration of a semi-structured questionnaire to the sample of stakeholders. The project partners between March and April 2015 prepared a draft of the questionnaire and then it was pretested, in order to improve it by two local experts. At the end, the final questionnaire version was administered to stakeholders between May 2015 and March 2016.

The questionnaire is made up of 12 closed-ended questions divided into four thematic sections called: general information, importance of forest functions, relevance of threats, and personal information. The first thematic section focuses on the general information about organization or associations (i.e. name, location, interviewer's role in the organization or association).

The second thematic section considers the importance of nine forest functions and six sub-functions described in Table 1. The stakeholders assessed the level of importance of the forest functions and sub-functions using a 5-point Likert scale (from 1 = very low importance to 5 = very high importance). Particularly, the stakeholders, in reference to the context of their study area, expressed an opinion about the level of importance of the forest functions answering the following three questions:

(*i*) In your opinion, which is the level of importance for the following forest functions in your study area? (1 = very low importance to 5 = very high importance);

(*ii*) In your opinion, which is the level of importance for the following three types of biodiversity (biodiversity conservation) in your study area? (1 = very low importance to 5 = very high importance);

(*iii*) In your opinion, which is the level of importance for the following three types of protection against natural hazards in your study area? (1 = very low importance to 5 = very high importance).

The third thematic section focuses on the threats to forest multifunctionality identified through the analysis of official documents and in-depth interviews with key actors (local experts of forest-based sector). After this analysis, 10 main threats to forest ecosystems were identified: (*i*) forest abandonment

Table 1. Description of forest functions and sub-functions used in the survey, modified by Lindberg et al. (1997), Krieger (2001), Weiss (2001), Hierl et al. (2008), FAO (2013), Demir et al. (2014), Wunder and Thorsen (2014)

Forest function	Description
Landscape conservation	enhancing the quality of landscapes by providing aesthetic-scenic values
Biodiversity conservation	preserving flora and fauna and ecological processes as a result of the protection of the space occupied by forests
– landscape	preserving biodiversity at the landscape level
– fauna	preserving biodiversity of animal species
– flora	preserving biodiversity of plant species
Recreation	backdrop for non-consumptive recreational activities such as hiking, bird watching, wildlife, viewing and other such pursuits; attracting substantial recreational activities (game, fishing)
Timber production	delivering different assortments of timber
Bioenergy production	delivering wood for energy production (e.g. fuelwood, woodchips)
Non-wood forest products production	delivering goods of biological origin other than wood (i.e. honey, fodder, fruits and berries)
Protection against natural hazards	very high importance for human safety due to their role in protecting against natural hazards
– soil erosion	direct and indirect roles in protecting soil from erosion and against the soil loss
– floods	direct and indirect roles in preventing floods (e.g. by retaining and intercepting heavy rains)
– landslides	direct and indirect roles in preventing and contrasting shallow and deep landslides
Air quality improvement	reducing the air pollution (carbon sequestration) affecting human health and decreasing quality of life especially in cities
Water quality improvement	helping maintain high water quality, influencing the volume of available water, and regulating surface and groundwater flows

(unmanaged forests), (*ii*) forest fires, (*iii*) illegal cuttings, (*iv*) introduced alien species, (*v*) urbanization and development of the tourism sector, (*vi*) air pollution, (*vii*) overgrazing in forest areas, (*viii*) waste from agricultural and forestry activities, (*ix*) impacts on soil caused by the realization of new forest roads, (*x*) movement of motorized vehicles in the forest. The level of threat to forest multifunctionality was assessed by stakeholders responding to the question: "In your opinion, which is the level of importance for the following threats to forest multifunctionality in your study area?" (1 = very low importance to 5 = very high importance).

The forth thematic section considers the personal characteristics of respondents such as age (divided in 16–34, 35–49, 50–64, and more than 64 years old), gender and level of education (distinguishing among primary school, secondary school, high school and university or post-university degree).

Data analysis. The collected data were statistically processed distinguishing between study areas and groups of interest. The statistically significant differences were tested in accordance with ordinal data type, using the non-parametric Kruskal-Wallis test. The Kruskal-Wallis test was used to evaluate differences between three or more treatment conditions (or populations). This test is alternative to the single factor ANOVA because this test requires numerical scores that can be used to calculate means and variances.

In addition, the collected data were synthesized in two importance-threat matrices distinguishing between study areas and groups of stakeholders. These matrices are intended to represent graphically the relationships between the importance of forest functions and the threat factors as perceived by the stakeholders.

RESULTS

At the end of the data collection step, 71 of 320 stakeholders (22%) completed the questionnaire. In terms of geographical distribution the interviewees are distributed as follows: 36 from Sila (51% of total respondents), 13 from Pollino (18%), 12 from Serre Calabre (17%) and 8 from Catena Costiera (11%). While two respondents are residents in the areas outside the four case studies.

The stakeholders were divided into several groups: 27 are public administrations (38%), 19 are associations-non-governmental organizations (NGOs) (27%), 14 are the academia and research institutes (20%), and the remaining 11 are representatives of professional associations of forest-wood chain (15%). In addition, the respondents are mainly aged between 35 and 49 (37%), followed by 50–64 (32%) and 18–34 years old (21%). Only 10% of respondents are more than 64 years old. Males (76% of the total respondents) with a high level of education mainly form the sample of stakeholders: 39% of respondents have a high school degree, while the remaining 61% has a university or post-university degree.

Study areas

The results show that for 71 stakeholders, the two most important forest functions (Table 2) are related to forest conservation and to the sanitary-hygienic functions, while the productive and touristic functions are perceived with slightly less importance. In particular, biodiversity conservation (average value of 4.58) and landscape conservation (4.49) are considered the most important

Table 2. Importance of forest functions according to the stakeholders' opinions by case study

Forest function	Study area								total (n = 69)	
	Pollino (n = 13)		Sila (n = 36)		Catena Costiera (n = 8)		Serre Calabre (n = 12)			
	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
Landscape conservation	**4.77**	0.44	**4.47**	0.84	4.25	1.39	**4.42**	0.79	**4.49**	0.85
Biodiversity conservation	**4.69**	0.48	**4.58**	0.77	4.13	1.36	**4.75**	0.45	**4.58**	0.77
Recreation	3.62	1.19	3.77	1.09	3.50	1.07	3.42	1.16	3.65	1.10
Timber production	2.46	1.51	3.06	1.16	2.57	1.81	3.67	1.30	3.00	1.36
Bioenergy production	2.46	1.45	2.91	1.07	3.63	1.77	3.42	1.31	3.00	1.30
Non-wood forest product production	3.69	1.03	3.86	0.93	3.75	1.16	3.83	0.72	3.81	0.93
Protection against natural hazards	**4.46**	0.88	4.11	1.06	**4.63**	0.74	**4.42**	1.00	4.29	0.98
Air quality improvement	4.38	1.19	**4.42**	1.02	**4.75**	0.46	**4.42**	1.00	**4.45**	0.99
Water quality improvement	4.15	1.14	3.94	1.11	**4.88**	0.35	4.25	1.06	4.15	1.07

the first three forest functions in bold; n – number of respondents

Table 3. Relevance of threats according to the stakeholders' opinions by case study

Threats	Study area								total (n = 69)	
	Pollino (n = 13)		Sila (n = 36)		Catena Costiera (n = 8)		Serre Calabre (n = 12)			
	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
Forest abandonment	3.75	1.29	**4.00**	1.35	3.75	1.39	3.67	1.44	**3.87**	1.34
Forest fires	**4.15**	0.99	**4.28**	0.79	**4.00**	1.85	**4.00**	0.89	**4.17**	1.01
Illegal cuttings	**4.08**	1.38	**4.39**	1.05	3.75	1.58	**4.33**	1.15	**4.25**	1.19
Introduced species	**3.85**	0.99	3.24	1.23	2.86	1.35	3.67	1.37	3.40	1.23
Urbanization	3.15	1.28	3.23	1.21	**3.88**	1.64	3.42	1.31	3.32	1.29
Air pollution	3.00	1.53	3.47	1.16	3.63	1.77	3.17	1.19	3.35	1.30
Overgrazing in forest areas	3.23	1.17	2.85	1.37	3.00	1.20	2.67	1.15	2.91	1.26
Waste	3.08	1.26	3.89	1.19	**3.88**	1.55	3.25	1.48	3.62	1.32
Realization of new forest roads	3.69	1.49	3.37	1.35	3.38	1.51	3.83	1.34	3.51	1.38
Motorized vehicles in forest	3.38	1.19	3.33	1.20	2.88	1.13	**3.92**	1.08	3.39	1.18

the first three threats in bold; n – number of respondents

forest functions followed by air quality improvement (4.45) and protection against natural hazards (4.29). Conversely, the productive forest functions (timber and bioenergy production) are considered as the less important functions with average values of 3.00 for both functions.

Observing the data for case studies it is possible to highlight that there are not any differences for the first two forest functions; in two case studies (Sila and Serre Calabre) prevails the biodiversity conservation, in one case study (Pollino) the landscape conservation, and in one (Catena Costiera) the water quality improvement.

These differences confirm territorial peculiarities of the study areas from different points of view. In particular, in Sila (without the Sila National Park) and in Serre Calabre, the forest ecosystem has important biodiversity and ecological significance related to its complicated geological, climatic evolution and age-old human action that has affected the territory amid the Mediterranean region.

In the Pollino area, there is a very heterogeneous landscape constituted of various ecosystems ranging from Mediterranean to Alpine habitats (elevations between 134 and 2,266 m a.s.l.).

In Catena Costiera, there are five thermal water springs, one of them, the Terme Luigiane Park, is a well-known place surrounded by forested and rocky mountains.

The results regarding the stakeholders' perception of threats to forest multifunctionality show that two threats are considered more relevant compared to the others: forest fires and illegal cuttings (Table 3). The illegal cuttings are considered the first threat in two case studies (Sila and Serre Calabre) with average values of 4.39 and 4.33, respectively. In the other two case studies (Pollino and Catena Costiera) the first threat is forest fires (average values of 4.15 and 4.00). The third threat indicated by respondents is the unmanaged forests; this problem is quite relevant for the stakeholders of Pollino (3.75) and Sila (4.00). Besides, it is interesting to highlight how in Catena Costiera the most relevant threats are linked to the human activities of the urbanized areas. The urbanization, the abandonment of waste in forest areas and the air pol-

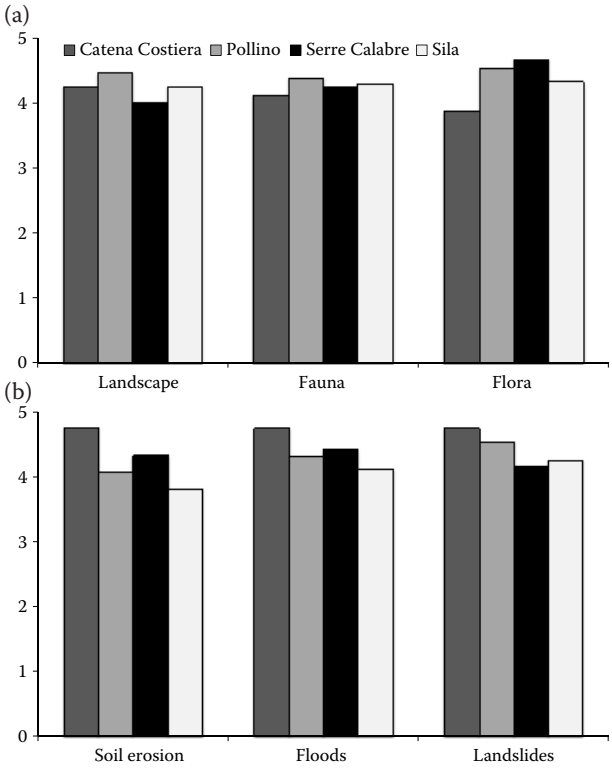

Fig. 2. Importance of sub-functions related to biodiversity conservation (a) and protection against natural hazards (b) by study area

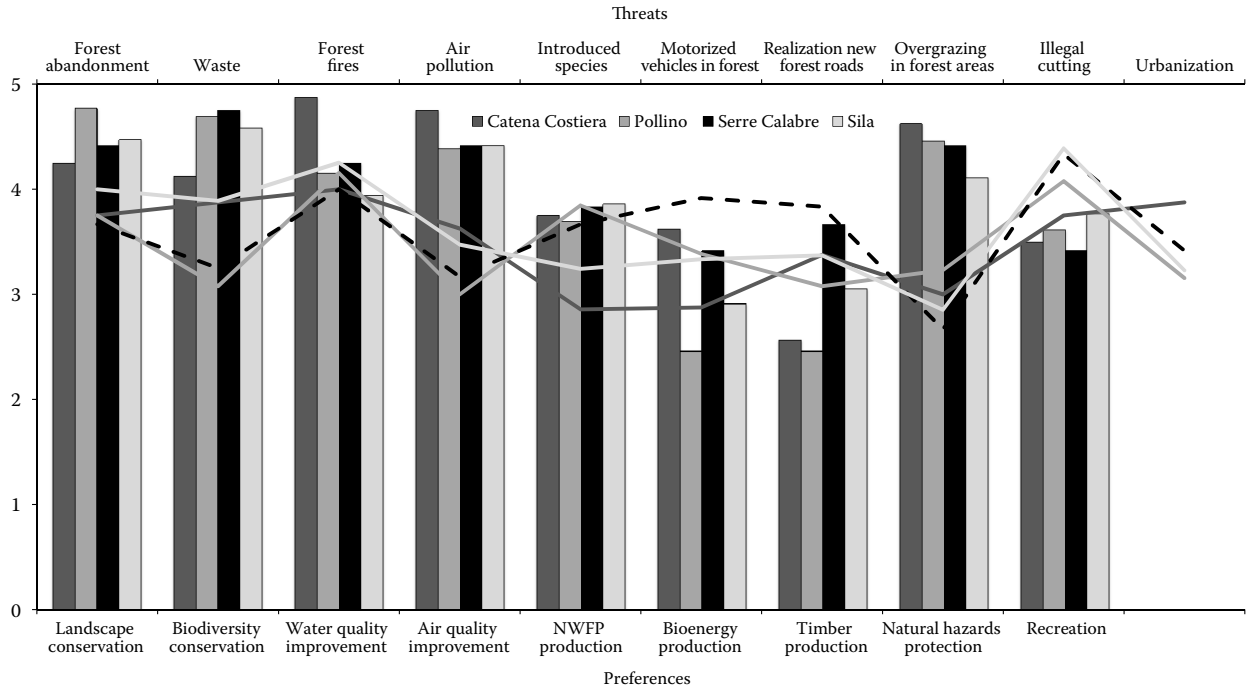

Fig. 3. Importance-threat matrix by study areas. The histograms refer to the preferences to forest functions, the lines refer to the perception of threats; NWFP – non-wood forest products

lution are considered three relevant threats in this study area, while in the other three case studies these threats are considered more marginally.

Particularly, two forest functions (biodiversity conservation and protection against natural hazards) were analysed distinguishing among sub-functions (Fig. 2). In Catena Costiera the biodiversity at a landscape level is perceived as more important than flora and fauna biodiversity, while in Sila these three aspects are perceived in the same way. In Pollino and in Serre Calabre, the flora biodiversity is perceived as the most important aspect. Regarding the protection against natural hazards, small differences exist between the case studies. The landslides are considered the most important hydrogeological hazards in two case studies (Pollino and Sila), while in Serre Calabre soil erosion and floods are considered more important than landslides.

The importance-threat matrix highlights that some threats are perceived as potentially endangering almost all forest functions (Fig. 3). According to the stakeholders' opinions, illegal cuttings and forest fires threaten the most important functions (i.e. biodiversity conservation and landscape conservation). Analysing data distribution by the study area some differences emerge from this pattern. In Catena Costiera the improvement of water quality is particularly threatened by the urbanization. In Serre Calabre also the use of motorized vehicles in forest and the realization of new forest roads are perceived as a threat to several forest functions (i.e. biodiversity conservation and protection against natural hazards).

Groups of stakeholders

The results highlight the absence of relevant differences between groups of interest (Table 4). For all groups of stakeholders the first three forest functions are: biodiversity conservation (for the public administrations with an average value of 4.48, for the associations-NGOs 4.79, for the academia 4.43, and for the professional associations 4.64), landscape conservation (4.56, 4.63, 4.21 and 4.55, respectively), and air quality improvement (4.52, 4.68, 3.86 and 4.64, respectively). For the professional associations of forest-wood chain the biodiversity conservation, the protection against natural hazards and the air quality improvement have the same level of importance (average values of 4.64). The timber production has the highest value for the professional associations (3.91), while the lowest value was registered for perception by the academia and research institutes (2.29). Conversely, the bioenergy production is considered relevant by public administrations (3.48) and professional associations of forest-wood chain (3.36).

The results concerning the threats show small differences between the groups of stakeholders (Table 5). Illegal cuttings and forest fires are considered the

Table 4. Importance of forest functions by groups of interest

Forest function	Group of interest								total (n = 71)	
	public administrations (n = 27)		associations-non-governmental organizations (n = 19)		academia (n = 14)		professional associations (n = 11)			
	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
Landscape conservation	**4.56**	0.93	**4.63**	0.68	**4.21**	0.89	4.55	0.82	**4.51**	0.84
Biodiversity conservation	**4.48**	0.85	**4.79**	0.54	**4.43**	0.85	**4.64**	0.81	**4.58**	0.77
Recreation	3.81	1.14	3.56	0.98	3.07	1.00	4.00	1.18	3.63	1.11
Timber production	3.15	1.19	2.72	1.45	2.29	1.20	3.91	1.22	2.99	1.34
Bioenergy production	3.48	1.09	2.61	1.50	2.21	0.97	3.36	1.21	2.99	1.29
Non-wood forest product production	3.74	0.94	3.89	0.81	3.64	1.22	4.09	0.70	3.82	0.93
Protection against natural hazards	4.48	0.70	4.32	1.00	3.64	1.34	**4.64**	0.67	4.30	0.98
Air quality improvement	**4.52**	0.80	**4.68**	0.82	**3.86**	1.46	**4.64**	0.67	**4.45**	0.98
Water quality improvement	4.30	0.82	4.33	0.91	3.36	1.50	4.36	0.81	4.13	1.06

the first three forest functions in bold; n – number of respondents

first two threats to forest multifunctionality in the Calabria Region for all groups of stakeholders (for the public administrations with an average values of 4.15 and 4.06, respectively, for the associations-NGOs 4.53 and 4.29, for the academia 4.07 and 4.14, and for the professional associations 4.27 and 4.36). As for the third threat, there are differences between the groups of stakeholders: the realization of new forest roads is perceived as a significant threat by environmental NGOs, while the representatives of academia and research institutes consider the presence of waste in forest as a significant threat. Conversely, for the representatives of public administrations and professional associations the main threat to forest multifunctionality is the non-management of forests.

Focusing on biodiversity conservation (Fig. 4) it emerges that the associations-NGOs perceive the conservation of flora biodiversity as more important, while for the academia and research institutes the biodiversity at a landscape level is the most important. Regarding the protection against natural hazards, it is highlighted that protection against landslides is more important for academia and research institutes and for public administrations. The protection against soil erosion and floods is much more important for professional associations of the forest-wood chain.

The analysis of the importance-threat matrix shows that illegal cuttings and forest fires are the most relevant threats (Fig. 5). Otherwise, there are some differences between the groups. The profes-

Table 5. Relevance of threats by groups of interest

Forest function	Group of interest								total (n = 71)	
	public administrations (n = 27)		associations-non-governmental organizations (n = 19)		academia (n = 14)		professional associations (n = 11)			
	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
Forest abandonment	**3.78**	1.28	3.53	1.37	3.57	1.60	**4.91**	0.30	**3.86**	1.34
Forest fires	**4.06**	1.20	**4.29**	0.92	**4.14**	0.89	**4.36**	0.74	**4.18**	1.00
Illegal cuttings	**4.15**	1.29	**4.53**	0.90	**4.07**	1.27	**4.27**	1.27	**4.25**	1.18
Introduced species	3.31	1.26	3.72	1.23	2.77	1.17	3.70	1.06	3.37	1.23
Urbanization	3.33	1.30	3.56	1.10	3.21	1.25	2.91	1.58	3.30	1.28
Air pollution	3.44	1.40	3.63	1.12	3.07	1.21	2.91	1.38	3.34	1.29
Overgrazing in forest areas	3.19	1.39	3.11	1.13	2.08	0.64	2.82	1.33	2.90	1.25
Waste	3.48	1.34	3.84	1.12	**3.71**	1.20	3.55	1.75	3.63	1.31
Realization of new forest roads	3.38	1.37	**4.22**	0.94	2.86	1.29	3.36	1.63	3.50	1.36
Motorized vehicles in forest	3.41	1.27	3.95	0.91	2.79	0.89	3.27	1.35	3.38	1.18

the first three threats in bold; n – number of respondents

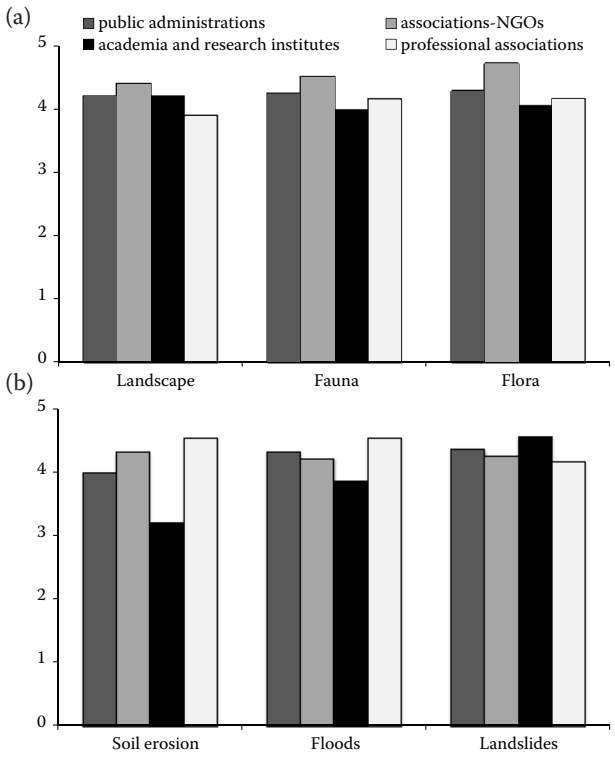

Fig. 4. Importance of sub-functions related to biodiversity conservation (a) and protection against natural hazards (b) by groups of stakeholders; NGO – non-governmental organization

sional associations indicated the forest abandonment as the most important threat to several forest functions. The realization of new forest roads and the motorized vehicles crossing the forest are perceived as very threatening by associations-NGOs, while they are not perceived as threatening by academia and research institutes. Moreover, the matrix shows that in general both functions and threats are perceived with a lower value by academia and research institutes than by the other stakeholders.

Kruskal-Wallis test

The Kruskal-Wallis non-parametric test shows more statistically significant differences both between the groups of stakeholders and between the study areas (Table 6). The protection against soil erosion shows statistically significant differences at $\alpha = 0.05$ for both study areas and groups of stakeholders while the biodiversity conservation of flora shows the same statistically significant differences at the significance level of $\alpha = 0.01$.

Recreation, timber and bioenergy production, protection against natural hazards (i.e. protection against soil erosion) and protection of flora biodiversity show statistically significant differences between the groups of stakeholders. Conversely, there are not any statistically significant differences between the study areas. Forest abandonment, realization of new forest roads, motorized vehicles in forest and overgrazing activity in forest show statistically significant differences between the groups of stakeholders. The perception of the introduced species is the only threat that shows statistically significant differences between the study areas.

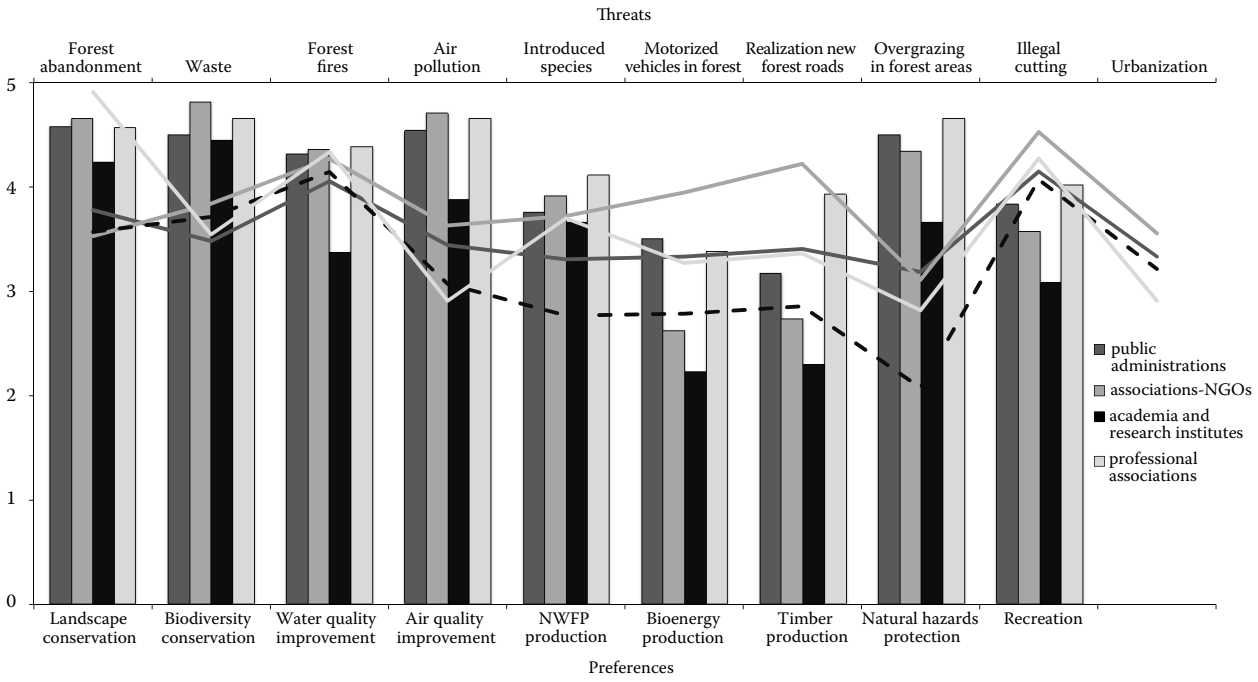

Fig. 5. Importance-threat matrix by groups of stakeholders. The histograms refer to the preferences to forest functions, the lines refer to the perception of threats; NGO – non-governmental organization, NWFP – non-wood forest products

Table 6. Kruskal-Wallis test

Variable		Study areas		Groups of stakeholders	
		χ^2	*P*-value	χ^2	*P*-value
Importance	Landscape conservation	1.39	0.71	4.55	0.21
	Biodiversity conservation	1.86	0.60	3.98	0.26
	– landscape	2.58	0.46	1.39	0.71
	– fauna	1.62	0.66	5.09	0.17
	– flora	7.01	0.07*	7.31	0.06*
	Air quality improvement	0.38	0.94	6.11	0.11
	Protection from natural hazards	3.04	0.38	7.50	0.06*
	– soil erosion	7.69	0.05**	10.62	0.01**
	– floods	6.70	0.08*	1.93	0.59
	– landslides	3.85	0.28	2.06	0.56
	Water quality improvement	6.38	0.09	5.64	0.13
	Non-wood forest product production	0.55	0.90	1.56	0.67
	Recreation	1.24	0.74	8.02	0.04**
	Timber production	5.34	0.15	9.51	0.02**
	Bioenergy production	5.22	0.16	10.40	0.01**
Threat	Illegal cuttings	1.66	0.65	1.55	0.67
	Forest fires	1.95	0.58	0.65	0.88
	Forest abandonment	1.26	0.74	10.63	0.01**
	Waste	5.16	0.16	0.60	0.89
	Realization of new forest roads	1.54	0.67	7.81	0.05**
	Motorized vehicles in forest	4.26	0.24	9.03	0.03**
	Introduced species	4.14	0.25	5.03	0.17
	Air pollution	1.84	0.61	2.91	0.41
	Urbanization	2.17	0.54	1.50	0.68
	Overgrazing in forest	1.58	0.66	7.79	0.05**

*significance at α = 0.1, **significance at α = 0.05; *n* – number of respondents (*n* = 69)

DISCUSSION

Forest functions

The results of this study on the perceived importance of forest functions for the stakeholders can be compared with other studies reported in the international literature. The comparison shows that the perceived importance is linked to the socio-economic context and the relative ecological importance at a local level.

Kumar and Kant (2007) investigated the preferences for several forest functions (recreation, economic products, economic services, spiritual values and environmental values) across four stakeholder groups (aboriginal groups, forest industry, environmental NGOs, and Ministry of Natural Resources) in North-western Ontario (Canada). The authors stated that according to the respondents' opinions (120 respondents) the environmental value of forests was considered as the most preferred benefit, followed by spiritual and recreational values. Another study carried out in southern states of the United States of America showed that for 548 respondents the most important function of public and private forests is the air quality improvement, followed by scenic quality (Tarrant, Cordell 2002).

In the European context, De Meo et al. (2011) and Paletto et al. (2011, 2014a) have analysed the stakeholders' preferences for different ecosystem services in four case studies in Italy. The authors evidenced that in two case studies the regulating services (natural hazard mitigation and water and air quality) are considered as the most important while in the other two case studies the cultural services (recreation, landscape aesthetics and gaming) are reputed the most important ones. In all these case studies, the provisioning services (timber and firewood and non-wood products) have a low importance for stakeholders.

In addition, a recent study aimed to investigate the preferences of the general public (1,503 respondents) and forest owners (150 respondents)

about the role of forests in Slovakia shows that the primary purpose for visiting forests for both groups is recreation (79.9% public and 68.7% forest owners), followed by non-wood forest products (12.2% public and 30.0% forest owners). In addition, respondents consider the other ecosystem services as marginal (Dobšinská, Sarvašová 2016).

With reference to protected areas, Clemente et al. (2015) showed that for the key stakeholders of a natural park in the south-west of Portugal the ecosystem services considered as the most important are recreation and tourism, and aesthetic landscape. Conversely, Nikodinoska et al. (2015) stated that the supporting services (habitat and species diversity, net primary production, and soil formation) and provisioning services (wood, food, water provision and forage for the livestock) are considered the most important by the tourists (165 respondents) of the Abisko National Park in the sub-Arctic Lapland (Sweden).

Threats

Concerning the threats to forest multifunctionality, the results of this study confirm the relevance of three main threats: forest fires, illegal cuttings and forest abandonment.

Forest fires have great impacts on forest functions because they indiscriminately affect everything in their path and the drastic rise in temperature causes irreversible damage to vegetation, ranging from injury to the destruction of timber. In Mediterranean countries, the fire risk is very high and in Italy, forest fire events have a very high incidence (Michetti, Pinar 2013). In particular, in Calabria, fire events are very frequent and the burned surface is one of the largest among Italian regions (Lovreglio et al. 2012). According to the official statistics, Calabria region was the first region in Italy for the number of forest fires in 2006–2008 (ISTAT 2010). In 2014, the forest area afflicted by fires was 6,563 ha, corresponding to the third region of Italy – after Sicily and Sardinia – by surface damage (CFS 2015). Depending on several factors (e.g. severity, intensity and duration of burning, soil characteristics, land use) the impacts of fire may be either beneficial or deleterious to the entire ecosystem (Neary et al. 1999). The passage of fire may even destroy the forest floor and fertile topsoil, triggering erosion, jeopardizing the stability of mountain slopes and leading to a decrease in carbon sequestration (Notaro et al. 2009). Fire disturbance may occur also on the animal population modifying their habitats. It influences the short-term response of insect abundance with positive or negative effects depending on the ecological traits and habits of taxa especially in highly modified ecosystems, such as the Mediterranean forests (Elia et al. 2012).

Illegal cuttings have a negative impact on forest structure, tree richness and biodiversity, functional composition and productivity (Vaglio Laurin et al. 2016). In Calabria the illegal cuttings have been recognized as a driving factor in determining harsh environmental conditions for natural regeneration that caused a reduction of the range of species (Barbati et al. 2010) inducing negative effects on many forest functions (e.g. biodiversity conservation, landscape conservation, timber production, recreation).

The forest management has a direct influence on almost all forest functions. Higher volumes of deadwood and levels of biodiversity characterize the unmanaged forests (Green, Peterken 1997; Duvall, Grigal 1999; Kruys et al. 1999). Green and Peterken (1997) reported high volumes of deadwood in unmanaged old growth woodlands (104.4 $m^3 \cdot ha^{-1}$), and 23.9 $m^3 \cdot ha^{-1}$ in managed semi-natural stands in the United Kingdom. Paletto et al. (2014b) evidenced that the standing and lying deadwood volume in forests decreases as the intensity of management increases. Aude and Poulsen (2000) showed the absence of many species of epiphytic cryptogams in the managed beech forests in Denmark compared to the unmanaged forests. Conversely, the unmanaged forests may give rise to negative effects on pest control, forest tree composition (Zlatanov et al. 2012) and biodiversity at a landscape level (Müllerová et al. 2014).

CONCLUSIONS

The paper analyses the importance of forest functions and threats to forest multifunctionality as perceived by stakeholders in four study areas located in the south of Italy. Generally, the perceived importance of forest multifunctionality is linked to the socio-economic context and to the relative ecological importance at a local level. The results of this paper indicate that the perception of both forest functions and threats depends on the individual characteristics of the stakeholders (e.g. knowledge, environmental sensibility). Due to the complexity of the socio-economic relationships, the results should be considered as preliminary results. The future steps to validate the preliminary results should be the organization of thematic working

groups among stakeholders. During these working groups, an external facilitator would address the discussion among stakeholders with the aim of identifying potential management strategies at a local level. The role of the facilitator would be to guide the discussion, to debate about some specific issues (e.g. forest functions or threats), to give everyone the same opportunity to discuss and to reach a shared decision. The management strategies must aim to enhance the forest functions considered as the most important by stakeholders and to reduce the threats to forest multifunctionality.

The Calabria Region has one of the highest forest cover rates in Italy and the highest production of energy power from forest biomass. In this region, the forest sector is important from the economic point of view. Otherwise, the perception of the productive functions is lower than that of the other forest functions and differences among stakeholders exist which could trigger social conflicts. The utilization of forest areas may have many positive effects, but it is necessary to manage them in a sustainable way taking into account the ecological, economic and social aspects in a forest management plan. As reported by Fares et al. (2015), the forestry managers should be addressed to develop Europe's forests sustainably through five key issues: plant resilient species, promote carbon storage, manage disturbances, consider renewable energy and quantify and market other benefits. Forest management plays an important role in limiting the threats and in improving the capacity of forests to provide ecosystem services. Therefore, forest management may play an important role to solve potential conflicts resulting from illegal cuttings, realization new forest roads, and overgrazing.

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