



Exploring visitors' perceptions of silvicultural treatments to increase the destination attractiveness of peri-urban forests: A case study in Tuscany Region (Italy)



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ARTICLE INFO

Keywords:

Recreational activities
Visitors
Preferences
Degraded forests
Forest management

ABSTRACT

Peri-urban forests are characterized by multiple-use and various kinds of recreation activities. Public forest services have to take into account ecological, economic and social issues to provide a sustainable management of peri-urban forests, able to improve their attractiveness. Understanding visitors' demands and perceptions on peri-urban forests is a key element to support decision-makers and ensure proper management of these forests. This study is aimed at investigating visitors' perceptions and preferences regarding the characteristics of the peri-urban forests and the role of silvicultural treatments. The investigation was implemented in the Monte Morello peri-urban forest located near the metropolitan area of Florence (Italy). The forest is a dominant black pine and Calabrian pine plantation, established in the sixties for protection purpose but largely abandoned. Recently, silvicultural treatments have been applied to restore the ecological stability and enhance the resistance and resilience of forest. An innovative selective thinning was applied to compare its effects (economical, ecological and social) with the traditional thinning and with unmanaged areas. Visitors' perceptions and preferences were collected through the administration of a face-to-face interview to 201 respondents. The survey investigated three aspects: recreational use of peri-urban forests; benefits of peri-urban forest vegetation; preferences towards the characteristics of the peri-urban forest. The visitors assessed from the aesthetic point of view three images of the Monte Morello forest after different silvicultural treatments (traditional thinning, selective thinning and unmanaged forest). The results show that the preferred type of peri-urban forest is a mixed forest of coniferous and deciduous with a random arrangement of trees in space. The tourist facilities (i.e. waste baskets, picnicking and sport areas) are perceived in a positive way by visitors. With regard to the forest management alternatives, the results show that the visitors prefer the managed forest through a selective thinning.

1. Introduction

In last decades, the role of urban and peri-urban forests has changed regarding the recreational and environmental aspects due to the urbanization and globalization phenomena that occurred in many parts of the world (Blazevska et al., 2012; Pastorella et al., 2017). The world's population is quickly becoming urbanized in the last century: in the '50 of twentieth century less than 30% of the world's population lived in cities, in the 2000s this percentage rose to 47% and it is expected to grow to 60% by the year 2025 (Sanesi and Chiarello, 2006). The globalization phenomenon has reduced the distance – physical and virtual – between world's people and, consequently, it has partially standardized tastes, preferences and habits of the urbanized people (Sheppard, 2015). Particularly, since the 1960s the relevance of

instrumental values (or extrinsic values) – concerning the satisfaction of human needs (i.e., protection and food) – decreased, while in the eyes of the people the intrinsic values related to the health and the integrity of natural ecosystems have grown in importance (Inglehart, 1977). In this context, the majority of people of post-modern society considers more important the environmental, social and cultural values of forests (e.g., recreational activities, landscape aesthetic, habitat conservation, climate change mitigation, and protection against natural hazards) than the economic values (e.g., timber, biomass for energy, food and fodder) (Bengston, 1994; Paletto et al., 2012). With particular reference to countries with advanced economy, urbanized people perceive the rural spaces, the urban and the peri-urban forests as resources capable of providing clear air, shade and protection for wildlife, leisure facilities, recreational and sports opportunities (Tuffery, 2014; Andrada

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II et al., 2015).

There are differences in recreational use between urban and peri-urban forests: urban forests are more intensively used for day-use oriented activities (i.e., jogging, dog walking) and characterized by a higher use on workdays. Also in the ambit of urban forests the level of forest use, the users composition, and the temporal distribution of various activities is influenced by the degree of urbanity in terms of number and closeness of settlements, business areas, schools and so on (Arnberger, 2006). Consequently, both urban and peri-urban forests can perceive different kinds of recreation use (Van Herzele et al., 2005).

Pointing the attention on peri-urban forests, from the terminological point of view, these forests can be defined as forest stands with amenity values situated near urban areas (Blazevska et al., 2012).

Currently, peri-urban forests have a high value due to the recreational demand by people who live in towns and big cities (Zhu and Zhang, 2008; Andrada II and Deng, 2010). Consequently, these forests play an important multifunctional role providing many benefits to society such as pleasant landscape, pollution control, climate change mitigation, physical and psychological benefits, peace, relax and quiet and potential recreation opportunities (Robinette and Gary, 1972; Andrada II et al., 2015). Tyrväinen (1999) classified the benefits provided by peri-urban forests into the following main categories: social benefits (recreational opportunities, cultural and historical values of green areas); aesthetic and architectural benefits (landscape changes through different colors, textures, forms and densities of vegetation); climatic and physical benefits (cooling, wind control, temperature and humid control); ecological benefits (biotopes for flora and fauna); and economic benefits (timber, fuelwood, berries, honey and mushrooms). At the same time, these forests are affected by multiple anthropogenic pressures including soil compaction, housing fragmentation and infrastructure development (Tzoulas et al., 2007; Blood et al., 2016). These pressures often lead an alteration of the structure and composition of peri-urban forests due to the introduction of alien species, ecological disturbance and development of tourism infrastructures and facilities.

The recent increase social demand for aesthetic and recreational use of peri-urban forest resources gave a positive impetus to the

development of studies and researches on people's (residents and visitors) preferences and perception toward these forests. In the European literature, many studies have investigated the individual preferences for the aesthetic aspects of forests related to the forest management, such as tree species composition, horizontal and vertical stand structure and deadwood distribution (Tahvanainen et al., 2001; Tyrväinen et al., 2005; Edwards et al., 2012; Paletto et al., 2013; Jankovska et al., 2014; Pastorella et al., 2016b). Tahvanainen et al. (2001) in a recreation area near the city of Turku (Finland) analyzed the effects of different forest management activities on the scenic beauty and recreational values of the forest. Subsequently, Tyrväinen et al. (2005) highlighted that the residents' use of green spaces (urban and peri-urban forests) appears to be motivated by the need for psychological health with relevant social implications. Recently, Paletto et al. (2013) investigated residents' preferences for forest management strategies and stand characteristics in the peri-urban forest of the Trento municipality (North Italy), while Pastorella et al. (2016b) highlighted visitors' preferences for forest stand characteristics in the peri-urban forest of Sarajevo city in Bosnia-Herzegovina. Blazevska et al. (2012) analyzed visitors' perceptions and preferences towards the urban forests of the Aerodrom municipality (Macedonia). In addition, Jankovska et al. (2014) evaluated the impact of different management activities on the landscape attributes in order to identify the preferred landscape models for recreational use according to local residents (Riga urban forest) in Latvia. The results of these studies show that people consider urban and peri-urban forests as a peaceful and quiet place for relaxation, jogging, walks and aesthetic contemplation. The natural features of urban and peri-urban forests – e.g., groups of trees, hedgerows, water bodies – are highly preferred by people to artificial features (e.g., benches, fences, picnics and refreshment areas). From the forest management point of view, people prefer urban and peri-urban forests regularly managed, characterized by higher tree species diversity, higher color variability (mix between coniferous and deciduous), natural growth, and without obstacles to human activities (e.g., deadwood, shrub layer). Despite the above mentioned studies, there is still a paucity of information on the relationship between silvicultural treatments and people's aesthetic



Fig. 1. Location of the study area (Monte Morello peri-urban forest) in Tuscany Region (Italy).

preferences in peri-urban forests.

Starting from these considerations, the main objective of the present study is to investigate the visitors' preferences toward peri-urban forests in order to fill the literature gap and support forest managers in increasing forests' attractiveness. The research question is thus to understand the effects of different silvicultural treatments on people's aesthetic preferences toward forest management scenario. The research was conducted in a case study in Central Italy (Tuscany Region): the peri-urban forest of Monte Morello. The area is involved in the Project LIFE14 CCM/IT/905 FoResMit (Recovery of degraded coniferous Forests for environmental sustainability Restoration and climate change Mitigation) aimed to analyze the multifunctional role of the peri-urban forests.

2. Study area and methods

2.1. Study area

The study area is the peri-urban forest of Monte Morello (43°51'20"N; 11°14'23"E), located in the Sesto Fiorentino municipality and close to the urban area of Florence in Tuscany Region (Fig. 1). This forest is the result of the reforestation activities realized over a surface of around 1,035 ha from 1909 to 1980. The main tree species used in the reforestation of Monte Morello are black pine (*Pinus nigra* J.F. Arnold), Calabrian pine (*Pinus brutia* Ten. subsp. *brutia*), cypress (*Cupressus spp.*), flowering ash (*Fraxinus ornus* L.), Turkey oak (*Quercus cerris* L.) and Downey oak (*Quercus pubescens* L.). Monte Morello reforestation was realized with a density of about 2,700 trees per hectare, but during the rotation period the necessary silvicultural treatments have not been applied, and the stands have been largely abandoned with important consequences on trees stability, mortality and increase of fire risk. Currently, Monte Morello forest can be considered a degraded forest characterized by poor regeneration, marked susceptibility to adversities, huge quantity of deadwood and a high degree of flammability (Cenni et al., 1998; Nocentini, 1995). The deadwood (lying deadwood and standing dead trees) has not been removed from the forest during the silvicultural operations for economic and ecological reasons. In particular, the deadwood is considered a key component for the maintenance of biodiversity and at the same time the removal of deadwood for bioenergy production is not economically profitable.

The altitude of the area is between 55 m and 934 m a.s.l., and the climate is characterized by precipitations concentrated in the period from autumn to early spring and a dry summer in which July is the driest month, while October and November are the most rainy months. During the last decades (from the early 80s) the total annual rainfall is 1,003 mm and the average annual temperature is 13.9 °C.

From the touristic point of view, the peri-urban forest of Monte Morello is very popular, highly frequented by hikers from the province of Florence during all seasons of the year.

2.2. Research framework

The research was structured in three steps in order to investigate the visitors' preferences and perceptions towards the Monte Morello peri-urban forest and the effects of different silvicultural treatments on the destination attractiveness.

In this context, the destination attractiveness is defined as the perceived ability of the destination to deliver individual benefits (Mayo and Jarvis, 1981) and it is influenced by two categories of attributes (Van Raaij, 1986; De Meo et al., 2015): innate characteristics (e.g., natural resources, geographical location, climate, ecology) and man-made characteristics (e.g., transportation facilities, network of trails, hotels and other accommodation, facilities for sport and recreation).

The three steps of the research can be summarized as follows: (1) development and pre-testing of a semi-structured questionnaire; (2)

identification of the sample of visitors of Monte Morello forest and administration of the questionnaire; (3) data elaboration and interpretation of the results.

Step 1 – Development and pre-testing of the questionnaire

The questionnaire used in this study was developed taking into account the main aspects that influence people's preferences and perceptions for urban forests as defined by Schroeder and Anderson (1984) and Schroeder (1990). The three aspects identified by the authors and adapted to peri-urban forests can be synthesized as follows (Schroeder and Anderson, 1984; Schroeder, 1990): (1) recreational use of peri-urban forests; (2) perceived benefits of peri-urban forests vegetation; (3) preferences and perceptions towards peri-urban forests characteristics. Consequently, the questionnaire was divided into thematic sections considering these three key aspects. The questionnaire was structured into thematic sections not only to reduce the risk of respondents getting tired or bored, but also to facilitate data collection (Nielsen et al., 2007).

The first version of the questionnaire was developed in February 2016 and pre-tested with four visitors in early March 2016. After the pre-test stage, the final version of the questionnaire (Annex 1) consists of 15 questions (2 open-ended and 13 closed-ended questions) divided in four thematic sections: "Personal information", "Recreational use of forest", "Benefits provided by peri-urban forest", and "Preferences and perceptions towards peri-urban forest".

The first thematic section ("Personal information") focuses on the personal information of the respondent such as: Q1.1 gender; Q1.2 age (distinguishing among four classes: less than 25 years old; 25-44 years old, 45-64 years old and more than 64 years old); Q1.3 level of education (elementary school degree; high school degree; University degree and post-University degree); Q1.4 actual job (employed in the public sector; employed in the private sector; housewife; student; pensioner; and unemployed), and place of residence. The last question (Q1.5) investigates the place of residence to evaluate the distance from the Monte Morello peri-urban forest, with the aim of understanding the relationship between the respondent and the study area.

The second thematic section ("Recreational use of forest") focuses on visitors' behavior during their visit to Monte Morello peri-urban forest. Generally, people's preferences for forests are expressed in their choices of which sites to visit and how to use these sites (Schroeder, 1990). Therefore, in order to investigate the recreational use of peri-urban forests is necessary to investigate visitors' habits and reasons of visit. In this thematic section four questions were included; the first three questions concerning visitor's habits: number of times that the respondent has visited the forest in the last year (Q2.1); day of visit, distinguishing between weekend and working days (Q2.2); visiting time (Q2.3). The last question of this thematic section (Q2.4) focuses on the reasons for visiting Monte Morello forest considering six main reasons: hiking, sports activities, collecting non-wood forest products, relaxing in a natural environment, picnicking, and eating local products. The respondents assessed each reason using a 5-point Likert scale response format (from 1 = very low importance to 5 = very high importance).

The third thematic section ("Social benefits provided by forest") focuses on the social benefits provided by Monte Morello peri-urban forest to society. In the international literature, benefits of urban and peri-urban forest vegetation include two main categories of individual benefits (Konijnendijk et al., 2006): benefits involving aesthetic enjoyment and relaxation, and benefits involving sports and social contact. In this study, a wider range of benefits was considered in the questionnaire: tourism-recreation; fauna and flora (biodiversity) conservation; improvement of air quality (carbon stocking); protection from natural hazards (e.g., landslides, rockfalls); protection of cultural and historical values and local identity; provision of timber and fuelwood; creation of jobs opportunity for the local population. This thematic section consists of a single question (Q3.1) where the respondents assessed the importance of the seven above-mentioned benefits using a 5-point Likert scale response format (from 1 = very low importance to

5 = very high importance).

The last thematic section (“Preferences and perceptions towards the peri-urban forest”) of the questionnaire considers three aspects related to forest management for recreational purpose: i) tourist facilities; ii) characteristics of forest stand, and iii) silvicultural treatments. In the first question (Q4.1) respondents declare their opinion on the capacity of tourist facilities in increasing the attractiveness of a destination. Afterwards, the respondents identified which tourist facilities (i.e., picnicking areas, areas for sports activities, benches, trail marking, waste baskets) are more suited to improve the destination attractiveness (Q4.2). Concerning the second aspect related to forest management – which considers the characteristics of forest stands – two questions were included: the first one (Q4.3) investigates visitors' preferences for tree species composition distinguishing between three types of forest: (1) broadleaved forests, where the percentage of coniferous in the forest is less than 20%; (2) coniferous forests, where the percentage of broadleaves in the forest is less than 20%; and (3) mixed forests with two or more species. The second question (Q4.4) focuses on visitors' preferences relating to the stand structure of peri-urban forest considering the following three types of structure: (1) regular distribution in the space of trees with similar height and size; (2) random distribution in the space of trees with different height and size; (3) completely untouched forest.

The last question (Q4.5) of this thematic section investigates visitors' aesthetic perception towards the effects of silvicultural treatments. For this purpose, three images of Monte Morello forest after different forest management strategies have been shown to visitors. The images represent three forest management scenarios of the Monte Morello forest, after different silvicultural treatments (see Annex 1):

- (1) *Status quo* scenario: currently the Monte Morello peri-urban forest is not actively managed, the standing dead trees and the lying deadwood are not removed;
- (2) Selective thinning scenario: in this scenario the choice of the trees to be cut is based on a positive selection (thinned 30-40% of basal area). During cutting all crown-volume competitors trees are harvested, standing dead trees and lying deadwood of 1st and 2nd decay class with dbh > 20 cm are removed. The selective thinning is the silvicultural treatment proposed by the Project LIFE14 CCM/IT/905 FoResMit in order to improve the tourist attractiveness of the area and to increase the positive effects on climate change mitigation;
- (3) Traditional thinning scenario: the choice of trees to be cut is based on a negative selection (thinned from below 15-20% of basal area). During cutting only small and leaned trees and standing dead trees are harvested, while the lying deadwood is not removed. The traditional thinning is the common silvicultural treatment applied in Central Italy in the forest management of coniferous forests.

The aim of this last question is to identify the preferred type of forest from the aesthetic point of view according to the visitors' opinions.

Step 2–Identification of the sample of visitors and administration of the questionnaire

The final version of the questionnaire was administered to a sample of visitors in the period from April to July 2016 (four months).

The sample of visitors was sized considering the main characteristics of the Monte Morello forests such as the surface (little more than thousand hectares), points of access to the forest (i.e., rest areas, parking), and network of trails. Therefore, three sampling points – in close proximity to rest areas and parking – have been identified to conduct interviews. The visitors to be interviewed were selected in a systematic way, selecting one out of two visitors who arrived in the sampling points.

The interviews were conducted both in the working days and in the weekend in order to include in the sample the different types of visitors. At the end of the period, 30 days of interviews were realized (25% of

potential days of the survey period): 10 working days and 20 Saturdays and Sundays.

The questionnaire was administered face-to-face to the visitors of Monte Morello forest by a single interviewer. This administration system was chosen because the face-to-face administration has the following advantages (Goyder, 1985; De Leeuw, 1992): higher response rates, higher quality of data acquired and opportunity to explain the complex questions.

At the end of the survey period, 269 visitors of Monte Morello peri-urban forest were contacted to be interviewed.

Step 3–Data elaboration and interpretation of the results

For all the questions the main descriptive statistics have been developed using XLStat 2012: median for the data collected using the Likert scales response format (Q2.4 and Q3.1), percentage of frequency distribution (%) for all other questions.

In addition, the data collected using the Likert scales response format were statistically compared using Mann-Whitney and Kruskal-Wallis non-parametric tests to highlight the influence of socio-demographic characteristics of respondents (gender, age and level of education) on the answers. The non-parametric Mann-Whitney U test is used to compare two population means that come from the same population and it is based on the following three assumptions: the sample drawn from the population is random, the samples are mutually independent, and the ordinal measurement scale is assumed. The non-parametric Mann-Whitney U test was used to analyze the differences by gender. The non-parametric Kruskal-Wallis test is used when the assumptions of ANOVA are not met in order to assess significant differences on a continuous dependent variable by grouping independent variables (three or more than three groups). In this study, the non-parametric Kruskal-Wallis test was used in order to assess the differences by age and level of education.

The data collected with the Q4.5 were elaborated using the Analytic Hierarchy Process (AHP) approach. The AHP is a hierarchical weighted decision analysis method aimed at solving complex decision problems and making accurate decision and judgment for complex system (Saaty, 1987). In this question, the respondents compared the three images of Monte Morello peri-urban forest in pairs (pairwise comparison), according to the following scheme:

Image A	5	3	1	1/3	1/5	Image B
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The image preferred by the visitors was identified with the calculation of the priority value of each image using the eigenvalue method. In particular, the results of the pairwise comparison have been represented in a reciprocal matrix (*A*) where the relative weight is expressed by a_{ij} located at the right side of the diagonal and its reciprocal as $1/a_{ij}$ is located in the opposite side of the diagonal.

$$A = (a_{ij}) = \begin{pmatrix} w_1/w_1 & w_1/w_2 & \dots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \dots & w_2/w_n \\ \vdots & \vdots & \ddots & \vdots \\ w_n/w_1 & w_n/w_2 & \dots & w_n/w_n \end{pmatrix}$$

In the matrix, the row indicates the relative weight of each image with respect to the others. When $i = j$, then $a_{ij} = 1$. Next, the transpose of the vector of the weights w is multiplied by matrix *A* to obtain the vector represented by $\lambda_{max}w$, that follows the principle (Saaty, 1987):

$$(A - \lambda_{max}I)w = 0$$

Where:

λ_{max} = largest Eigenvalue of matrix *A*

I = identity matrix of size *n*.

n = number of rows or columns in the matrix

The value of λ_{max} is always positive, equal or higher than *n*. The consistency of the respondents' information depends on how much the value of λ_{max} deviates from the value of *n*. In cases where λ_{max} equals *n*,

Table 1
Reasons for visiting the Monte Morello peri-urban forest (median values).

	Hiking	Sport activities	NWFP collection	Relaxing	Picnicking	Food
<i>Gender</i>						
Male (n = 120)	4	1	1	5	1	1
Female (n = 81)	5	1	1	5	1	1
<i>Age</i>						
Less than 25 years old (n = 9)	3	3	1	3	1	1
26–44 years old (n = 61)	4	1	1	5	2	1
45–64 years old (n = 84)	5	1	1	5	1	1
More than 64 years old (n = 47)	5	1	1	5	1	1
<i>Level of education</i>						
Elementary school degree (n = 54)	5	1	1	5	1	1
High school degree (n = 82)	5	2	1	5	1	1
University degree (n = 60)	5	1	1	5	2	1
Post-university degree (n = 5)	5	1	1	5	1	1
<i>Actual jobs</i>						
Public sector employees (n = 33)	4	1	1	5	1	1
Private sector employees (n = 62)	5	4	1	5	1	1
Housewives (n = 9)	3	1	1	5	5	1
Students (n = 12)	4	2	1	5	1	1
Pensioners (n = 53)	5	1	1	5	1	1
Unemployed (n = 13)	5	1	1	5	2	1
Other (n = 19)	4	1	1	4	1	1
Total (n = 201)	5	1	1	5	1	1

the responses are perfectly consistent (Saaty, 1987). The matrix A is, thus, tested for consistency using the following formula (Alonso and Lamata, 2006):

$$CI = \frac{(\lambda_{\max} - n)}{(n - 1)}$$

$$CR = \frac{CI}{RI}$$

Where:

CI = consistency index;

CR = consistency ratio;

RI = expected consistency index obtained from random generated comparisons of the same order n .

Saaty (1987) has computed and presented a list of RI estimates for positive reciprocal matrices of orders 2 to 14. In this study, we used the RI computed by Alonso and Lamata (2006) through a simulation method. The value of CR should be lower or equal to 0.1 (10%) in order to have consistency of the matrix A .

3. Results

3.1. Socio-demographic characteristics of the respondents

At the end of the survey, the response rate was 75%: 201 visitors completed the questionnaire, while 68 refused to fill out the questionnaire. This response rate is similar to that of other *in-situ* studies carried out in Italy that show a response rate between 70% and 90% (Notaro and Dallapiccola, 2000; Gios and Notaro, 2001; Pastorella et al., 2016a).

The sample of respondents is composed of 59.7% males and 40.3% females (Q1.1), while the age distribution of the respondents is the following (Q1.2): 4.5% less than 25 years old, 30.3% between 25 and 44 years old, 41.8% between 45 and 64 years old, while remaining 23.4% is more than 64 years old. Consequently, the sample of respondents is biased towards the adult classes considering that the age of 65.2% of total respondents is above 45.

With regard to the level of education (Q1.3) the distribution of the sample of respondents is synthesized as follows: 26.9% of respondents has a elementary school degree; 40.8% of respondents has a high school degree; 29.9% of respondents has a University degree (Bachelor's or

Master's degree), while the remaining 2.5% of respondents has a post-University (PhD) degree. The distribution is evenly split between three main classes, while the persons with a PhD degree are a minority of the sample.

Finally, with regard to the actual job (Q1.4) the sample of respondents is mainly composed of private sector employees (30.9% of total respondents) followed by pensioners (26.4%), public sector employees (16.4%), unemployed people (6.5%), students (6.0%), and housewives (4.5%). The remaining 9.3% is distributed among other jobs not mentioned in the proposed list.

The target of visitors of Monte Morello forest (Q1.5) is mainly represented by local visitors: 40% of respondents comes from Florence municipality; 28% from Sesto Fiorentino municipality; 26% from other municipalities of Tuscany Region; 4% from other Italian regions (i.e., Emilia-Romagna, Lazio and Apulia) and 1% from other European countries (i.e., France). Consequently, we can assert that the forest is frequented by locals, while attracting a few outside visitors.

3.2. Recreational use of forest

The average of visits per year to the peri-urban forest of Monte Morello is less than 5 times for the majority of respondents (50.7%), while the remaining visitors are distributed in the following way: 12.4% between 5 and 10 times per year; 14.9% between 16 and 50 times per year; 8.5% between 51 and 100 times per year and 13.4% more than 100 times per year. In average one person visits the study area 45 times per year; this average value is quite high due to the persons that spend a very high number of days in this peri-urban forest. Generally, these persons are retired who live in the Sesto Fiorentino municipality or in other municipalities in proximity of Monte Morello forest (i.e., Calenzano and Campi Bisenzio municipalities).

Most of the visitors prefer going in the forest during the weekend (62.7% of total respondents), while the people who spend their day in Monte Morello on working days are only 11.9%. The remaining 25.4% of respondents attends Monte Morello peri-urban forest both in the weekend and in the working days.

The average time spent in the Monte Morello forest is only a few hours (75.6% of total respondents) followed by the visitors who spend the whole day there (16.9%). The remaining 7.5% stays in Monte Morello forest for less than one hour.

Concerning recreational uses, the results show that the most important reasons for visiting Monte Morello peri-urban forest are relaxing in a natural environment and hiking (Table 1). The other activities are considered less important by the majority of respondents.

Considering the gender, the only remarkable difference comparing the median values is that female respondents give greater importance to hiking. The non-parametric test of Mann-Whitney ($\alpha = 0.05$) shows statistically significant differences for the following two reasons: hiking ($p = 0.039$) and sport activities ($p = 0.010$).

The results show that for visitors aged over 45 relaxing in a natural environment and hiking are the main reasons for visiting Monte Morello forest. For the visitors aged under 44 years the main reason for visiting Monte Morello is still hiking, but also sport activities and relaxing are important for younger people, aged less than 25. The non-parametric test of Kruskal-Wallis ($\alpha = 0.05$) shows statistically significant differences for two reasons: relaxing into the nature ($p = 0.008$) and picnicking ($p = 0.043$).

The level of education is a socio-demographic variable that has little influence on the reasons for the visit: the only differences are that visitors with high school degree are more likely to do outdoor sports and visitors with University degree evaluate picnicking more important respect to the other categories of visitors. The non-parametric test of Kruskal-Wallis ($\alpha = 0.05$) shows statistically significant differences only for one reason: sport activities ($p < 0.0001$).

3.3. Benefits provided by peri-urban forest

The respondents highlighted that the most important benefits provided by Monte Morello peri-urban forest are tourism-recreation, biodiversity conservation, air quality and cultural values (Table 2). Considering the location of Monte Morello forest – closed to the Sesto Fiorentino municipality and the metropolitan area of Florence – the role of this area as a green lung and relaxation area was predictable. For the same reasons Monte Morello forest is considered by the visitors as an important source for carbon stocking. Conversely, the economic benefits – provision of timber and fuelwood and creation of job opportunities – are considered by the sample respondents as the least important benefits.

Observing the data by gender, no differences are evidenced between males and females. In fact, the non-parametric test of Mann-Whitney

($\alpha = 0.05$) shows no statistically significant differences.

The age of respondents is a socio-demographic variable that has influence in particular on two benefits: biodiversity, and cultural values. Younger people assign a lower importance to biodiversity and cultural values than the oldest ones. The non-parametric test of Kruskal-Wallis ($\alpha = 0.05$) shows statistically significant differences for three benefits: cultural values ($p < 0.0001$), air quality ($p < 0.0001$), and biodiversity ($p = 0.029$).

The level of education of respondents influences in a different way the various benefits. In particular, respondents with a post-University degree assign lower importance to air quality, timber and fuelwood provision and job opportunities compared to less educated people. Less educated people, with elementary school degree, assign higher importance to protection from natural hazards. The non-parametric test of Kruskal-Wallis ($\alpha = 0.05$) shows statistically significant differences for the following benefits: timber and fuelwood provision ($p = 0.031$), air quality ($p = 0.033$).

The most important benefits provided by Monte Morello peri-urban forest distinguished by employment categories are the tourism-recreation, biodiversity conservation and air quality for all categories. Public sector employees assign higher importance to job opportunities respect to other categories.

3.4. Preferences and perceptions towards the peri-urban forest

3.4.1. Tourist facilities

The majority of respondents think that tourist facilities improve the attractiveness of Monte Morello peri-urban forest (Q4.1): 25.4% of total respondents affirm that tourist facilities have a very high positive impact on tourist attractiveness and 22.4% a positive impact. Conversely, 19.4% of respondents think that tourist facilities have a very high negative impact on tourist attractiveness and 13.9% a negative impact. The median value is 3 in a 5-point Likert scale response format.

The tourist facilities most appreciated by visitors are the following (Q4.2): waste baskets (117 of 138 respondents to this question); picnicking areas (110 of 138 respondents); benches and areas for sports activities (100 of 138); and in the last place the trail marking (90 of 138).

Table 2
Benefits provided by Monte Morello peri-urban forest for individual and society (median values).

	Tourism-recreation	Biodiversity	Air quality	Protection	Cultural values	Timber and fuelwood	Job opportunities
<i>Gender</i>							
Male (n = 120)	5	5	5	4	5	3	2
Female (n = 81)	5	5	5	4	5	3	2
<i>Age</i>							
Less than 25 years old (n = 9)	5	4	5	5	4	3	2
26–44 years old (n = 61)	5	5	5	4	4	3	2
45–64 years old (n = 84)	5	5	5	5	5	3	3
More than 64 years old (n = 47)	5	5	5	4	5	3	2
<i>Level of education</i>							
Elementary school degree (n = 54)	5	5	5	5	5	3	2
High school degree (n = 82)	5	5	5	4	4	3	2
University degree (n = 60)	5	5	5	4	5	3	2
Post-university degree (n = 5)	5	5	3	4	5	2	3
<i>Actual jobs</i>							
Public sector employees (n = 33)	5	5	5	4	5	2	3
Private sector employees (n = 62)	5	5	5	5	4	3	2
Housewives (n = 9)	5	5	5	4	4	3	2
Students (n = 12)	5	5	5	5	4	3	2
Pensioners (n = 53)	5	5	5	5	5	3	2
Unemployed (n = 13)	5	5	5	4	4	2	2
Other (n = 19)	5	5	5	4	3	3	2
Total (n = 201)	5	5	5	4	5	3	2

Table 3
Visitors' preferences for the characteristics of peri-urban forest (frequency distribution).

Socio-demographic characteristics	Tree species composition		
	Coniferous forests	Broadleaved forests	Mixed forests
<i>Gender</i>			
Male (n = 120)	13.3%	22.5%	64.2%
Female (n = 81)	3.7%	18.5%	77.8%
<i>Age</i>			
Less than 25 years old (n = 9)	0.0%	55.6%	44.4%
26–44 years old (n = 61)	4.9%	18.0%	77.0%
45–64 years old (n = 84)	9.5%	19.0%	71.4%
More than 64 years old (n = 47)	17.0%	21.3%	61.7%
<i>Level of education</i>			
Elementary school degree (n = 54)	13.0%	9.3%	77.8%
High school degree (n = 82)	6.1%	22.0%	72.0%
University degree (n = 60)	11.7%	31.7%	56.7%
Post-university degree (n = 5)	0.0%	0.0%	100.0%
<i>Actual job</i>			
Public sector employees (n = 33)	9.1%	21.2%	69.7%
Private sector employees (n = 62)	6.5%	17.7%	75.8%
Housewives (n = 9)	0.0%	11.1%	88.9%
Students (n = 12)	0.0%	50.0%	50.0%
Pensioners (n = 53)	13.2%	20.8%	66.0%
Unemployed (n = 13)	25.0%	37.5%	37.5%
Other (n = 19)	15.8%	15.8%	68.4%
Total (n = 201)	9.5%	20.9%	69.7%

Socio-demographic characteristics	Stand structure		
	Regular distribution	Random distribution	Completely untouched
<i>Gender</i>			
Male (n = 120)	10.0%	55.0%	35.0%
Female (n = 81)	2.5%	54.3%	43.2%
<i>Age</i>			
Less than 25 years old (n = 9)	22.2%	66.7%	11.1%
26–44 years old (n = 61)	9.8%	45.9%	44.3%
45–64 years old (n = 84)	6.0%	57.1%	36.9%
More than 64 years old (n = 47)	2.1%	59.6%	38.3%
<i>Level of education</i>			
Elementary school degree (n = 54)	11.1%	55.6%	33.3%
High school degree (n = 82)	6.1%	50.0%	43.9%
University degree (n = 60)	5.0%	60.0%	35.0%
Post-university degree (n = 5)	0.0%	60.0%	40.0%
<i>Actual job</i>			
Public sector employees (n = 33)	3.0%	51.5%	45.5%
Private sector employees (n = 62)	12.9%	43.5%	43.5%
Housewives (n = 9)	0.0%	66.7%	33.3%
Students (n = 12)	8.3%	66.7%	25.0%
Pensioners (n = 53)	0.0%	64.2%	35.8%
Unemployed (n = 13)	25.0%	62.5%	75.0%
Other (n = 19)	10.5%	68.4%	21.1%
Total (n = 201)	7.0%	54.7%	38.3%

3.4.2. Characteristics of peri-urban forest stand

The results show that the preferred type of forest, from the aesthetic point of view, is a mixed forest with a random distribution of trees in the space and a differentiated horizontal and vertical stand structure (Table 3). In other words, the most appreciated kind of peri-urban forests by the sample of visitors are forests with a high level of naturalness – random distribution of trees, presence of different tree species (coniferous and deciduous), and trees with a different height and size – but regularly managed.

Concerning the tree species composition (Q4.3), the visitors prefer mixed forests (69.7% of total respondents) followed by broadleaved forests (20.8%) and coniferous forests (9.5%). This result shows that pure coniferous forests – such as Monte Morello forest – are considered unattractive from a touristic point of view.

The frequency distribution by gender is the following: mixed forests (64.2% of total males, 77.8% of total females), broadleaved forests (22.5% of males, 18.5% of females), and coniferous forests (13.3% of

males, 3.7% of females).

The results by age show that the preference for coniferous forests increases in the older age classes (0% of the respondents aged less than 25 years, 4.9% of the respondents between 26 and 44 years, 9.5% of the respondents between 45 and 64 years, 17.0% of the respondents aged more than 64 years).

For the other socio-demographic characteristics of the respondents no substantial differences are observed. The level of education is not a variable that influences the preferences for the tree species composition of the peri-urban forest, because the majority of respondents prefer mixed forests: 77.8% of total respondents with an elementary school degree, 72.0% of respondents with a high school degree, 56.7% of respondents with a University degree, and 100.0% of respondents with a post-University degree. Conversely, people with a higher level of education prefer broadleaved forests (31.0% of respondents with a University degree).

About the stand structure (Q4.4), the visitors prefer peri-urban

Table 4
Priority scores for the images of the Monte Morello peri-urban forest after three different silvicultural treatments by groups of respondents.

Image/Group of visitors	Sesto Fiorentino municipality (n = 57)	Other municipalities of Tuscany Region (n = 130)	Other Italian regions or foreign countries (n = 14)	Total (n = 201)
Image 1 – Status quo scenario	0.2411	0.1966	0.2031	0.2093
Image 2 – Traditional thinning scenario	0.2597	0.3062	0.2314	0.2873
Image 3 – Selective thinning scenario	0.4992	0.4972	0.5655	0.5034
CI	0.000137	0.000923	0.001369	0.000416
CR	0.000026	0.001756	0.002609	0.000793

forests characterized by a random distribution of trees in the space, with a differentiated stand structure both vertically and horizontally (54.7% of total respondents). The respondents who prefer completely untouched forests are 38.3%, while the remaining 7.0% prefer more artificial forests with a regular distribution of trees and an undifferentiated stand structure.

The visitors' preferences examining separately males and females are the follows: 55.0% of males and 54.3% of females prefer the random distribution of trees (with differentiated stand structure); 35.0% of males and 43.2% of females prefer untouched forests; and 10.0% of males and 2.5% of females prefer the regular distribution of trees (with undifferentiated stand structure). Consequently, we can assert that the females prefer slightly more forests with a high level of naturalness.

3.4.3. Silvicultural treatments

The results of pairwise comparison (Table 4) show that for the visitors the most popular image of Monte Morello peri-urban forest is the Image 3 (priority score of 0.5034), followed by the Image 2 (0.2873) and in the last place the Image 1 (0.2093). In addition, these results show that visitors prefer managed peri-urban forests (Image 2 and Image 3), while unmanaged peri-urban forests (*status quo* scenario) are evaluated negatively from the aesthetic point of view by the sample of respondents.

The selective thinning, aimed at harvesting 30–40% of basal area and at removing the standing dead trees and lying deadwood, is considered the best forest management strategy from the aesthetic point of view by the majority of respondents. Consequently, the selective thinning can be considered a forest management strategy aimed at increasing the tourist attractiveness of Monte Morello peri-urban forest. Conversely, the current situation should be avoided, intervening with active forest management, in order to enhance the touristic attractiveness of the area.

When observing the results by group of respondents considering their proximity to the study area, interesting differences are highlighted. The priority order is the same for all three groups, but the visitors from other regions of Italy and from foreign countries emphasize the aesthetic importance of Image 3-Selective thinning scenario (priority score of 0.5655), while the other two groups assign equal importance to this type of forest (priority score of 0.4992 and 0.4972 respectively for the residents in the Sesto Fiorentino municipality and in the other areas of Tuscany Region). Besides, the residents of Sesto Fiorentino municipality consider the Images 1 and 2 aesthetically equivalent considering that the priority scores are 0.2411 (Image 1-*Status quo* scenario) and 0.2597 (Image 2-Traditional thinning scenario).

For all comparisons, the consistency ratio (CR) resulted less than 0.1.

4. Conclusions and discussion

The results highlight that the visitors appreciate managed forests, while unmanaged peri-urban forests – *status quo* scenario of this study

– are perceived in a negative way. In particular, the preferred type of peri-urban forest is a mixed forest of coniferous and deciduous species, with a random arrangement of trees in the space. These findings are consistent with the international literature, in particular with some studies that have shown the preferences of visitors and residents for mixed forests in different European contexts (Gundersen and Frivold, 2008; Paletto et al., 2013; Pastorella et al., 2014; Grilli et al., 2016). In addition, a literature review shows that the willingness to pay of visitors is higher for mixed forests compared to pure coniferous forests or deciduous forests (Grilli et al., 2014).

In peri-urban forests, the visitors perceive the presence of tourist facilities – in particular waste baskets, picnicking and sport areas – in a positive way (Jankovska et al., 2014).

With regard to deadwood, several studies have shown that tourists perceive the presence of deadwood (standing dead trees and lying deadwood) in urban and peri-urban forests in a negative way (Tyrväinen et al., 2003; Golivets, 2011; Jankovska et al., 2014). These results are in accordance with results obtained in Monte Morello study area where the selective thinning, aimed at removing the standing dead trees and lying deadwood, is considered the best forest management strategy from visitors. Conversely, Pastorella et al. (2016b) show that a high percentage of visitors in a case study (peri-urban forest of Sarajevo city in Bosnia-Herzegovina) perceive positively standing dead trees and lying deadwood in forest. In addition, Hauru et al. (2014) in a case study in Finland (Helsinki city) demonstrate that urban forests with fresh logs are considered more aesthetically appealing than forests with old or no logs.

With regard to forest management alternatives, some authors highlight that respondents prefer to retain the current state of forest management (*status quo*) (Hanley et al., 1998; Horne et al., 2005). Conversely, Jankovska et al. (2014) show that the sample of respondents investigated in their survey is in favor of changing the *status quo*. Also in Monte Morello case study respondents are in favor of an alternative forest management (selective thinning scenario). These differences are probably due to three factors: characteristics of the current state of forest management (managed/unmanaged forest), recreational use of forest and cultural context (geographical area). The unmanaged peri-urban forests are negatively perceived by visitors in all contexts, while the cultural context can influence visitors in preferring peri-urban forests more “natural” (without tourist facilities and with a random distribution of trees) or “urbanized” (with tourist facilities and with a regular distribution of trees).

When considering the relationship between socio-demographic features and perceptions and preferences accorded to different aspects of forests (including forest attributes and benefits provided by forests), emerges that the interactions between individuals and nature in general are complex and in some cases deeply influenced by the shift from traditional to modern society (Murdock and Provost, 1973). This is the case of the relationship between gender and nature; nevertheless women still tend to have a more intense relationship with nature and to accord higher value to the contemplative and spiritual values of forest, tending to have a more intimate intense relationship with it

(Buckingham-Hatfield, 2000). Findings of the present research concerning recreational uses of forests confirm that women assign higher values than men to aesthetic and spiritual services like relaxing and picnicking (Paletto et al., 2013)

Concerning benefits provided by forest, the present research is in accordance with other studies evidencing that females assign a high value to spiritual, aesthetic, and historical aspects of forests, while males attribute a higher importance to economic benefits (Tarrant and Cordell, 2002; Kumar and Kant, 2007).

Findings related to preferences for different types of forests are in line with those of another research conducted by the authors (Paletto et al., 2013) in Northern Italy (Alpine region) investigating the relationship between perceptions and respondents' gender, age, education, and geographical location. Also this research highlights that females have a greater preference for mixed forests compared with males and that preference for evergreen forests increases in elderly people.

Results are consistent with the works of Kumar and Kant (2007) and Paletto et al. (2013) evidencing that irrespective of context, less educated people are the most attached to forest-related benefits; people with lower levels of education assign greater importance to air quality, timber and fuelwood provision.

Studies and researches, which focus on visitors' perceptions and preferences towards the aesthetic characteristics of peri-urban forest can support decision makers (planners and managers) in the definition of strategies aimed at improving the attractiveness of a site. In order to increase the attractiveness of a peri-urban forest, the innate characteristics influenced by forest management are tree species composition, stand structure and the presence of deadwood, while the man-made characteristics concern the construction and maintenance of tourist facilities.

The present study sought to increase knowledge about the people's preferences for different silvicultural treatments in order to overcome the current knowledge gap. The knowledge of the opinions of the population regarding the various aspects connected to forest management, provides decision makers the elements to both identify and plan management actions in the territory (O'Brien, 2006). In particular, forest planners and managers of Southern Europe could be supported in order to increase forests' attractiveness of a site.

Acknowledgements

The present study was realized in the framework of LIFE project FoResMit (LIFE14 CCM/IT/000905) "Recovery of degraded coniferous Forests for environmental sustainability Restoration and climate change Mitigation" aimed at testing and verifying the effectiveness of management options for the restoration of degraded coniferous forests in meeting climate change mitigation objectives.

The authors want to thank the visitors of Monte Morello forest who filled out the questionnaire and provided useful information and suggestions.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.ufug.2017.06.020>.

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