Cultural landscape: Towards the design of a nocturnal lightscape

Cultural landscape: towards the design of a nocturnal lightscape

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Abstract
The current debate on the cultural landscape is focused on an inclusive definition. It proposes active enhancement practices and local planning tools that are also dedicated to the study of scenic-perceptive components and visual values. However, the current indications are limited to the definition of day images of sites, and are not based on investigations of the corresponding nocturnal images. The legislation and the recommendations in force in the field of lighting supply performance requirements, related to street and urban lighting, do not provide any indications regarding territorial contexts or widespread heritage sites.
This paper presents a critical analysis of the lighting condition of different territorial contexts, places of widespread heritage, in particular with reference to the Italian context. The present situation has been investigated through a qualitative analysis, based on a comparison between day and night images, and a quantitative analysis, developed through a measurement campaign on representative case studies of the recurrent territorial context. In most cases, an absence of a specific lighting design strategy, aimed at defining a suitable nocturnal perception of the cultural landscape, has emerged from the collected data.
The aim of the work has been to underline the importance of the study of nocturnal images and to show the possibility of developing an analysis and design methodology for these contexts. This approach should be based on a systemic vision, which should allow not only single monuments to be valorised, but also the places and landscapes that characterise a territory from a morphological and cultural point of view.

Keywords: Cultural landscape, widespread heritage, lighting, lightscape, measurement campaign.

1. Introduction

The topic of cultural heritage and protection and enhancement practices has witnessed a growing interest in contemporary culture. The concept of heritage has been transformed and stratified and a more complex articulation has been reached [1]. We have progressively moved away from the concept of *cultural good*, meaning a single object with a historical value, to *cultural landscape* [2, 3], which is considered as an inclusive system of cultural heritage and territorial context, generated by the joint efforts of humans and nature. This trend has led to the need to investigate the values that could be derived from an interaction between landscape, heritage and culture [4] and to integrate the process of enhancement of cultural heritage and protection of the landscape.
The most inclusive definition of the concept of heritage involves a revision of the protection and enhancement process, whereby the multiple components are included in a complex and unique system. At the same time, in the management of our cultural heritage, the overcoming of the passive protection principle and the insertion of purposes linked to the fruition and expansion of the communicative potential of the goods are now being promoted.
Over the last two decades, the law system has also promoted this approach: it reached its peak at an international level with the European Landscape Convention [5], implemented in the different national laws. In Italy, the European Convention has recently been the subject of a critical review process, promoted by the Ministry of Cultural Heritage, Activities and Tourism [6]. Moreover, its principles are in line with what the Constitution of the Republic [7] and the Code of Cultural Heritage and Landscape established [8].
The will to try to overcome the concept of individual cultural goods, in order to achieve a more articulated and extended vision of heritage, which considers both individual features and relationships, requires an interdisciplinary approach and new research dynamics. In the pursuit of these objectives, the landscape planning, management and control instruments are gradually being updated, integrating new strategies with traditional policies aimed at including such elements as perceptual components, landscape connection networks, visual values and enhancement of the scenic-perceptive aspects [9]. The concept according to which the aesthetic value was considered a subjective element, and therefore irrelevant for public policies, is now in fact considered obsolete. At present the study of scenic aspects and of visual impacts are fundamental factors in the approach to a territory, as elements which, when integrated with cultural and environmental factors, promote the expressiveness of a landscape, its recognisability and the expression of its values.
Planning rules provide analysis methods and indications for the daytime images of a territory. However, the contemporary social habits involve the night hours much more than in the past, thus promoting a continuous use of the territory.

Over the decades, lighting from a simple infrastructure has become one of the main components of an urban project; nevertheless, this innovative reflection is limited, in most cases, at the physical borders of the cities. The territory surrounding the cities and the variety of urban landscapes are absent from the nocturnal imagery [10].
The relationship between landscape and lighting has been the subject of several studies [10, 11], which have in particular been conducted in France since the 1990s, aimed at rediscovering the importance of the nocturnal image of the landscape and at introducing new ideas to the cultural debate. The central role of landscape in enhancement policies has emerged from these researches and the need to manage the definition of the nocturnal image with sensitivity, in order to avoid the generation of unsuitable images of the context [10].

2. Light and cultural landscape

2.1. The role of lighting

Lighting design practices have undergone an evolution over the years, mainly as a result of the technological progress that has been made, but also due to cultural and social phenomena [12]. Until the 1980s, a functionalist attitude toward public lighting was widespread: its contribution was only linked to street lighting, in order to ensure the maintenance of the minimum levels of safety. The attribution of exclusively functional roles to lighting initially prevented the development of a critical reflection on the design of the nocturnal image of cities. From the 1980s, first in France and gradually in the rest of Europe, the concept of artificial lighting began to go beyond the limits of street lighting to become a cultural issue [13]. The concept of "urban lighting", aimed at satisfying qualitative as well as quantitative requirements, was born. Light became an instrument that could be used to communicate the city, a tool of social aggregation, guidance and orientation. This approach was initially limited to the illumination of the most significant elements of the urban scene: monuments [14]. Later, the need to include architecture in its wider urban context in order to generate a nocturnal reading of the overall system and to improve the usability and the quality of urban spaces, became evident. This new approach led to the study and definition of new lighting functions that are closely linked to urban planning [15, 16].
From a legislative point of view, lighting choices are regulated by European standards, which are implemented at a national level. Rules provide functional lighting parameters, that have to be respected, in order to guarantee road safety (EN 13201:2015) [17] and indications about the control of light pollution (CIE 126-1997) [18]. As far as the containment of light pollution is concerned, further limitations are introduced by regional laws. Indications regarding the energy consumption of public lighting plants, to ensure the sustainability of the interventions, are expressed in European communications concerning public facilities [19], and are implemented in the different National States. In Italy, these indications are reported in the document on Criteri Ambientali Minimi [Minimum Environmental Criteria] (CAM) [20], as an integral part of the National Action Plan for environmental sustainability of public administration consumption - Green Public Procurement (OAN GPP) [21], to which all Public Administrations must comply.
In each national State, in addition to the international legislation, specialised associations operate in order to raise the awareness of the culture of light, to collaborate in the development of standards and regulations and to disseminate periodic recommendations and guidelines. Among these, AIDI (Associazione Italiana di Illuminazione) operates in Italy; A.F.E. (Association Française de l'Eclairage) in France; I.L.P. (Institution of Lighting Professionals) in the United Kingdom; LiTG (Lichttechnische Gesellschaft e. V.) in Germany; NSVV (Nederlandse Stichting voor Verlichtingskunde) in the Netherlands; ibe-biv (Institute Belge de l'Eclairage) in Belgium; the "Comité Español de Iluminación" in Spain.
National laws also provide operational procedures and tools for the lighting design of outdoor spaces. In Italy, the Piano Regolatore dell'Illuminazione Comunale [General Plan for Town Lighting] (PRIC) was introduced at the end of the 1980s, to overcome the lack of a tool for the planning, implementation and management of urban lighting. PRIC is a planning tool that was drawn up by the municipal administrations to establish the requirements, restrictions and prescriptions regarding lighting characteristics for public and private lighting system projects throughout the municipal territory and to regulate new installations, in order to reduce light pollution, save energy and enhance the area.
In France, which is one of the most authoritative countries in providing models for a systematic and creative approach to lighting, the planning of lighting interventions may use different tools. The main instruments are the guidelines provided by S.D.A.L. (Schéma Directeur d'Aménagement Lumière), the directives of the Plan Lumière (when the aim is the specific enhancement of the historical-cultural heritage) and the operational guidelines of the "Cahiers des charges".
The study of sectoral legislation shows that, in most cases, quantitative requirements regarding such functional aspects as safety, the containment of energy consumption and limitation of light pollution are provided. However, the decisions concerning the qualitative and communicative aspects of light are delegated to the designer.
In addition, the criteria adopted for the lighting project of widespread cultural heritage sites coincide with those dictated by the functional requirements or those that are associated with the architectural lighting interventions of single monuments and buildings. In other words, there are no indications on how to guarantee the enhancement of the nocturnal image of the cultural landscape as a whole, through criteria that allow the construction of a harmonious image, as a result of a targeted project using a coordinated language.

2.2. The nocturnal images of the cultural landscape: the state of affairs

In order to investigate the current state of lighting in landscape contexts, a preliminary critical analysis of the present situation was conducted. The aim was to obtain knowledge on the state of affairs in territories with strong landscape connotations, characterised by widespread settlements or villages and therefore of widespread heritage importance [22]. Some positive examples emerged from a first analysis, at an international level, such as the lighting project for the Mont Saint Michel site (figure 1), developed by the Light Cibles Studio [23]. In this case, a careful lighting planning has defined a nocturnal image that is evocative of the specificity of the place and which is able to enhance the architectural and landscape characteristics of the site. Nevertheless, apart from a limited number of virtuous cases, which show how the skilful use of light can generate a nocturnal reading of the landscape, numerous cases of the absence of night-time image design emerged.

Figure 1

In Italy, the historical and cultural value of widespread heritage is of undisputed importance and has been the subject of national awareness raising policies [24]. The complexity and diversity of these contexts is also well known and this constitutes an important cultural resource.

In this research, the current image of the sites and the visual impact, as determined through the artificial lighting conditions, has been identified as a first fundamental step of investigation.

The analysis was conducted through a collection of nocturnal photos, thanks to which an overview of different and representative cases distributed throughout the national territory was obtained. The survey was developed for cognitive purposes and was therefore not intended to be exhaustive of the entire complexity of the Italian landscape, but to allow some critical reflection.

Figure 2 shows an example of the collected images, related to different contexts identified throughout the national territory. The analysis of the images made it possible to draw up some initial critical considerations from which the following emerged: (i) in most cases an attention to the study of a nocturnal image is absent and artificial lighting is limited to specific actions or it is only delegated to street lighting. (ii) The absence of a strategy that is able to connect the settlements and the landscape in a coordinate system. The consequence is the lack of an overall perception of the settlements and of the context, where only some elements, considered to be the most significant, are highlighted. In most cases, this strategy involves discomfort in the general perception of the site and an excessive and annoying luminance contrast. (iii) Heterogeneity in the use of light sources characterised by different colour temperatures. The problem is not the use of non-uniform colour temperatures, since the variations are not the result of design choices, but rather the result of uncoordinated interventions. (iv) as far as the optical characteristics of the luminaires are concerned, in many of the analysed cases, it was possible to observe that the ambient lighting of a settlement was not the result of dedicated lighting, but the effect of the diffusion of a light beam from street lighting.

Furthermore, many municipalities are undertaking the renovation of public lighting system, by substituting the existing luminaires with LED technologies to increase the energy efficiency, reduce the maintenance costs, while improving the lighting performance [25]. This renovation process may further influence the nocturnal lightscape, with effects that can be either positive (increase of the light colour rendering) or negative (change in light chromaticity and distribution). LED luminaires are characterized by high efficient optics, designed in order to reduce the dispersion of light flux beyond the surfaces for which light is required (i.e. the carriage for street lighting); consequently, the light pollution and the unnecessary energy consumption can be reduced. On the other hand, the reduction of spread light from LED luminaires could have consequences on the perception of the urban context from both interior and exterior observation points, as it could reduce the lighting of vertical surfaces (i.e. facades of the buildings). A further issue with regard to retrofitting

urban lighting systems with LED sources, in particular for historical urban settlements, concerns the color qualities of the light sources. Often, the luminaires replacement implied to change from warm white light with low color rendering index, typical of high-pressure sodium systems (2500K), to much colder white light (about 4000K) with higher color rendering index. These types of retrofitting interventions might rise questions related to the possible negative implications that the use of such a high correlated color temperature (CCT) could have on biological and circadian rhythms, as well as on the perception of architectures and landscape. To respond to these criticalities, technological evolution has made it possible to expand the available LED technologies, and today LED sources with 2200 K CCT, which simulate the perceptive effect of high-pressure sodium systems, improving color rendering and energy efficiency can be used in the retrofitting interventions.

From the analysis of the current situation, it emerges that, in most cases, there is a general lack of attention to the nocturnal design of the image of the cultural landscape. Obviously, it would be impossible to illuminate all the elements of the territory; however, innovative strategies could be directed towards creating lighting scenarios, based on the definition of a specific nocturnal image. This kind of studies concerning new strategies aimed at the definition of a coordinate nocturnal image of the cultural landscape could be applied in many national and international contexts, improving the environmental quality and the touristic attractiveness of the sites.

Figure 2

3. Research method

3.1. Research aim

Based on the preliminary analysis of the current state of lighting, a research project on the nocturnal image of territorial contexts with variable morphological characteristics, that is, of small urban settlements and widespread architectural assets, was launched. The research project is aimed, on one hand, at raising the issue and promoting the debate on the topic, and, on the other hand, at defining design tips and guidelines for the definition of the nocturnal landscape image. The proposal of design guidelines will result from the assessment of the current nightscape, carried out through both qualitative and quantitative analysis.

Within this frame, the aim of this paper is to describe the research method that has been conceived to address the analysis of the nocturnal landscape image, to present the case study that was selected for the application of the research method and to provide some preliminary results referred to the application of the early stages of the research methodology.

In defining the case study, attention was paid to the extra-municipal scale, considering systems and relationships between landscapes, settlements and architectures. The analysis was limited to the Italian context, and in particular to territorial morphologies that guarantee visibility and visual relationships from multiple observation points, not only inside urban settlements but above all outside them, in correspondence to road networks and relevant places of use of the territory.

The results obtained in the first phases of the research project are fundamental in order to critical evaluate the current lighting condition and to provide qualitative (visual survey) and quantitative (acquisition and elaboration of instrumental data) indications for the definition of design guidelines.

3.2. Methodological approach

The methodological approach conceived for this research project can be divided in three phases as described in figure 3.

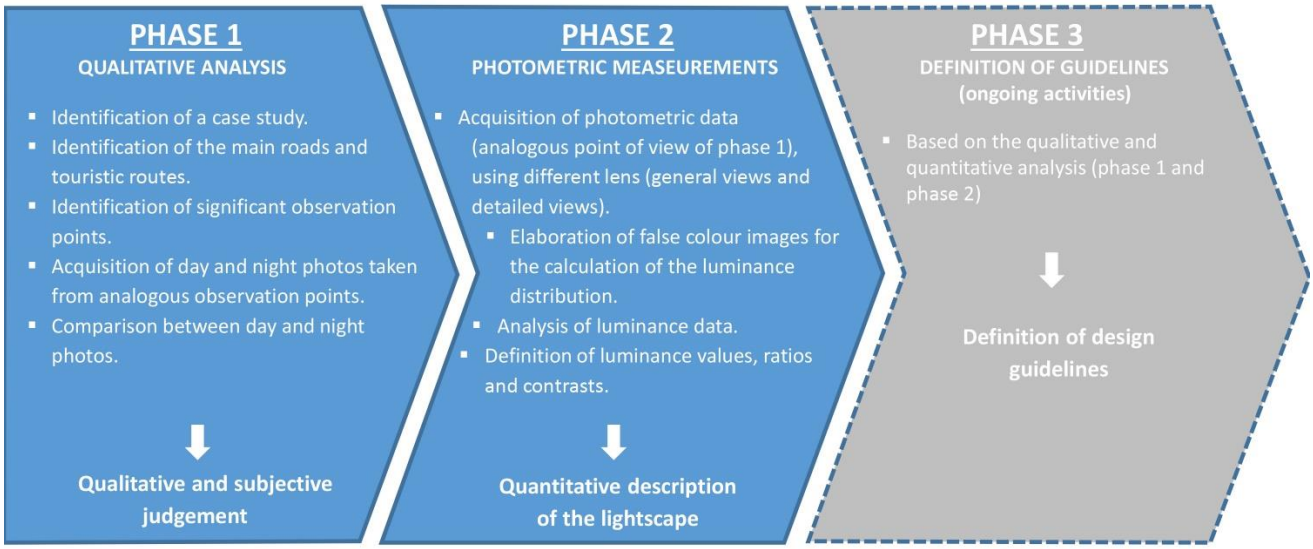

Figure 3

The first phase of the proposed methodology is aimed at the collection of qualitative data. Photographic investigations can be carried out in order to investigate the image of some representative case studies of recurrent territorial situations. The survey is conducted by comparing day and night photographs taken from analogous observation points, similar to those of the general public that frequent these sites.

The identification of the observation points from which to analyse and subsequently define the nocturnal image of the widespread heritage had to take into account different users and paths. Internal and external observation points are important for local users along daily use paths. Observation points for tourists are located along approach roads, scenic routes, lookout points, as well as in or near the settlements. The analysis was focused on human perception and it was therefore decided to limit the selection to images taken from real views, accessible to users.

The second phase is an *in situ* measurement campaign, carried out in order to obtain quantitative data on the current lighting condition. The collection of photometric data is necessary to define the luminance ratios and contrasts, as indications of the current condition, which are useful to compare data on different sites and to develop critical considerations and the subsequent design proposals.

The analysis can be conducted by means of luminance measurements, because this is the most representative photometric measurement of the brightness perceived when an object or a set of illuminated objects are observed [26].

In this study, an "LMK Mobile" TechnoTeam videophotometer (based on a Canon EOS digital camera) was used in the measurement campaign to evaluate the luminance distribution of the considered areas. In the acquisition phase the valid calibration range of the videophotometer (ISO values 100-400; aperture values in a range from f4 to f11) were respected. Two kind of camera lens were used (17-50 mm and 70-200 mm), based on the same Canon EOS digital camera, in order to take images of the entire settlement and detailed images of selected areas or relevant buildings. TechnoTeam's software "LMK LabSoft" was used in order to acquire data from the camera, using the corresponding calibration file, and to convert pictures into luminance distributions. Results were expressed as false colour images, representative of the luminance distribution into the framed area.

The third phase of the research project, which is not subject of this paper, will concern the further elaboration and correlation of qualitative and quantitative data, in order to determine a set of data on which to ground tips and guidelines to support the lighting design for these territorial contexts.

4. Case study

4.1. Identification and description of the case study

The methodological approach conceived for the analysis of the diurnal and nocturnal images of the cultural landscape has been applied on a case study of a specific area in the Piedmont Region of Italy.

The Piedmont Region has promoted particular attention to the scenic aspects and to landscape connection networks in its local landscape management tools. These factors are linked to the theme of the perception of the landscape, its

recognisability and the expression of identity values [27]. These objectives are outlined in the Piano Paesaggistico Regionale [Regional Landscape Plan] [28] and, in particular, in the attached Linee guida per l'analisi, la tutela e la valorizzazione degli aspetti scenico percettivi del paesaggio [Guidelines for the analysis, protection and enhancement of the landscape characterteristics] [29]. The tools provide guidance to help understand and manage the relationships and links between the components of the landscape, which are related to cultural and environmental values that define the local identity. These indications, which currently refer to the day images of the places and the management of the interventions, could benefit from the parallel definition of a methodology for the definition of the nocturnal images of the same sites. The Piedmont region, in addition to the previously cited laws, has recently updated a Regional Law [30] in order to reduce light pollution.
The territory identified as the case study is the Langhe-Roero and Monferrato vineyard landscape (figure 4). Some widespread settlements in this site were chosen as the focus of the analysis.

Figure 4

The selected site is recognised as a cultural landscape and has an undisputed environmental and cultural value at an international level, which can be confirmed from the UNESCO recognition of 2014 [31]. It is a serial site, which is called the *Vineyard Landscape of Piedmont: Langhe-Roero and Monferrato* [32, 33], and it is composed of six components that are protected by a buffer zone.
As it is possible to read in the description of the Serial Nomination [34], the property, which has a relatively homogenous tonality of landscape, covers a great diversity of features pertaining to its composition and its winegrowing and winemaking activities. The landscape is dotted with farms, winegrowers' huts (*ciabot*), isolated winegrowing farms, villages, which are often perched on high ground, larger towns on the edge of the vineyards, castles, Romanesque churches and ancient monastic buildings.
In the Justification of *Outstanding Universal Value* [34] it is possible to read that the site constitutes an outstanding and emblematic cultural landscape of particularly harmonious hillside vineyards and it bears testimony of a deep and long-established relationship between man and his natural environment. The property contains highly diverse built components, which provide a large number of significant landmarks in the vineyard landscape and in the urban village settings.
The area was chosen as a case study because it presents interesting characteristics from both the point of view of the recurrent morphology of the settlements [35], which are mainly characterised by a circumscribed village in a prominent position, and because of the value of the surrounding landscape. These elements were considered the premises for a project methodology which is aimed at the night-time enhancement of the sites that enjoy privileged visibility and inter-relationships between the settlements, the landscape context, and the viability system and tourist circuits. The site, also because of the UNESCO recognition, enjoys excellent tourist visibility and good accessibility. The flow of tourists is distributed throughout the year, particularly during local events. The site is equipped with a network of fast connection infrastructures that ensure an easy accessibility to the settlements. Moreover, in the area there are many touristic paths, marked and published in the main touristic guides.

4.2. Results

An area was chosen within the Langhe and Roero territory to which the methodological approach was applied. The portion of the territory includes some municipalities that are located in prominent and significant positions, from the touristic and use of the territory points of view. During the choice of the observation points, reference was in particular made to the Piedmont Regional Landscape Plan. The municipalities so far included in the analysis are: Govone, Magliano Alfieri, Guarene, Barberesco, Neive, Roddi, Grinzane Cavour, La Morra, Castiglione Falletto, Barolo and Serralunga d'Alba (Figure 5).

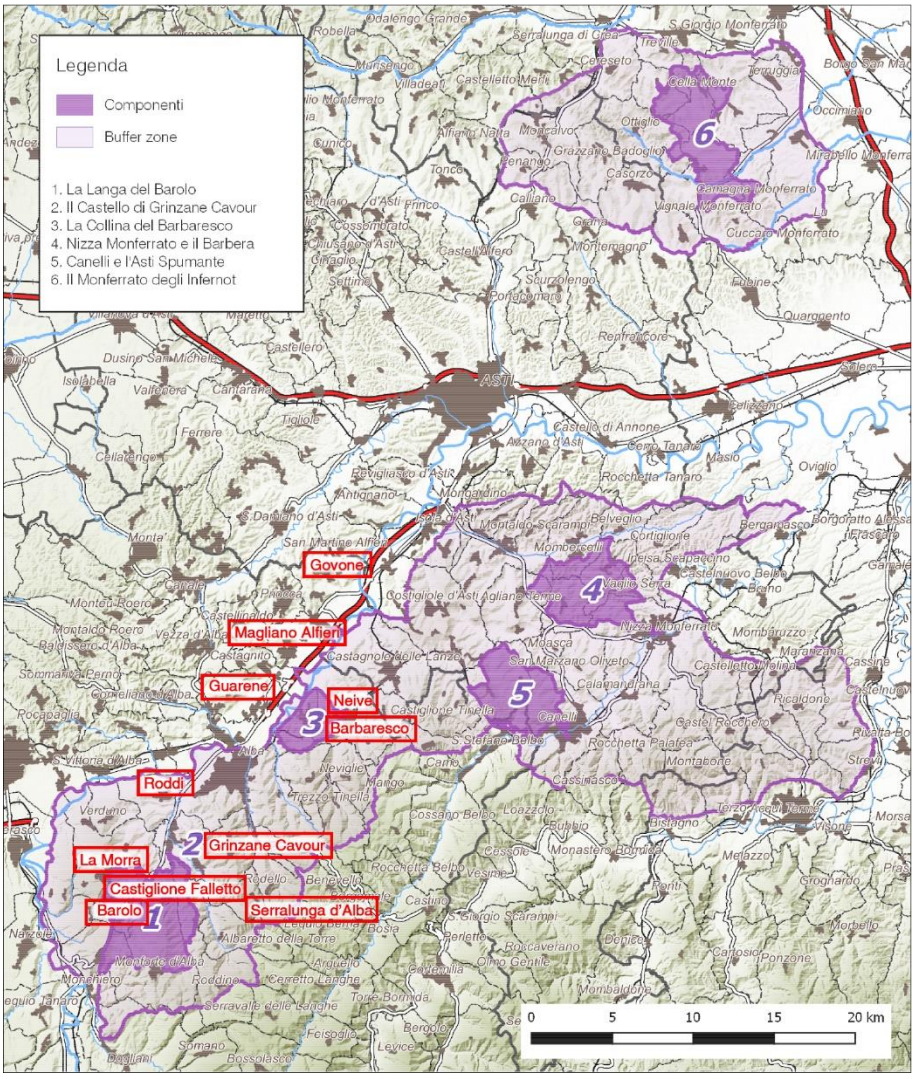

Figure 5

Some of the results relative to the municipalities of Govone and Neive are presented in this paper as examples.

The first phase foresaw the direct observation of the sites, and this involved a comparison of photographs taken both during the day and at night (Figure 6, 9), from the same observation point, as these sites were considered representative of the relationship between settlement, architectonic goods and landscape context. In the analysis, the considered observation points were all located along the main road and tourist routes in the territory. The research was related to the traffic system and tourist circuits, in order to connect the study to strategies for the enhancement and promotion of the territory, which could achieve new resources through the design of the nocturnal image of the sites.

The analysis confirmed the problems that had already emerged in the preliminary analysis carried out to asses the state of affairs at a national level. However, the comparison between the day and night images and the choice of the observation points made it possible to draw up more detailed considerations based on the direct knowledge of the chosen case study.

Day and night images, taken from two observation points, are reported as far as the Govone case is concerned. Observation points outside the urban settlement were chosen in correspondence to the access road networks to the municipality (Figure 6, 7).

Figure 6

Figure 7

From an analysis of the photographs, the presence of a specific lighting of certain significant elements of the urban scene, including the castle and the parish, emerged. By considering observation points outside the urban context, it was possible to observe how some of these elements, the bell tower for example, are only lighted on one side, that is, on the façade of the church, thus making this element clearly visible from one of the access roads to the municipality (Figure 7), but barely visible from the second access road (Figure 6). This clearly makes it evident that the logics behind the design of the lighting were only based on observation points inside the settlement. On the other hand, the castle is well-lit and clearly visible from various points of view, even from outside; however, the excessive lighting of the whole building, obtained with cold light sources and opposed with an almost inexistent lighting of the surrounding settlement, renders the overall image unnatural and creates a non-uniform and non-coordinated perception of the system as a whole.
In the case of the Neive municipality, for which two views taken from distant points outside the settlement are also reported (Figure 8, 9), a critical situation of the overall system has arisen at a perception level.

Figure 8

Figure 9

In correspondence to one of the access roads (Figure 8), the lighting of just the façade of the castle has determined a lack of perception of the other historic components and of the settlement itself. From the second observation point (Figure 9), the spot lighting of only some buildings and the uncoordinated use of colour temperature of the light have clearly emerged. Such a choice, which was presumably dictated by the different functional requirements of the buildings themselves, become critical when the overall nocturnal image of the system is considered from observation points outside the municipality.

From the first phase of qualitative analysis, based on the comparison between day and night images of two municipalities of the case study, some different information about the characteristics of the settlements from different observations points emerged (i.e. different level of visibility, excessive lighting of some buildings, etc.)

The second phase, aimed to quantitative analyse the nocturnal lighting conditions, foresaw the creation of luminance images, taken from the exact same observation points as the day and night photographs, in order to analyse the luminance distribution as perceived from outside the settlement (Figure 10). A preliminary analysis of the objective data confirmed the problems encountered at a perceptive level, and in particular highlighted the presence of strong luminance contrasts due to over-illuminated artefacts or part of artefacts beside buildings or part of settlements whose vertical surfaces are scarcely illuminated by the urban lighting.

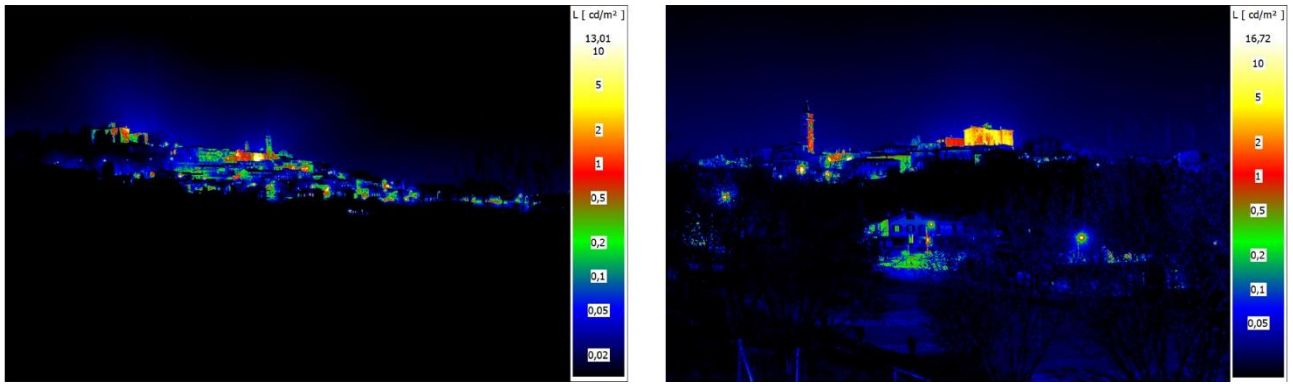

Figure 10

The collected data are presently undergoing further elaborations. Expected results concern the elaboration of the luminance images in order to extrapolate luminance values (maximum, average and minimum), define luminance hierarchies, evaluate luminance distributions and luminance contrasts within the perceived scene. The objective of this second phase is to identify, from the present conditions, quantitative data (luminance values, ratios, etc.) that, connected to the results of the first phase (subjective assessment of the day and night images) can help identifying positive and negative case records in order to draw up tips and guidelines for a design approach of the nocturnal image of the widespread patrimony (third phase).

5. Discussions and conclusions

From the analysis on territories with strong landscape connotations it is possible to conclude that there are numerous and different areas where the morphology determines a relationship between widespread cultural patrimony (e.g., hamlets, historical widespread settlements, etc.) and observation points along touristic and other roadways. This visual interrelation also makes the perception of the widespread patrimony possible during the night hours and from observation points outside the settlements.

The analysis of the current state has also pointed out that, at present, in most cases, there is a lack of attention to the definition of the nocturnal images of sites that can be used to create a system of the settlement, the most important architectures and the surrounding landscape context.
The results of the preliminary analysis presented in this paper support the hypothesis that an innovative approach to the lighting of these territorial contexts is necessary. In fact, considering what is expressed in the indications and standards at both a national and international level, it is now necessary to identify valorisation strategies that consider all the hours of life of goods, and which also pay attention to the nocturnal perception of the cultural landscape. According to this point of view, artificial light could be set up as one of the instruments of a valorisation project, and it could supply a significant contribution by facilitating the use of a site and defining its nocturnal image, with positive effects on the promotion of the territory and on touristic visibility. The estimation of financial earnings that could derivate from this kind of operation is out of the scope of this paper. Anyway, as some studies demonstrated [36], through nightscape projects it will be possible to perform night tourist activities and to enhance the touristic attractiveness of a site.
The definition of a nocturnal image involves both technical and cultural aspects and, like any other anthropic intervention on the landscape, requires an integration with and comparison of the meaningful cultural, social and environmental values of the site. Within this framework, a methodology to study the nocturnal image of territorial contexts with variable morphological characteristics has been conceived. The study is aimed at defining tips and guidelines for enhancing the nocturnal image of widespread cultural landscapes, which include monuments, villages with different historical stratifications, contemporary settlements, etc. In particular, the attention is focused on the image perceived from external points of view, as it contributes in providing information about the cultural value of the territory to people who approach the area.
The methodology that has been set up consists of two analysis phases (qualitative and quantitative) and a phase of data elaboration for the proposal of design tips and recommendations.
The preliminary results obtained from the application of the qualitative and quantitative analysis to some observation points of a specific case study demonstrated that the daily and night-time images provided different information about the characteristics of the settlements (i.e. some parts of the settlement are perceived from a point of view and not from another; single monuments attract the attention at night, while the whole settlement is perceived during the day; etc.). Furthermore, it demonstrated that the luminance images can be useful to translate into quantities the subjective impressions derived from the comparison between day and night pictures.
From the full implementation of the methodology on a larger sample of case studies, it is expected to achieve the following results. From phase one, a number of "perceptive criteria" to evaluate and compare the daily and night-time images can be extracted. As an example, criteria such as "*visibility*", "*standing out*", "*relation with the settlement*" could be identified for the images (Figures 6, 7, 8, 9). From phase two, some luminance metrics useful to describe le luminance distribution over the area of interest can be derived (i.e. maximum, mean and minimum luminance values, dispersion values, luminance contrasts, identification of luminance classes, etc.). In phase three, the elaboration and correlation of quantitative and qualitative data (perceptive criteria versus luminance values, contrasts, hierarchies, etc.) will be used to form the basis of design tips and recommendations for the definition of the nocturnal image of the cultural landscape.
Despite the evidence of the importance of a more conscious design of the night-time perception of the cultural landscape, it is also clear that the proposed approach may increase the level of complexity of the lighting design. Nowadays the outdoor artificial lighting design is based essentially on functional requirements, to ensure road safety, and on energetic and economic-environmental requirements, in a perspective of energy saving, reduction of the maintenance costs and limitation of light pollution. In case of urban lighting, a design able to integrate functional and safety aspects as well as aspects relating to the increase in value of the towns' architectural and monumental heritage is also required [37]. Based on these indications, the current urban lighting systems are designed to comply with the functional requirements for street lighting or to enlighten the main monuments and buildings in the cities. The proposed approach might introduce a new "layer" in the lighting design, which considers widespread heritage sites and points of view of external users. The outcoming tips and guidelines will provide additional indications with respect to the current approach. In particular, they could integrate the existing requirements (related to functional aspects, architectural lighting and internal users' needs) with new requirements aimed at providing a nocturnal image of the sites, also from external points of view.
This kind of approach should have consequences in the design of the lighting systems, in the uses of the territory and in the perception of the landscape.
The current urban lighting systems will have to be implemented or partially re-designed to provide the expected light on the horizontal surfaces (road lighting) and, to a certain extent, also on vertical ones (buildings' façades), to create an adequate image from external points of view. At present, the renovation of public lighting systems is among the measures that municipal administrations are adopting to reduce their expenditure budget and increase the city's environmental sustainability. These retrofit interventions of public lighting with LED technologies are mainly based on energy and economic-environmental requirements, thanks to the potentiality the new lighting and control technologies offer in the perspective of energy saving and reduction of the maintenance costs. In fact, as explained above, LED luminaires are characterized by optics designed in order to reduce the dispersion of light flux beyond the surfaces for which light is required (i.e. the carriage for street lighting), limiting the spread light. The proposed design guidelines will introduce new

elements in the lighting design process and will imply that the renovation of lighting systems should be managed considering also luminance values and contrasts of vertical surfaces. These indications, as well as the current requirements regarding the safety and the limitation of light pollution, should be considered in the design of the lighting system and in the selection of luminaires characteristics.
This kind of design approach could have consequences also on the landscape. The introduction of new policies able to consider the widespread heritage as a system, if adopted in large portion of territory, could define a more articulated and coordinated nocturnal image of the cultural landscape.
Moreover, new lighting strategies could influence the users and the uses of the territory. The design of the night-time image of widespread settlements and cultural heritage sites, based both on functional and enhancement requirements, could improve the lighting quality inside the settlements and the cultural value of the territory. Finally, attention on external points of view could contribute in the enhancement and on the promotion of new tourist strategies based on external routes.
The method that this study proposes anyway shows some limitations, in particular related to the first phase of qualitative analysis. The comparison between day and night photographs taken from analogous observation point could provide variable results depending on the day and on different times of the day in which the photographs were taken. However, this phase consists on a subjective analysis, aimed at acquiring qualitative data in order to evaluate the different day and night appearance of the same site and to elaborate considerations on the coherence between day and night image. The inevitable variation due to photos taken in different conditions should not lead significant variations in the analysis. In the second phase of instrumental analysis, the acquisition of photometric data is bound to the use of a photometric instrument able to evaluate the luminance of the scene. Furthermore, today there are several tools available for the acquisition of photometric data of luminance.
The methodology we are currently setting up is intended to join perceptive requirements, connected to the valorisation of a landscape, even during the night hours, with functional requirements, connected to safety and the reduction of electric consumption pertaining to the lighting and to the limiting of light pollution. A constructive interdisciplinary dialogue has been started in order to involve the organisations that work at a territorial level (i.e. local administrations, organisations assigned to the management of the territory, heritage offices, cultural associations, etc.). In this way, it is hoped to encourage the development of strategies that will overcome the perception connected to municipality boundaries to arrive at a more articulated and coordinated extra-municipality view, shared by several subjects and connected to the valorisation circuits of the cultural landscape. This in fact does not mean more lighting, but rather lighting in a more informed, sustainable and coherent manner in order to guarantee the correct use of the widespread patrimony and not of an isolated patrimony.
The authors intend to continue the study by extending the quantitative analysis to a significant number of samples in order to validate the analysis methodology considering a significant number of cases, in particular testing the analysis methodology in the municipalities of the case study. The elaboration of data and the extrapolation of luminance distributions, luminance contrasts and luminance hierarchies in the perceived scene will be used to form the basis of design guidelines for the definition of the nocturnal image of the cultural landscape.

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Figure captions

Figure 1 - Mont Saint Michel, France, night images. Lighting project: Light Cibles, Louis et Emmanuel Clair, 2006

Figure 2 - Examples of analysed images, related to different contexts identified throughout the Italian territory. Photographs show that, in most cases, there is a general lack of attention to the nocturnal design of the image of the cultural landscape
a) Bellagio, CO, Italy. (Ph. by Roberto Marasco, available via https://www.touringclub.it/borghi-ditalia)
b) Pitigliano, GR, Italy. (Ph. by Lara Lazzeri, available via https://www.touringclub.it/borghi-ditalia)
c) Ragusa Ibla, RG, Italy. (Ph. by Guido Paoli, available via https://www.touringclub.it/borghi-ditalia)
d) Murazzano, CN, Italy. (Ph. by Alessandra Manassero, available via https://www.touringclub.it/borghi-ditalia)

Figure 3 - Description of the methodological approach

Figure 4 - The Vineyard Landscape of Piedmont: Langhe-Roero and Monferrato.

Figure 5 - Boundaries of the UNESCO serial site "the Vineyard Landscape of Piedmont: Langhe-Roero and Monferrato". The municipalities included in the survey were highlighted in red.

Figure 6 - Comparison of day (a) and night (b) photographs. Municipalities of Govone, CN, Italy.

Figure 7 - Comparison of day (a) and night (b) photographs. Municipalities of Govone, CN, Italy.

Figure 8 - Comparison of day (a) and night (b) photographs. Municipalities of Neive, CN, Italy.

Figure 9 - Comparison of day (a) and night (b) photographs. Municipalities of Neive, CN, Italy.

Figure 10 - Luminance distribution expressed as a false colour images (see figures 5 and 6). Municipalities of Govone, CN, Italy.

Notes

Colours should be use for any figures in print