THE FOREST OF SAN PEDRO IN THE ALHAMBRA OF GRANADA: THE VISUAL CONCEALMENT OF HISTORIC MONUMENTS BY TREE VEGETATION

OCULTACIÓN VISUAL DE MONUMENTOS A CAUSA DE LA VEGETACIÓN ARBOLADA: EL BOSQUE DE SAN PEDRO EN LA ALHAMBRA DE GRANADA

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RESUMEN Se presentan una metodología y una herramienta de visualización objetiva, basadas en tecnología SIG, para el control, gestión y ordenación de masas vegetales de significativa función paisajística, que, por altura, volumetría y posición, puedan perturbar la percepción visual de la arquitectura de un monumento. Se analiza el caso concreto del bosque de San Pedro en la Alhambra de Granada (España). El objetivo del método es lograr un equilibrio entre el papel protector y ornamental de la vegetación sin ocultar visualmente los elementos arquitectónicos más relevantes del Conjunto Monumental. El modelo permite estimar la repercusión paisajística de la actuación, traducida en la superficie de la ciudad que vuelve a recuperar vistas sobre la arquitectura del monumento.

PALABRAS CLAVE Tecnología SIG; arbolado; percepción visual de monumentos; paisaje

ABSTRACT In this work, methodology and tools for objective visualization are presented. They are based on GIS technology for the control, management and organization of vegetal masses with a relevant landscaping function which, because of their height, volume and location can disrupt the visual perception of the architecture of a monument. Special attention is paid to the forest of San Pedro in the Alhambra of Granada, Spain. The goal of this method is to emphasize the protective and ornamental role of vegetation while controlling it so that it does not hide the most relevant architectural elements of historic monuments. The model permits an evaluation of the impact on the landscape of an intervention, making it possible to recover views of the architecture of the monument from the city.

KEYWORDS GIS; trees; visual perception of monuments; landscape

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INTRODUCTION

The forest of San Pedro is a tree-filled space of 4.2ha located on the slope to the north of the Alhambra. It is made up of 1,024 trees belonging to 21 different species. The predominant tree species is the European nettle tree (*Celtis australis* L.), which represents 66% of the total. After it, with percentages lower than 10% comes the wild privet (*Ligustrum lucidum* W.T. Aiton), almond trees (*Prunus dulcis* Mill. D.A. Webb), ash trees (*Fraxinus angustifolia* Vahl), bay trees (*Laurus nobilis* L.), elms (*Ulmus* spp.), false acacias (*Robinia pseudoacacia* L.), Judas-trees (*Cercis siliquiastrum* L.,) and cypresses (*Cupressus sempervirens* L.), among others. The average density of the tree mass is 240 units per hectare. The tallest nettle trees reach a height og about 20 meters, and some of them have trunks of about 1 meter in diameter.

In addition to the countless environmental benefits that this wood generates, the appropriate management of it responds to two main objectives. The first one is related to its importance for erosion control on the slope. The second one is the relevant role that the trees play in the landscape of the Alhambra when viewed from the vantage points in the Albaicín and Sacromonte.

Nevertheless, as the Management Plan of the Alhambra and Generalife points out: "Ocassionally, the excessive growth of the vegetation interferes with the contemplation of the monuments."[4]

Once this problem was identified, in 2012, the Gardens, Forests and Orchards Department of the Council of the Alhambra and Generalife commissioned the development of a methodology for the management of those trees whose growth resulted in the visual concealment of the north façade of the Alhambra. The guidelines and conclusions of the study were later incorporated into a Intervention Plan in the San Pedro forest that the technical committee of the Council of the Alhambra approved in 2013. It was implemented between 2013 and 2017. The present work presents the methodology, tools and management proposals that were developed, together with the results that were obtained.

The method follows article 19 of Law 14/2007, November 26, 2007, governing Andalusian Heritage Assets, where the concept of "visual or perceptive contamination" is dealt with. This can be applied to a situation in which a mass of trees can disrupt the visual perception of a monument.[5]

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4. Villafranca Jiménez, M.M. and Salmerón Escobar, P (Directors), Plan Director de la Alhambra y Generalife, 2007-2015, Granada, Patronato de la Alhambra y Generalife, 2010, p. 375.
5. Ley 14/2007, 26 November, Patrimonio Histórico de Andalucía (BOJA, 248, December 19).

IL. 1. The Alhambra and San Pedro woods from the Mirador de San Nicolás, 2011

IL. 2. Digital orthophoto showing the points of observation of the study and the San Pedro woods, with an indication of the present designation of the planting areas

METHOD

Choosing the observation points

The first step in the method was to choose the observation points from which the Alhambra and the forest of San Pedro can be viewed. The reference in this case was the inventory of views of the historic monuments that had been elaborated by the Alhambra Heritage Preservation Plan[6].

The criteria used to select the observation points were the following.

- The Alhambra and the forest of San Pedro had to be visible from the observation point –the area that was the object of the study had to be included in the visual field of the observation point.
- There had to be a clean view from the observation point –no relevant obstacles could interfere with the view.
- The observation point had to be on public property and have free access.
- The observation point had to be well known and frequently visited by a large number of people –high visual consumption.
- And, finally, whenever possible, the view from the observation point had to be one that was recognized both historically and artistically –so, it had to offer touristic interest.

The minimal number of observation points that are needed to apply method is one (1). As for the maximum number, there is no limit, the appropriate number depends on the geographic and visual complexity of the territory that is the object of the study.

Ideally, the greatest possible number of representative observation points in the territory from which observation takes place should be selected. The more "representative" observation points are selected, the better and more precise the results obtained will be.

In this specific case, five observation points were chosen. All of them were well known and appreciated, quite consolidated as such, freely accessible, frequently visited and highly consumed by visitors to the city. Besides, they offered the kind of geographic representativeness that the method required since they faced the historic monuments and woods from different directions and were located at different heights. These observation points were the Mirador de San Nicolás, the Mirador de la Placeta de Carvajales, Plaza Nueva, the Paseo de los Tristes, and the Mirador del Camino del Sacromonte.

Digital model of the terrain

A visibility analysis must be based on a digital model of the terrain (MDT) including the area that is the object of the study as well as the observation points. The Instituto Geográfico Nacional's official MDT raster image of 5 meters per pixel was used, more specifically sheet 1009, which shows the urban nucleus of Granada (*MDT_5m*). Based on that model, a new digital model with a higher resolution of 0.1 meters per pixel was generated (*MDT_5m_10cm*). The aim of this was, on the one hand, to prevent the formation of steps on the relief that might derive from the 5 meter per pixel resolution. On the other, the objective was to get results that could make the analyzed elements sufficiently visible on a map. In this case, those elements were masses of trees that could hardly be studied with pixels equivalent to 5 meters, a size that is larger than some treetops.

On the other hand, the digital model of the historic monuments was also made by using the cartographic base of the Alhambra and Generalife in *shapefile* format. A MDT with a pixel resolution of 0.1 meters per pixel (*MDT_ALH_10cm*) was thus created. Because it was more precise within the Alhambra itself, this model updated the aforementioned one in order to create the definitive digital model of the terrain (*MDT_GEN_10cm*). This is the model that has been used to elaborate all the calculations and topological operations that were necessary to produce results with the present method.

Following this, the selected observation points were located on a plan by means of a digital orthophoto. They were later positioned in space (XYZ) by projecting the previous points on the *MDT_GEN_10cm*. In this way, a 3D layer (*PUNTOS_OBS*) was obtained that included the XYZ coordinates for each observation point.

Limit of visualization

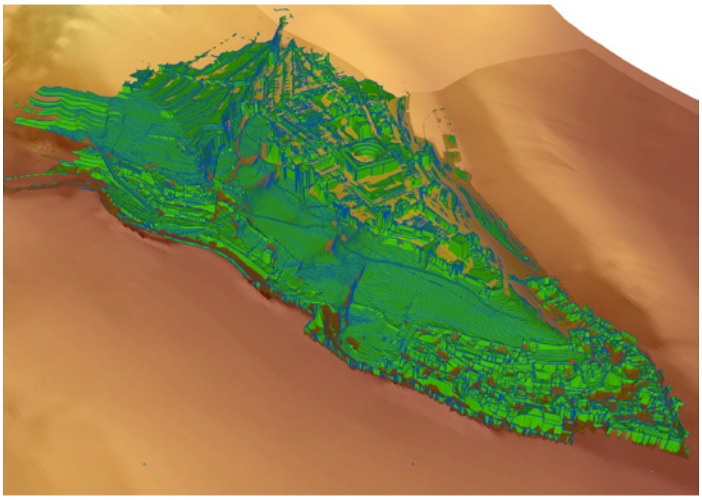
The variable around which the entire process of model-making and calculus tries to answer a question: "What is it that we would like to be seen of these historical monuments?" In this case the starting point is

6. García de los Reyes Arquitectos Asociados, S.L.P.U., Plan Especial de Protección y Catálogo del Sector Alhambra (unpublished), Granada, Patronato de la Alhambra y Generalife, 2010, pp. 249-375.

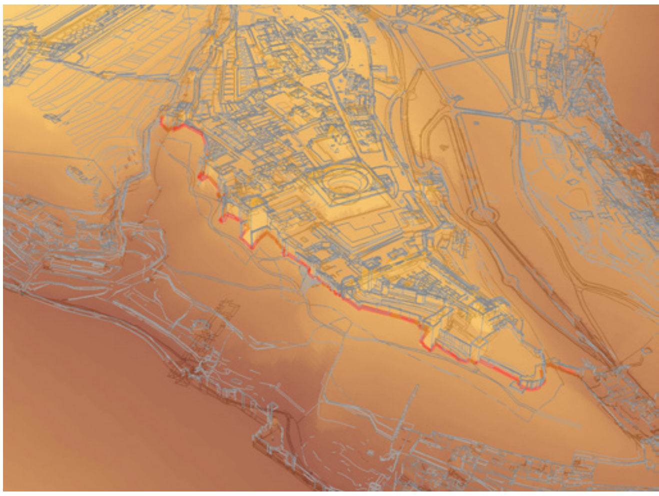
the most restrictive answer: "The whole of the architecture of the northern façade of the Alhambra has got to be seen." So, visual priority is given to the architecture over the vegetation of the woods.

Graphically, all of that is translated into the devising of a line that marks the visual limit of that which must be seen from the observation points. Such a line is defined as the "visualization limit" and, initially, it is drawn by means of a 3D polyline in CAD (LINE_BASE:DWG) that is simplified on a layer of 3D points (BASE_POINTS) by using the vertexes or those points where the line produces a significant inflection.

These 3D points, which will be called "reference points", delimit the object that is to be visually analyzed and, together with the observation points (vantage points) are used as a base for the inter-visibility study.



IL. 3. Digital Model of the Terrain with vectorial elements. MDT_GEN_10cm



IL. 4. Visualization limit. LINE_BASE

IL. 5. Visual line-ups. MDT_ (name of the observation point)

Visual line ups

This stage of the methodology involves the generation of planes (defined by triangles) from each observation point to all the reference points on the façade of the monument.

Previously, it was necessary to carry out a visibility study so as to find out the reference points that were visible from each observation site and discard those that were hidden. For this operation, the MDT_GEN_10cm was used, and raster coverage for each observation point was generated. Later, the visible reference points were selected by using the previously-generated visibility raster coverage. The operation was repeated for all the observation points and a layer was obtained for each, which was made up by just its visible points.

At this point of the process it is already possible to draw the line ups that connect the observation points with the visible reference points, forming triangles every two consecutive points.

The whole consists in a 3D fan-like surface of interlinked triangles. This topologic operation is repeated for each observation point so that *shape* coverages of 3D polygons are obtained.

From the perspective of landscape, these "planes" represent the spatial frontier. Any vegetation that might go over it will be concealing the visualization limit of the monument and, therefore, covering part of the built volume.

In terms of vegetation management, the planes establish the maximum height that the vegetation must reach so as not to interfere with the visual lines from the vantage point to the monument.

Since it was necessary to carry out operations with other raster coverages, a MDT of maximum vegetation heights was generated using the interlinked triangular planes as a base.

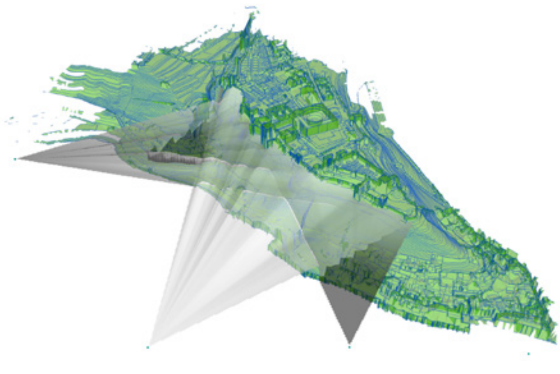
Raster of average maximum vegetation height

After the surfaces of the maximum tree height for each observation point were known, several questions rose:

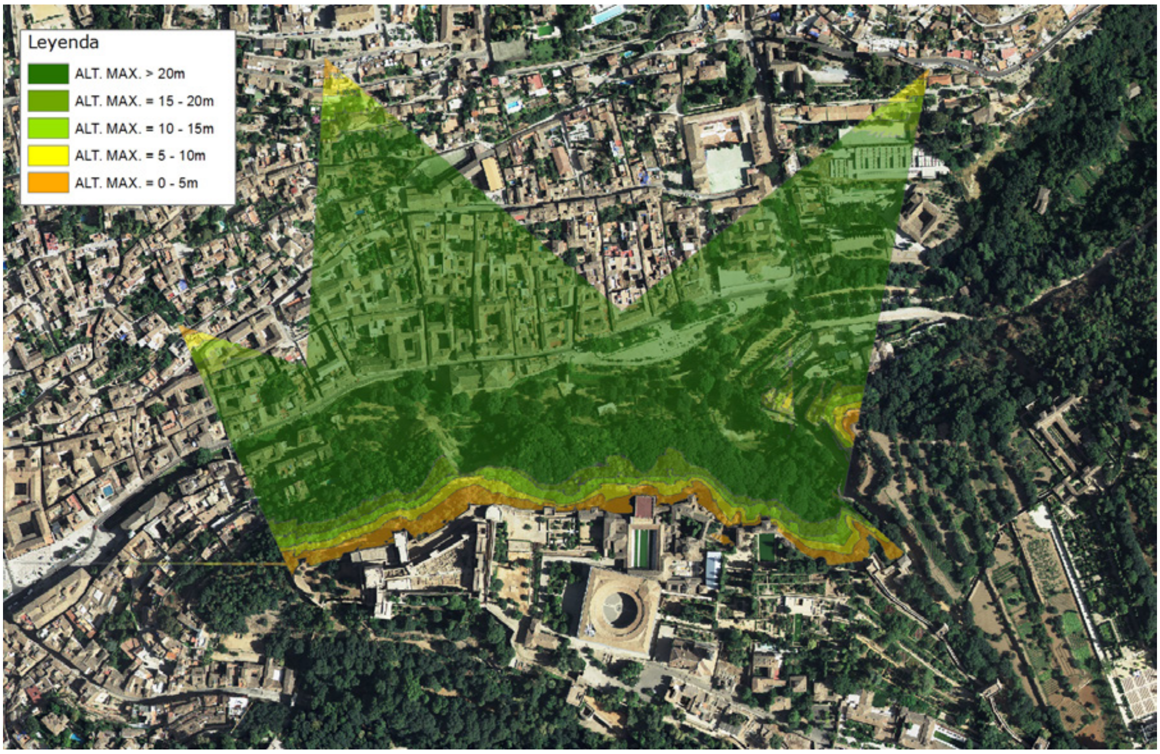
- Since the same tree may surpass the maximum height of several plane surfaces, which of those planes should be chosen for analysis?
- And why should only one plane be chosen and not all of them at the same time?
- Yet if all the planes are chosen, are all of them equally important or from some vantage points are the planes more relevant than others?

In terms of methodology, the dilemma was solved by using all the surfaces, although more emphasis was laid on the sites where "visual consumption"—that is, the total number of observers, was greater throughout the year. After applying the concept of "visual consumption", it was possible to come up with a "visual weight" for each of the surfaces. Then, with the help of a system of geographic information, calculations to determine an "average surface" were carried out.

In turn, the "average surface" made it possible to obtain the "raster coverage of average maximum height", which was a great achievement. Thanks to this raster it would be possible to establish planting areas (*rodales*) according to the maximum growth height.



IL. 6. Raster of maximum average height of the vegetation. Tridimensional. ALT_MAX_MED



IL. 7. Raster of maximum average height of the vegetation. Plan. ALT_MAX_MED

It must be pointed out that the precision of the model is not only in direct correlation with the number of observation points and their geographic representativeness but also with the precision of the data on visual consumption at the observation point. Because there is not a statistical record of the number of visitors to the Albaicín and its vantage points (*miradores*), the authors, taking their personal experience as a base, assigned the following visual consumption values to the observation points: Mirador de San Nicolás (= 4); Placeta de Carvajales (=1); Plaza Nueva (=1); Paseo de los Tristes (=3), and Mirador del Camino del Sacromonte (=2).

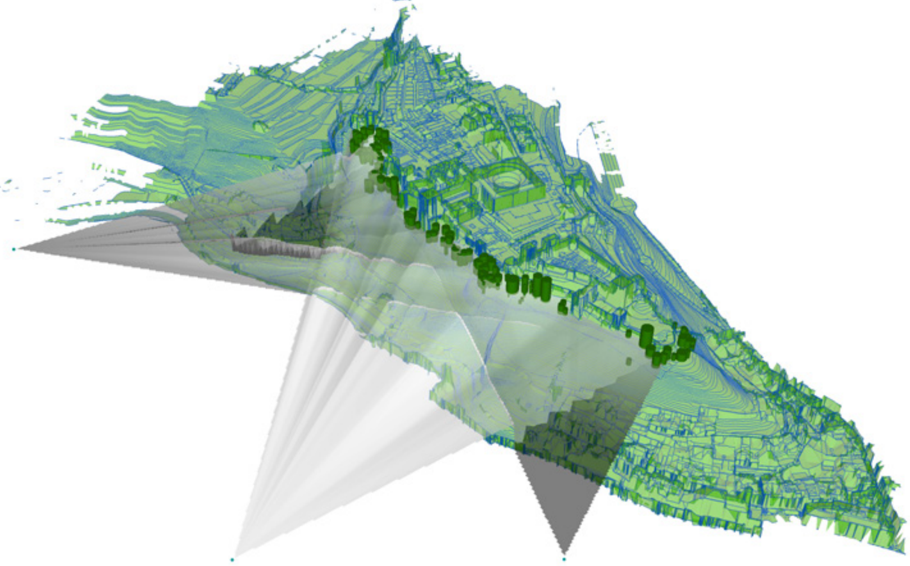
Because the larger wooded surfaces are very unevenly distributed in space, the whole number to be used as the divisor to establish the average was determined by analyzing the number of surfaces of the observation points that affect all the pixels of the area to be studied. In order to do so, an abbreviated procedure was used so as to prevent the generation of new coverages and the wasting of time on calculus operations. On the one hand, a surface (*SUMA_ALTMAX*) was generated on which the maximum-height values of all the observation points were gathered, multiplied by the visual consumption factor of each of them. On the other, a raster image with the maximum average height of the vegetation was produced (ALT_MAX_MED) by carrying out the division of the total addition of heights by the division raster previously calculated.

Projection of tree positions

The present methodology requires an inventory of the vegetation including the following variables: XY position, species (scientific name), girth of the trunk (in centimeters, information taken at a height of 1.3m), and maximum height of crown.

The inventory of the tree positions in the San Pedro forest was elaborated during the spring of 2013. The positions that included a trunk perimeter superior to 62 cm (trunk diameter=000=20cm) were inventoried. The total of inventoried positions was 1,024 trees.

IL. 8. General plan of the San Pedro forest with the inventory of tree vegetation



IL. 9. Intersection between the raster of average maximum height and the tree tops in the tree positions on the uppermost band of the San Pedro forest, which are represented as cylinders according to tree height and crown diameter.

The (XY) points corresponding to the inventory of the tree mass (Arbolado D20 Rodal 4 BA) were positioned in space (XYZ) by using as reference the *MDT_GEN_10cm*. A new "z" field was generated with the value of the height at which each tree base was located. A 3D coverage of tree mass was produced and named *ARBOLADO_3D*.

Criteria for the management of tree masses that conceal views

After the average visual surface was calculated and the tree positions in the San Pedro forest were inventoried, it was necessary to establish a series of management criteria to be used as guidelines for the intervention on the problematic masses of trees concealing the views of the Alhambra.

The most obvious criteria were the "height of the tree" (or the section of the tree crown that went over the average visual surface, thus causing concealment problems) and the "shape of the tree crown"—naturally, the more voluminous crowns produce greater concealment. Another criterion was the "distance from the tree to the façade of the historic monument". To prevent fires, the Management Plan of the Alhambra and Generalife[7] establishes de need of a 15-meter wide security perimeter from the walls that must be free from dense tree masses. One more condition was the "landscape function" that some of the trees had. Far from hiding the architecture of the monuments, those trees were used, or had been planted, to cover infrastructures such as spotlights, sheds, service doors, etc. The individual value of the tree, its own singularity was obviously another decisive factor to consider. The fact that the tree mass is a heritage element of special importance regarding the environment and the landscape itself must be emphasized. For that reason, despite having established a "visualization limit" that would help to see as much of the architecture as possible, it was advisable to qualify it by defending those trees that were especially relevant and singular and had a specific individual value. Some of those trees might generate problems of concealment but, by contrast, they contributed other values of great interest.

Finally, the application of the criterion of "distance from the tree to the façade of the monument" made it necessary to establish some guidelines that would permit to break all the possible "rigid lines" and "abrupt transitions" which the aforesaid criterion might produce. In visual areas where trees did not cover towers or other relevant visual landmarks, it would be possible to have small groves or individual trees that create recesses and projections tending to produce a more natural and organic visual result.

Height of the tree mass

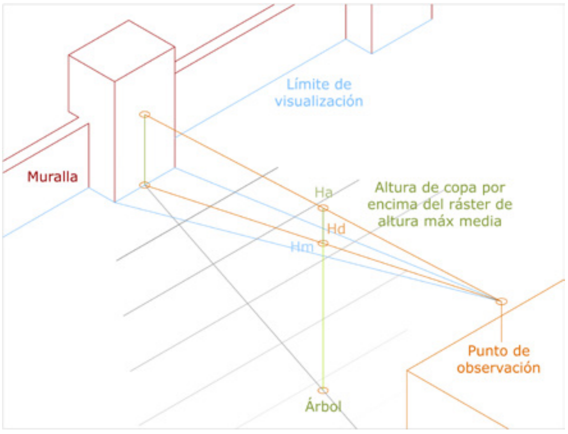
The height of the crown of each tree is calculated by using the z altitude, where the base of the tree has been positioned; then the breadth of each base is added. Thus, the *ARBOLADO_3D* coverage is obtained. This generates another coverage (*ARBOLADO_ALT_MAX*) to which the information on the raster of the average maximum height (*ALT_MAX_MED*) is added on a field.

The difference in height (Hd) is obtained by subtracting the breadth of the tree mass recorded in the inventory (Ha) from the average maximum height (Hm) reflected on the raster *ALT_MAX_MED*.Then the percentage (Hratio) that Hd represents in comparison to Ha is calculated.

The management criterion establishes that if the drastic pruning of a tree, such as cutting its entire top off, has to be undertaken periodically or repeatedly in order to prevent visual concealment, it is preferable simply to remove the tree. The main reason is that such severe lopping is hard on a tree and that, on many occasions, it causes the shaft to rot. In addition, this kind of pruning leads to a high breaking risk because it favors the growth of a great number of branches (adventitious buds) that with the passing of time, the impact of wind forces and the weight of snow end up destroying the structure of the specimen. To reduce the risk of fractures this sort of pruning has to be done continually and, since it is impossible to have mechanized access to most sites, it requires manpower and climbing techniques that are not cheap. Keeping those circumstances in mind, it is necessary to rethink if it is appropriate to invest a great deal of time and money on trees that have suffered drastic lopping, face rotting problems and involve an added risk for the safety of visitors and of the workers who look after the forest. The other option is to replace those trees with others that have the right height to avoid concealment and that in the

7. Ibid., p. 397

future will only require formation and maintenance pruning. Making this kind of decision is not easy, and each individual case will have to be studied in detail. In our opinion, when it is necessary to cut off over a third of the height of a tree—cutting off the top in most cases, which is always more than one third—it is advisable to carry out progressive pruning to reshape the individual. If that is not feasible, the tree should be removed. When the height that has to be detracted from the tree is lower than a third of the total height, the plan will be to carry out progressive pruning to reshape it and whatever kind of pruning may be needed later to conform the tree—pruning for balance, for the reduction of the crown, for maintenance and so on.



IL. 10. Difference in height (Hd) between the tree height data recorded in the inventory (Ha) and the data on average maximum height from the raster (Hm)

The following management criteria are established:

- If the height of the tree top does not surpass the average maximum height, the PRESERVATION the specimen is proposed (Hratio ≤ 0%).
- If the height of the tree top surpasses the average maximum height, what needs to be calculated is if the excess is greater than one third of the tree size. If it is not, PRUNING is feasible and advisable (Hratio ≤ 33.3%). If it is greater, the feasibility of PRUNING TO RESHAPE the will be studied. If reshaping pruning is impossible, the REMOVAL of the tree is proposed (Hratio > 33.3%).

Shape of the tree top

The following criterion is adopted based on the shape of the species and on the grouping of specimens: If the tree top has a column shape, PRESERVATION is recommended, unless the trees are grouped in a way that they make up a visual screen, in which case REMOVAL is recommended.

In the San Pedro woods the common cypress (*Cupressus sempervirens* L.) is the only species affected by this criterion. There are thirteen specimens that do not make up a visual screen, so their PRESERVATION is accepted.

Distance from the tree to the fortress wall

The REMOVAL of all the trees located less than 5 meters from the façade—a distance measured in plan—is recommended. We would like to point out that the decision to mark the limit at 5 meters, instead of the 15 meters that the Management Plan recommends, was made because the 15-meter limit proposal involved sacrificing a large number of trees.

There are several reasons to justify this decision. The first was the prevention of possible damages to the monumental buildings caused by contact with the tree tops and branches. The second was the need to establish a safety band against fires. The third was to ensure accessibility for the close-up viewing and inspection of the architecture of the monuments.

Specific use of the tree

It is thought that a tree fulfils a function in landscape when, among other things, it covers elements that are visually contaminating. According to article 19.2 of law 14/2017 of November 26, 2017, governing Historical Heritage of Andalusia, the following, among others, are considered elements of visual or perceptive contamination:

- Permanent or temporary buildings or installations that due to their height, volume or distance may disrupt the perception of the asset.
- Installations needed for the supplying, generating and consumption of energy.
- Installations needed for telecommunications.
- Signs, notices and exterior publicity.
- Street furniture.
- Elements intended for collection of urban residues.

IL. 11. Safety perimeter against fire, 5 meters from the wall

This criterion justifies the PRESERVATION of any tree that, according to the aforementioned physical criteria, may have been considered for PRUNING or REMOVAL.

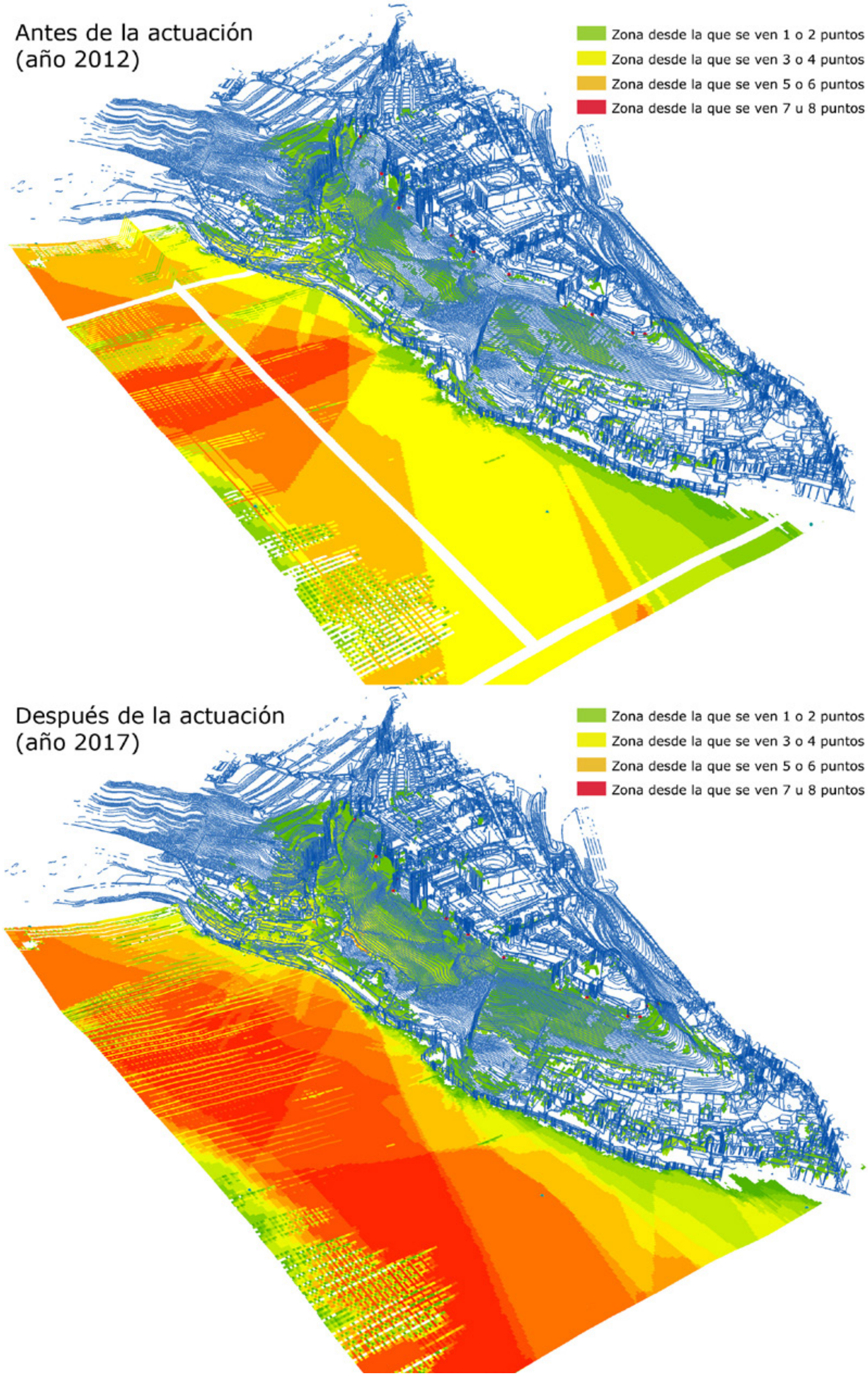
Landscaping interest of trees

The strict application of the aforementioned criteria, most especially the one regarding the distance between the trees and the walls of the fortress, could give rise to a rigid line or brusque transition between the wall and the upper band of the forest.
Therefore, it is necessary to apply a landscaping criterion (a correcting factor) that will provide this limit with greater naturalness by permitting recesses and projections of vegetation in the spaces that are visually less conflictive, such as long stretches of wall.
The application of that guideline will allow some trees to be preserved, those that in spite of gathering the technical conditions that recommend their removal due to concealment issues, play a clear role in the composition of the view or contribute to a more natural scenic outcome. These trees are usually located in transitional visual areas, like long stretches of wall, and do not conceal relevant landmarks, such as towers or the façades of palaces.
For the selection of the tree specimens to be preserved for landscaping reasons, the views from inside the monuments themselves are also analyzed *in situ* and through digital photography. The objective is to prevent visitors from noticing the band without trees when they look out from the paths along the walls or the towers of the monument.
The observation points (*miradores*) inside the monument are chosen following the same criteria that was used for establishing the exterior observation points. They are the following: bastion or ravelin of the Alcazaba, Torre de las Armas, Torre del Cubo, Torre de Comares, the Romantic Gallery, Peinador de la Reina, Torre de las Damas, and Torre de los Picos.

Singularity of trees

Lastly, the individual value or singularity of each of the trees that have been proposed for removal is taken into account. Thus, healthy, robust trees with a good shape will be preserved, as will those trees that can be considered singular according to the following:

- Historical reasons: Trees that may have a bond with an important figure, a historic or cultural event, a legend, or a story, or it may be the vestige of a previous conception of the landscape and its management.
- Social reasons: Trees that may be the object of special affection or consideration on the part of the people.
- Botanical reasons: Trees the age, dimension or shape of which are outstanding or unusual for their species, or trees that can be considered rare because of their species or variety, because of their unusual presence in a location or because of their exclusive presence in it.



IL. 12.Comparison of the visual impact on the landscape after the intervention –before (2012) and after (2017). In red, the area from which between 7 and 8 key points can be observed

VISUAL IMPACT OF THE INTERVENTION

The proposed model is called an inter-visibility model because it enables carrying out visibility studies in both directions.
"Key points" are those points that stand out for their relevant topographic position regarding the visibility intended for their analysis. After the reference key points have been established, and taking into account the parameters of maximum vegetation height that have been previously defined, it is possible to analyze the areas of the city from which the reference points can be seen.
To do so, a new coverage of key points is generated using the previous reference point coverage as a first step. Then, the visibility calculations are made by means of the reference key points and the *MDT_GEN_10cm*, and a treeless visibility map is obtained (*V_TERRENO*).
A *MDT_ARB_10cm* raster is needed to create the map of visibility which includes trees. The raster can be obtained by using a 3D coverage of tree-mass cylinders (representing tree shapes) that updates the *MDT_GEN_10 cm* raster. In order to do that, a layer of polygons is made up with the tree-filled coverage starting with the 3D coverage of tree-mass points and the data regarding tree-top diameter. With this new MDT and the same key points, the analysis of visibility with trees *(V_ARBOLADO)* is repeated. With both raster coverages (*V_TERRENO and V_ARBOLADO*), it is now possible to obtain a derived coverage (by just using a mathematical subtraction) that emphasizes the new areas of the city from which key points are visible and from which the views of the Nasrid monument have been improved.

RESULTS

In application of the methodology developed in the present work, 58 trees have to be sacrificed due to the concealing of views, a number that represents 5.66% of the total tree mass in the forest of San Pedro forest. It was also determined that 32 trees had to undergo the lopping of their tops, which represents 3.13% of the total tree mass.
The visual effect of the intervention, calculated on a study surface of 500,000 sq. meters corresponding to the Digital Model of the Terrain, shows a 20.53% increase in the visibility of the key points of the study surface when compared to the present situation.
The result can be checked by comparing the views of the Alhambra from the Mirador de San Nicolás in the images taken in 2012 and 2017.

CONCLUSIONS

In gardening and restoration of greenery interventions connected to historical monuments, the lack of careful considerations as to the potential growth in volume and height of the vegetation tends to be one of the most frequent causes of problems regarding landscape contemplation and even the maintenance of heritage assets.
When the height of the trees is not appropriate for reasons that have to do with landscape, those trees must be, progressively and according to a plan, replaced by others of a smaller size that can still provide the functions required of vegetation.
The present work develops a methodology and a tool for objective visualization based on GIS technology intended for the managing and arrangement of tree masses that, due to their height, volume or distance, may disrupt the visual perception of the architectural values of a monument.
The methodology proposed, based on visual line-ups from the main vantage points from which the monument of the Alhambra can be viewed, permits to obtain a system of 3D surfaces representing the maximum height of vegetation in a raster format.
The 3D information obtained, the naturalized aspect and organic forms of which stand out, allows to establish a planting plan with intervals of maximum height in mind.
These results are completed with the application of other parameters that permit the appropriate adjustment of the model according with the particular circumstances of the site.
For the application of the methodology, it is indispensable to have a digital model of the terrain, a tridimensional representation of the monument and a full inventory of the tree vegetation.
As mentioned in the explanation of the methodology, it is important to emphasize that the key to the model is the definition of the visualization limit.
This phase of the study must be tackled from an interdisciplinary approach in order to guarantee respect for the different ways of seeing and interpreting the same physical or virtual reality.

Finally we would like to stress that, in our opinion, the main achievement of this work is the contribution of a methodology that focuses on objective variables and makes it possible to obtain quantitative results. Consequently, it facilitates decision-making with regards to the preservation, management and arrangement of urban or peri-urban expanses of forest grounds that, due to their impact on the landscape, are part of the environment of historical monuments.

IL.13. Comparative view from the Mirador de San Nicolás between august-2011 and june-2017