



## ASSESSING CULTURAL ECOSYSTEM SERVICES DURING THE COVID-19 PANDEMIC AT THE GARDEN OF NINFA (ITALY)

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**ABSTRACT** - Green areas provide Cultural Ecosystem Services (CESs), that is, the ecosystem outputs that enable a range of experiential and intellectual activities. These include health promotion, recreation, enjoyment of the cultural heritage, and aesthetic experiences. The demand for CESs has grown during the first half of 2020, when most of the EU Member States had to face a stringent lockdown to contain the spread of the Covid-19, and people have undergone considerable psychophysical distress. In this framework, the Garden of Ninfa, one of the most visited Gardens of Italy, with its natural, historical, and architectural beauties delivers precious CESs, which have however been poorly studied. In this research, through a survey, we investigated the CESs delivered by the Garden of Ninfa in the immediate post-lockdown period, providing at the same time a monetary evaluation. The results show that people mostly visit the Garden of Ninfa for the aesthetic experience, followed by the resonance in terms of culture or heritage and health promotion; the combination of water bodies and fauna is highly effective in delivering CESs. The monetary evaluation, ranging between 1.0 and 2.7 Million EUR per year, may stimulate the replication of similar initiatives, especially in highly altered areas. The safety measures put in place by the governance of the Garden of Ninfa have safeguarded the tour experience from the Covid-19 fear of infection.

**KEYWORDS:** NATURAL CAPITAL, ECOSYSTEM SERVICES, OUTDOOR RECREATION, NATURA 2000 SITE.

### INTRODUCTION

In the opening months of 2020, the coronavirus disease (Covid-19) started spreading all over the world, and in March 2020 the World Health Organization officially declared the pandemic (Ciotti et al., 2020). Italy was the first European country critically affected by the Covid-19, and from the 10<sup>th</sup> of March 2020 to the 4<sup>th</sup> of May 2020, the Government has imposed a complete lockdown. From then, until September 2020, freedom restrictions were weaker, and the population was allowed to come back to most of the habitual activities (including traveling) respecting some safety measures such as social distancing and the use of face masks. However, isolation, social distancing, and fear of the infection have brought considerable psychological distress to the population (Mucci

et al., 2020), enhancing disturbances such as depression and anxiety (Sher et al., 2020).

In this framework, the demand for Cultural Ecosystem Services (CESs) has rapidly grown, presumably to fulfill the needs for connectedness with nature (Beery et al., 2021; Derks et al., 2020). Following the Common International Classification of Ecosystem Services (CICES, Haines-Young and Potschin, 2018), CESs are “characteristics of elements of nature that provide opportunities for people to derive cultural goods or benefits”. Nature is indeed experienced as an environment for resting and recovering from the daily stress, providing a source of relaxation and recreation, and the percentage of green space in people’s living environment has shown a positive

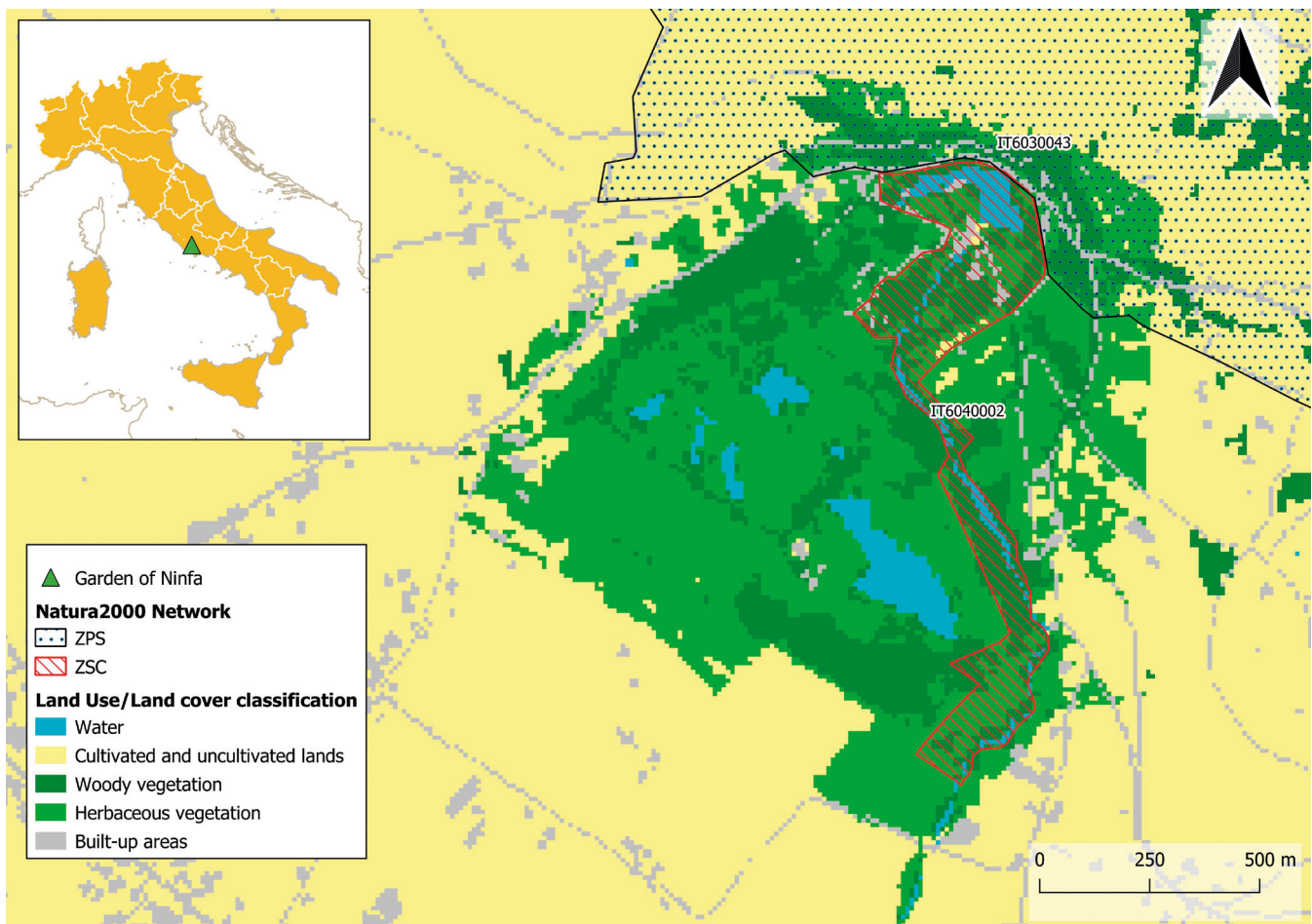
association with their wellbeing (Maas et al., 2006; Meuwese et al., 2021; Beckmann-Wübbelt et al., 2021).

In recent years, Ecosystem Services (ESs) have become an essential tool for decision-making on ecological and social issues (Cheng et al., 2019); the assessment of ESs can be a support tool for urban and landscape planning and to define policy strategies aimed at improving life quality (Egoh et al., 2008; Willemsen et al., 2008; Lautenbach et al., 2011; Manes et al., 2016). However, the evaluation of CESs is still arbitrary as those are considered “intangible” and “non-material compared to other services (Martín-López et al., 2009; Tilliger et al., 2015; Cheng et al., 2019), and robust CESs indicators are still lacking.

Surveys represent the most efficient approach to characterize CESs at the site scale, allowing for capturing perceptions directly from the users (Willock et al., 2017) and providing useful impacts for the management of ecosystems (Larson et al., 2019).

This research aimed at assessing the CESs delivered by the Garden of Ninfa (Figure 1), a highly visited garden in central Italy, partly falling in the Natura2000 network, owned and

managed by the Roffredo Caetani Foundation (hereafter, the R.C Foundation). We hypothesized that the Garden delivers the following CESs: health promotion, recuperation or enjoyment through passive or observational interactions (CICES code 3.1.1.2); resonance in terms of culture or heritage (CICES code 3.1.2.3); aesthetic experiences (CICES code 3.1.2.4). Through a survey, we investigated which CES is mostly appreciated by visitors, and what are the main environmental characteristics linked to the CESs delivery. We focused on the following aspects: i) the motivations which lead visitors to the Garden, ii) the attractiveness of the most representative features of the Garden, iii) the mood variation, cultural enrichment following the visit, and the safety perception concerning the Covid-19 pandemic. A variety of studies have investigated different aspects of the Garden of Ninfa, from the fauna (Fabiani et al., 2018) to the flora (Jin, 2017) and the architecture (Mancini et al., 2019). However, to our knowledge, no one focused on CESs delivery, and just one (Buongiorno et al., 2018; not available online, this study must be requested from the R.C Foundation) has investigated the perception of visitors, even though not in a CESs perspective.



**Figure 1.** Land use and land cover map of the Garden of Ninfa derived from Sentinel-2 data. Natura2000 sites are shown.

Our study provides information for better management of the natural capital and to enhance the provisioning of CESs; since it was carried out in 2020, the results should be compared with those from multiple years, to highlight any influence or bias induced by the Covid-19 pandemic.

## MATERIALS AND METHODS

### *Study Area*

The Garden of Ninfa (hereafter, the Garden, Figure 1) is located in the municipality of Cisterna di Latina (Lazio Region, central Italy) in the Pontine plain, a heavily and intensively cultivated area. It was settled on the ruins of the Medieval city of Ninfa and was declared a Natural Monument in 2000; a part of it falls within the Natura 2000 Network, as a Special Area of Conservation (IT6040002, aquatic environments). The Garden is owned and managed by the Roffredo Caetani Foundation, a no-profit organization that aims to “honor and perpetuate the memory of the noble Caetani family and to continue their social and educational work”. The Garden includes the Historic Garden and the Natural Park of Pantanello. The Historic Garden extends for 10 hectares and is characterized by an extremely rich flora with more than 1300 plant species, both indigenous and allochthonous (R.C Foundation, 2020a). It is crossed by the River Ninfa; its fauna includes the *Salmo trutta macrostigma*, locally also known as the Trout of Ninfa, and other vulnerable and endangered species such as *Lampetra planeri* B. and *Emys orbicularis* L. (Regione Lazio, 2016). It is also famous for the historical ruins of the medieval town of Ninfa, which include the rest of houses, churches, bridges, and defensive walls. The Pantanello Natural Park (about 100 hectares) has been re-naturalized from the mid-nineties and has several ponds and marshes, which occupy about 12 hectares. It hosts more than 100 bird species, including *Aythya nyroca* G., *Ardea purpurea* L. and *Circaetus gallicus* G. (Lega Italiana Protezione Uccelli, LIPU). In the last few years, the Historic Garden was visited by more than 90,000 people per year (data provided by the R.C Foundation); ticket ranges from 0 € to 15 €, according to age and disability status. The R.C Foundation states that the flow of visitors is kept below the threshold of 240 visitors h<sup>-1</sup>, which is considered the sustainable carrying capacity; however, this threshold has been established on empirical observations, without dedicated scientific research behind it. In 2020, instead, the Historic Garden registered 71,688 visitors, which is 21% less than the previous year. Like other Historic Gardens across Europe (Hodor et al., 2021), in 2020 the Garden of Ninfa has implemented a safety procedure aimed at minimizing the risk of Covid-19 throughout the visit.

To control the volume of visitors, the Garden could only be visited under reservation, and the body temperature of visitors was measured. School trips, that usually bring a considerable amount of visitors, were suspended. Staff members along the path were in charge of making visitors respect the social distancing of 1 m; dispensers with sanitizing gel were placed along the path. The tour lasted for about 1 hour, during which visitors had to wear a face mask and gloves (R.C Foundation, 2020b). All the instructions concerning the hygiene and health measures were provided to visitors both online and by the staff members, right before the tour started. The Pantanello Natural Park instead has always been closed to the public, even before the pandemic.

### *Research questions and data collection*

We hypothesized that the Garden mainly delivers three CESs, that is, health promotion, recuperation or enjoyment through passive or observational interactions (CICES code 3.1.1.2); resonance in terms of culture or heritage (CICES code 3.1.2.3); aesthetic experiences (CICES code 3.1.2.4). We were interested in identifying whether or not visitors show preferences for one of these; if individual elements of the landscape contribute in a differential way to the CESs provision; if the sociodemographic background somehow influences the CESs perception. Plus, we wanted to collect some other information (e.g. mood variation, safety perception about the pandemic) to provide the Garden's governance with other usable findings.

The survey was therefore aimed at assessing the following aspects:

- i. Identifying the main motivations that entice visitors visiting the Garden, as a way for addressing the attraction for different CES.
- ii. Identifying the most attractive features of the Garden, as a proxy for identifying those features with a major role in the CESs delivery.
- iii. Investigating the change in the mood and cultural enrichment generated by the visit; investigating if, the Covid-19 pandemic situation negatively influenced the feeling of visitors during the visit.

According to Migliardi (2008), we used simple terminology and avoided questions that might require more than one answer. The survey included closed-ended (dichotomous or 5-point Likert scales) and multiple-choice questions (Appendix 1). Likert scales were used to transform qualitative information into a quantitative measure (Langermeyer et al., 2015). The survey was delivered *in loco* in a paper version, or online using a QR CODE to access the Google Form. The survey was entirely written in the Italian language and was completely anonymous. From July 2020 to the end of

September 2020, at the end of the visit, all the visitors were kindly invited to voluntarily compile the survey in one of its forms. Inclusion criteria were adult age (at least 18 years old), and good command of the Italian language. In the end, we collected 311 responses.

### **Survey's structure**

#### *Socio-demographic characterization*

Even though the scientific evidence is still lacking (Hegetschweiler et al., 2017), several studies have hypothesized that the perceptions of CESs might be linked to the socio-demographic background of respondents (Plieninger et al., 2013; Van Berkel et al., 2014). For this reason, participants were asked to fill in their personal information, such as age, area of origin (Country, Region, and province), and employment. Age data were aggregated into five groups, which are: young adults (18-30 years old), adults (31-40 years old), middle-aged adults (41-40 years old), young seniors (51-60 years old.), and seniors (61-79 years old). Those groups were chosen as they generally represent people with different roles in the family organization, job market, and political and civil engagement (Berens et al., 2016), and might show differences in the perception of CESs. We defined the following employment categories: Student, Employee, Entrepreneur/Freelance, Retired, Unemployed, Other (Plieninger et al., 2013).

#### *Visit motivation*

We identified six motivations that might have induced people to visit the Garden and proposed them on a 5-point Likert scale (1 being “low interest”, 5 being “high interest”). We used this approach as a means to evaluate the perception of each CESs by visitors; each motivation was associated with one of the before-mentioned CESs (see section *Research questions and data collection*). These motivations are:

1. Historical heritage (e.g. Historical ruins), given by the remains of churches, towers, walls, and houses of the medieval city of Ninfa (CICES code 3.1.2.3).
2. Recreational, given by the possibility to take a walk and relax observing the beauties of the Garden (CICES code 3.1.1.2).
3. Aesthetic-landscape value, given by the aesthetic value attributed to the Garden (CICES code 3.1.2.4).
4. Psychophysical well-being, that is, is the satisfaction deriving from being immersed in nature (CICES code 3.1.1.2).

5. Gardens, intended as green areas consisting of paths and well-developed pedestrian areas that have an environmental function and host remarkable biodiversity, with a variety of animals, plants, and other living organisms (CICES code 3.1.2.3).
6. Cultural and scientific interest in Historic Gardens (CICES code 3.1.2.3).

Median values and distribution of response frequencies, based on socio-demographic classes, were calculated to describe our results., Ranges (Higher score - Lower score) were also calculated to better address the variability of responses among classes.

#### *The attractiveness of the Garden of Ninfa*

To investigate whether the CESs delivery is linked to some specific environmental characteristics, like the presence of water bodies, historical ruins, and others, we proposed two questions. First, we selected five environmental components which in our opinion better characterize the Garden, that is, aquatic environments, fauna, historical ruins, flora, and landscape, and asked visitors which one aroused more interest. Participants were asked to select a maximum of two responses. Then we identified 10 resting points that can exemplify the selected environmental characteristics along the path, and asked respondents to choose which one – highlighted through a map (Annex 1) – was the most attractive. Each visitor could mark more than one site. Here (Table 1) we provide a brief description of each resting point. Both questions belong to the family of multiple-choice questions; however, whereas in the first one we directly ask for the environmental characteristic that aroused more interest, in the second it can be derived inductively.

#### *Change in the mood, cultural enrichment, and safety perception*

Participants were asked if there was any change in mood following the visit and if there was a cultural enrichment. Concerning mood, it has been proved that emotional well-being is enhanced by contact with nature (Hartig et al., 2016; Neill et al., 2019). However, despite there is plenty of evidence regarding urban green areas such as parks (Carrus et al., 2015; Vujcic et al., 2019), work still needs to be done for Botanical and Historic Gardens. As for the cultural enrichment, we believe that the cultural heritage of the Garden, as well as the work carried out by guides, are capable of exerting a positive impact. Both the mood change and the cultural enrichment were evaluated on a 4-point Likert scale.



**Table 1.** Description of the resting points.

<b>S. Maria Maggiore Church</b>	Medieval church, the most important in Ninfa, presumably built at the end of the XI century, where Alexander III (Rolando Bandinelli) was consecrated Pope in 1159 A.D.
<b>St. John Church</b>	On this site it is possible to observe the ruins of the towers and the apse of the monastery of San Giovanni, both built in the medieval period. It is also possible to observe the birch grove and the Malus hill.
<b>Water Features</b>	On this site, it is possible to observe the water features and several plant species, such as <i>Quercus ilex</i> L., <i>Platanus hispanica</i> Mill. ex Münchh., <i>Cedrus deodara</i> (Roxb.) G. Don, <i>Magnolia campbelli</i> , <i>Rosa</i> 'M.me Alfred Carriere', <i>Rosa</i> 'Wilhelm', <i>Rosa</i> 'Felleberg', <i>Rosa</i> 'Albertine'
<b>Via Pontis</b>	"Via Pontis" (or "Viale dei Cipressi") is the main road of the medieval city; from there you can also see the most important houses of Ninfa (developed in the XIII century).
<b>Gloria Square and San Biagio Church</b>	Gloria square and the Church of San Biagio, built in the XII century. Probably, this site is the only one non built in the medieval city. This place is where citizens used to gather.
<b>Ponte a due luci</b>	"Ponte a due luci" or "Ponte del Macello", a bridge, close to the ancient walls.
<b>Roman Bridge</b>	On this site it is possible to observe the structure of the medieval city and the masonry bridge, built in Roman era.
<b>The Bamboo Water spring</b>	This site hosts Bamboo sticks from China; from there it is possible to observe a corner of <i>Camellia japonica</i> L. and <i>Salix reticulata</i> L.
<b>The River Ninfa</b>	The Ninfa River flows throughout the city and Garden. It is possible to observe different plants such as <i>Magnolia x loebneri</i> "Leonard Messel", <i>Magnolia grandiflora</i> L., <i>Viburnum opulus</i> L.
<b>Town hall Square</b>	The Town Hall is a building built in the XII century, seat of the municipality of Ninfa. The town hall was renovated in the XIX century and converted into a country residence.

We also investigated the visitor's perception of safety concerning the Covid-19 emergency, asking whether they felt safe during the tour owing to the safety procedures put in place by the R.C Foundation (answers were Yes or No). We believe that this information provides the managers with useful and actionable knowledge, since the sense of safety improves the whole experience, thus maximizing the delivery of CESs.

#### Monetary evaluation

We used two different approaches for the monetary evaluation of the CESs delivered by the Garden. The first one is based on an international report, which

was used as a reference database for The Economics of Ecosystems and Biodiversity (TEEB) framework (Van Der Ploeg et al., 2010). This report is based on a comprehensive literature review that assesses the monetary value of several Ecosystem Services (including CESs) provided by inland wetlands. The report does not use the CICES classification system; therefore, we have used the CESs categories more closely related to those considered in Ninfa Garden as *Aesthetic value*, *Recreational and tourism opportunities* and *Inspiration for culture, art, and design*. The monetary value is delivered in \$ ha<sup>-1</sup> year<sup>-1</sup>; we converted it into € ha<sup>-1</sup> year<sup>-1</sup>.

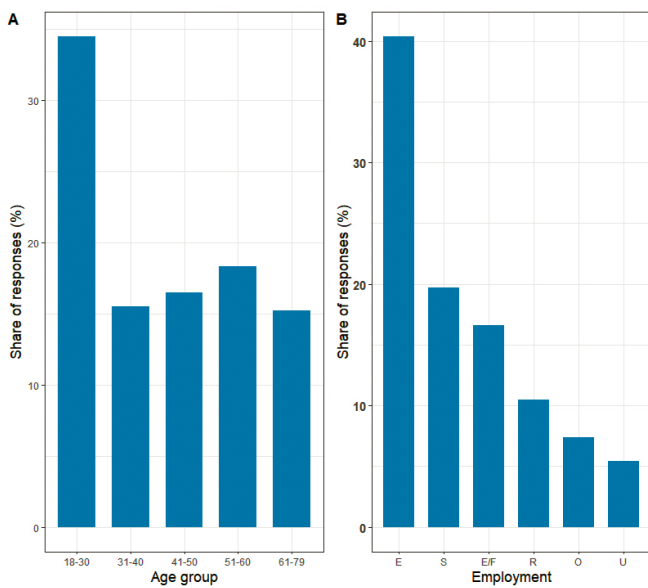
The second evaluation is based on the revenue derived from ticket sales, for the years 2019, 2020, and 2021. The data was provided by the R.C Foundation.

## RESULTS

### Socio-demographic characterization

We found that 98.7% of respondents were from Italy; the remaining 1.3% came from other countries such as France, the Netherlands, and Spain. Among Italian visitors there was a clear prevalence from the Lazio Region (67.4%); all other Regions are below the 5% of respondents, except for Lombardy (5.8%).

The share of Age groups and the employment status are represented in Figure 2a. The most represented age group was by far young adults (34.5%), followed by the young seniors (18.3%). As for the employment status, (Figure 2b), about 40% of the respondents are employees, followed by students (19.7%).



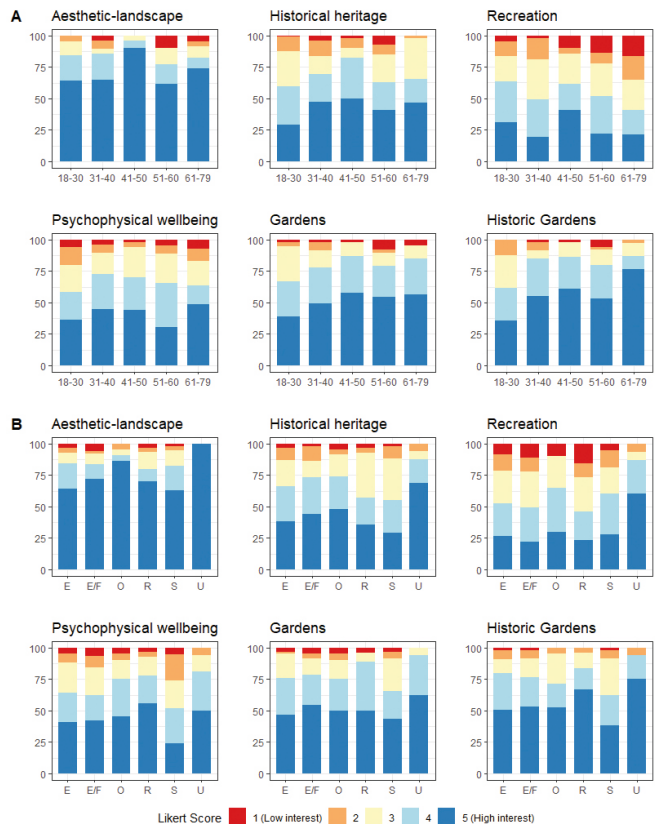
**Figure 2.** Respondents' Age group (2a) and employment (2b) frequencies (expressed in %). E: employee; E/F: entrepreneur/freelance; O: other; R: retired; S: Student; U: unemployed.

### Visit motivation

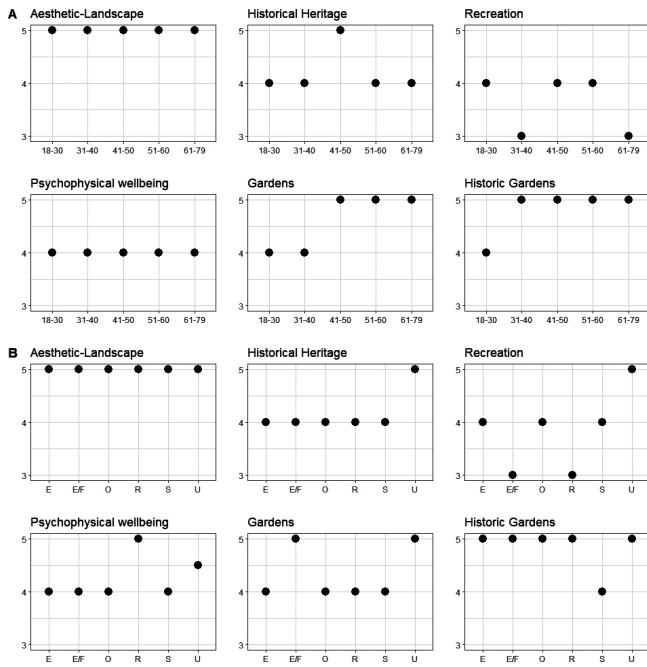
All age and employment groups reported a median value of 5 for *aesthetic-landscape*, with at least 75% of the scores falling within 4 and 5, which makes it the highest-ranked motivation (Figure 3 and 4). Interestingly, this is the only motivation with a median value of 5 for young adults and students. *Historic Gardens* is also highly appreciated: all age and employment groups, except for young adults and students, reported a median value of 5, with way more than 60% of preferences falling within 4 and 5. More

than 75% of Seniors attributed the highest score to this motivation. *Recreation* is instead the lowest-ranked one, with a median value of 3 for two age and two employment groups, that is, adults, seniors, entrepreneur/freelance and retired respectively; Unemployed is the only group with a median value of 5 for this motivation, whith about 60% of respondents who gave a Likert score of 5. The attraction for *Gardens* is quite strong in all groups, with all median values falling within 4 and 5 and frequencies of 5 exceeding 35% for all age and employment groups, whereas the attraction *Psychophysical wellbeing* and *Historical heritage* fall in an intermediate position, showing median values of 4 for all age and employment groups, with a few exceptions. Interestingly, Unemployees reported the highest median value for all the motivations except for *psychophysical well-being*, and 100% of them gave the highest score to *Aesthetic-Landscape*.

Ranges (data not shown) are included within 3 and 4, with a few exceptions. A range of 2 is observed in Middle-age adults for *Aesthetic-Landscape* and Unemployed for *Gardens*; a range of 0 is observed in Unemployed for *Aesthetic-Landscape*.



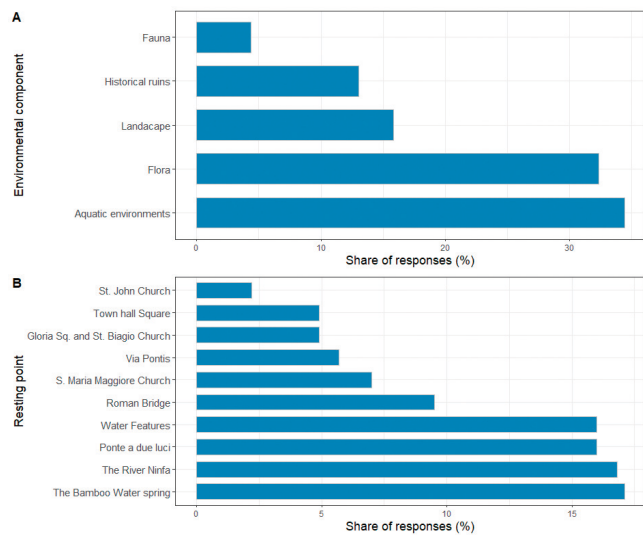
**Figure 3.** Likert score frequencies for the proposed motivations in different age groups (3a) and employment groups (3b). Frequencies are expressed in %. E: employee; E/F: entrepreneur/freelance; O: other; R: retired; S: Student; U: unemployed.



**Figure 4.** Median value (y-axis) for age groups (4a) and employment groups (4b) in each motivation. E: employee; E/F: entrepreneur/freelance; O: other; R: retired; S: Student; U: unemployed.

*Attractive features of the Garden of Ninfa*

The most appreciated environmental components were aquatic environments (34.4%) and flora (32.3%); the components that aroused less interest were Historical Ruins (13.0%) and Fauna (4.3%, Figure 5a). The most voted resting points were *The Bamboo Water Spring*, *The River Ninfa* and *Ponte a due luci* (which all falls close to



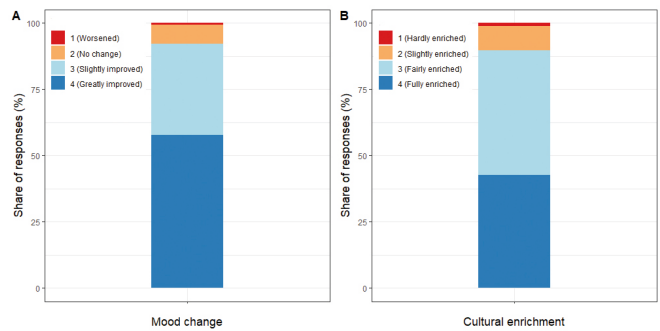
**Figure 5.** Preferences for environmental components and resting points. Frequencies are expressed in %.

water bodies and host a remarkable flora); the less voted was *St. John’s Monastery* (Figure 5b), followed by other archeological ruins such as *Church of S. Maria Maggiore* and the *Townhall square*.

*Change in the mood, cultural enrichment, and safety perception*

A vast majority of the respondents (92% of the sample) reported a slight to great improvement in mood following their visit to the Garden (Figure 6a); two respondents reported a worsening in the mood. 89.5% of participants felt that the visit was fair to fully culturally enriching, while 1.2% felt that it hardly enriched them (Figure 6b).

Most of the participants (98.1%) felt that it was a positive and safe visit despite the Covid-19 pandemic, while 1.9% of participants have not felt completely safe.



**Figure 6.** Likert score frequencies for mood change and cultural enrichment, expressed in %.

*Monetary evaluation*

The aesthetic value accounts for about 167,500 € ha<sup>-1</sup> year<sup>-1</sup>; the recreational and tourism opportunities account for about 45,800 € ha<sup>-1</sup> year<sup>-1</sup>; the inspiration for culture, art, and design accounts for 57,000 € ha<sup>-1</sup> year<sup>-1</sup>. Hence, the overall monetary value of CESs provided by the Historic Garden of Ninfa is equal to 270,300 € ha<sup>-1</sup> year<sup>-1</sup>. Considering that the Historic Garden extends for about 10 ha, the yearly monetary value of the CESs is equal to EUR 2.703 million. According to data provided by the R.C Foundation, the revenue derived from the tickets sold in 2019, 2020, and 2021 was 1.060 million EUR, 1.071 million EUR, and 1.173 million EUR respectively.

## DISCUSSION

Buongiorno (2018) found that 64% of the respondents in 2018 were from Lazio Region; in our study, this percentage is equal to 67%. Therefore our study carried out right after the first lockdown in Italy shows that the rules for the containment of the Covid-19 pandemic might have not drastically affected the flow of visitors living in Italy.

Compared to what was obtained by Buongiorno (2018), the presence of young adults has almost doubled; all other age groups have decreased, apart from the young seniors, which is stable at around 20%. According to several studies (Beery et al., 2021; Derks et al., 2020), restriction measures for containing the pandemic have increased the demand for outdoor recreation, but this tendency is age-dependent. Indeed, in our case, we argue the threat of the infection has prevented elderly people from doing outdoor activities much more than it has done with younger people. That interpretation is supported by other studies, which reported that young people are more likely to increase their outdoor activity compared to older age groups in the immediate after-lockdown period (Venter et al., 2021).

Being *Aesthetic-landscape* the top-ranked motivation, it is clear that *aesthetic experiences* (CICES code 3.1.2.4) is the highest perceived CESs. *Resonance in terms of culture or heritage* (CICES code 3.1.2.3) is also highly appreciated. *Activities promoting health, recuperation or enjoyment through passive or observational interactions* (CICES code 3.1.1.2) is instead less valuable to people since *Recreation* and *Psychophysical wellbeing* are the two lowest-ranked motivations. Even though they used a different CESs classification system, similar results were obtained by Riechers et al. (2018) and Jim et al. (2006), who found that the aesthetic value of nature is highly perceived regardless of the socio-demographic status. The lower scores for motivations related to the CESs CICES code 3.1.1.2 (health promotion, recuperation or enjoyment through passive or observational interactions) across all socio-demographic groups could be linked to the fact that this CES is complex and multifaceted, and it's strongly related to the cognitive perception of people (Andersson et al., 2015; Aguado et al., 2018). Plus, it still has limited recognition in both people and scientific literature (Dou et al., 2017; Kosanic et al., 2020). Dou et al. (2020) found out that the perception of CESs such as Aesthetic experience, education, and science notably decrease in older people; however, our results point to a different direction, since older age groups have high median scores (4 or 5) for the motivations related to CESs code 3.1.2.3 and 3.1.2.4.

The relation between the socio-demographic status and the CESs perception is still unclear. Indeed, according to Hegetschweiler et al. (2017), who carried out a review on

CESs in Europe, only a few studies reported a significant effect of socio-demographic parameters on the CESs-derived benefits, whereas in most cases (Dade et al., 2020; Katz-Gerro et al., 2015) the socio-demographic characteristics seem to not affect relaxation and nature interactions. For this reason, there is the need for more studies aimed at exploring the relation between CESs and socio-demographic characteristics of CESs users. In this framework, we decided to report our results on employment groups to implement the lack of knowledge on this field, without speculating on causes underpinning the observed differences across the socio-demographic groups.

The delivery of CES is mostly related to the combination of water bodies and flora. Indeed visitors voted *Aquatic environments* as the environmental component that aroused more interest, and the 3 most appreciated resting points (that is, *Ponte a due luci*, *Ninfa River*, and *Bamboo Water Spring*, see Annex 1) are placed right along the course of the River Ninfa (see Annex 1), where a remarkable flora is also visible. Although the Garden hosts more than 100 bird species, the fauna seems not to be perceived as relevant by the visitors. This result can be because faunal observations are prevented by several factors, such as the anthropic disturbance given by visitors and the presence of a high-speed road adjacent to the Garden. Nonetheless, it should be remarked that the Pantanello Natural Park, which is closed to the public, hosts the majority of the fauna. Similarly, the historical heritage seems not to be as appreciated as water bodies and flora. Previous studies reported that water bodies provide more diverse CESs than other landscape features (Dou et al., 2020); we state that also in our case people are inclined to perceive the local dominant landscape type as the more important because they feel surrounded by a certain type of natural features and establish a deeper interaction, thus getting more non-material benefits from them.

The positive impact on the mood is comparable with what was found by Beckmann-Wübbelt et al. (2021) for urban and peri-urban forests; nevertheless, it's worth reminding that, whereas urban and peri-urban forests can generally be freely accessed for recreation and physical activities, the guided tour of the Garden must undergo much more stringent rules (see section *Study area*). For this reason, further studies assessing the change of mood of people visiting Gardens and Historic Gardens are required.

The monetary evaluations provide various information to planning and decision-makers. On one side the report by Van Der Ploeg et al. (2010), providing an extensive framework of reference in the context of economic evaluation of ESs, allows indicating the inland wetland ecosystem, for which there is a lack of information in the current literature. On the other, the tickets income can be a good indicator to highlight the economic benefits of the Garden Ninfa, especially in areas subjected to intensive agriculture like the Pontine plain.



The results evidence that the biodiversity conservation and maintenance of nature might be a sustainable opportunity for generating income and green-collar jobs while preserving functioning ecosystems and their services. It's noticeable that, according to the data provided by the R.C Foundation, the revenue from ticket sales did not drop drastically in 2020 compared to 2019, despite the number of visitors did. This is attributable to the suspension of school trips since school students are generally low-paying visitors. Moreover, it is interesting to notice that the Garden of Ninfa has proven to maintain its attractiveness beyond the pandemic context, underling the crucial role that the natural spaces and the CESs they provide, can have in reducing stress and improving mental and physical well being.

## LIMITATIONS

This study presents some general limitations that should be addressed to improve future research on CES. First of all our approach, as for all studies which make use of surveys, is based on human perceptions, which are inevitably subjective. Following Israel et al. (1992), the sample size (n = 311) is insufficient for reaching a precision level of 10% with a confidence level of 95% for both age and employment groups; therefore, we can not be sure that we properly represented groups. Despite the efforts, two main aspects did not allow us to collect more responses. First, the absence of a good Internet network within the Garden slowed down the loading of the QR code, thus discouraging visitors from compiling the online survey. Then, for the paper version, one could argue that the fear of infection might reduce the number of people willing to compile it, as it involves touching pens and papers. In further studies, to extend our sample and to make it more representative, we are likely to implement measures such as providing the QR code on the material which is handed out to visitors, so they may compile the survey at a later time.

Another limitation was that we did not track the response, which can be a useful means to detect any selection bias (respondents may differ systematically from nonrespondents, e.g in terms of age).

As for the monetary evaluation, it is not meant to be exhaustive. For example, here we don't consider that the human capital (e.g. guides, workers for the maintenance of paths, gardeners), which has several associated costs, is highly involved in the operating of the garden.

## CONCLUSIONS

This study has helped to better characterize the CESs provided by the Garden of Ninfa. We found that people are most interested in *aesthetic experiences* (CICES code 3.1.2.4), followed by *resonance in terms of culture or heritage* (CICES code 3.1.2.3) and *activities promoting health, recuperation or enjoyment through passive or observational interactions* (CICES code 3.1.1.2). Water bodies and flora are strongly related to the delivery of CESs; fauna and historical ruins are instead less valuable to visitors.

The majority of visitors reported a remarkable mood improvement, which was unquestionably valuable in the immediate post-lockdown period, as well as a cultural enrichment; the adopted safety procedure is effective in safeguarding the tour experience from the fear of the infection. The monetary evaluations should be used as a tool for stimulating stakeholders and policymakers to protect biodiversity, functioning ecosystems, and their CESs as well as to replicate the virtuous model of the Garden of Ninfa, especially in highly altered areas such as the Pontine plain.

This study provides further cues for deepening the provision of CESs by the Garden of Ninfa.

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## APPENDIX 1: THE GARDEN OF NINFA

This Survey was realized by the Laboratory of Functional Ecology and Ecosystem Services in collaboration with the Roffredo Caetani Foundation. The survey aims at assessing the interests and satisfaction of the visitors of the Garden of Ninfa.

The response time should take approximately 5 minutes.

There are no right or wrong answers: we want to collect your personal opinion. For our purposes, it is important that you answer all the questions; we ask you to respond carefully and sincerely.

Thanks for your kind collaboration

### Other information

The collected data will be treated following the privacy laws and under the Legislative Decree 30 June 2003 n. 196 “Code regarding the protection of personal data” and art. 13 GDPR 679/16 - “European regulation on the protection of personal data”, guaranteeing the anonymity of the participants.

### Personal information

- Age
- Place of origin: Nation  
Region  
Province

### Employment (Mark with an X):

- Student
- Employee
- Entrepreneur/  
freelance
- Retired
- Unemployed
- Other

### Motivation of the visit

(Mark with an X. 1: low interest; 5: high interest)

	1	2	3	4	5
Historical heritage (e.g. Historical ruins)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Recreational	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Esthetic-landscape value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Psycho-physical well-being	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gardens	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cultural and scientific Interest in Historic Gardens	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### How has your mood changed since your visit?

(Mark with an X)

- Worsened
- No change
- Slightly improved
- Greatly improved

### Did the visit culturally enrich you?

(Mark with an X)

- Hardly enriched
- Slightly enriched
- Fairly enriched
- Fully enriched

### Which resting point, amongst those marked with a number in the following figure, have you appreciated the most?

(Mark with an X; you can choose more than one resting point)

- S. Maria Maggiore (n. 1)
- St. John Monastery (n. 2)
- Water features (n. 3)
- Via Pontis (n. 4)
- Gloria square and San Biagio Church (n. 5)
- Ponte a due Luci (n. 6)
- Roman bridge (n. 7)
- Bamboo water spring (n. 8)
- Ninfa River (n. 9)
- Town hall square (n. 10)

### Which environmental component aroused more interest

(Mark with an X a maximum of 2 choices)

- Aquatic environments
- Flora
- Fauna
- Historical ruins
- Landscape

### Considering the Covid-19 emergency, also owing to the safety measure put in place, did you have a positive day of amusement?

- Yes
- No





- |                       |   |                        |                      |
|-----------------------|---|------------------------|----------------------|
| 1. S. Maria Maggiore  | 4. Via Pontis                             | 6. Ponte a due Luci    | 9. Ninfa River       |
| 2. St. John Monastery | 5. Gloria square and<br>San Biagio Church | 7. Roman bridge        | 10. Town hall square |
| 3. Water features     |   | 8. Bamboo water spring |                      |