04

Nature:
biotic and abiotic
factors

Nature and culture

Nowhere is the relationship between nature and culture better seen than in landscapes. When it comes to cultural landscapes, their essence and their character in terms of heritage may revolve around natural elements, with well-known examples being Sugarloaf Mountain in Rio de Janeiro and Mount Fuji in Japan as well as Mount Timanfaya in Lanzarote and Mount Parnassus in central Greece. However, they may also provide a scenic component without which the heritage values of a landscape would be incomplete or difficult to define. For example, it would be difficult to imagine the Vega de Granada without the backdrop of the Sierra Nevada, or the valley where Anguiano and the Monastery of Nuestra Señora de Valvanera are found without the Sierra de la Demanda. Regardless of whether such natural elements represent the defining feature of a landscape or provide it with a prominent backdrop, they must be recorded in an orderly manner following a logical sequence in order for us to subsequently establish how they interact with those created or imagined by humans. Furthermore, the cyclical changes of the natural environment mean the way a landscape is perceived is marked by great contrasts, something which is not always properly dealt with in landscape analyses. Examples include the difference between day and night (and everything in between) as well as the seasons and the transitions between them.

The purpose of analysing the natural components of a cultural landscape is (apart from identifying those that have taken on values as part of its heritagisation process) to produce an overview that outlines to what extent these components and their interaction with others have shaped the character of the

landscape in question, and lays out how to best protect them, manage them and monitor changes to them. The purpose of this is to ensure their heritage value is not diminished or jeopardised in any way.

We suggest the natural components of a landscape be studied in the following order:

· Landforms (geomorphology or analysis of relief)
· The presence (or absence) of water (whether running or standing)
· Climatic conditions
· Biodiversity (or lack of, which is not a bad thing), this including flora and fauna

Before looking at each of these points in detail, it is important to note that not all rocks, trees, species of animal and other physical components present in an area necessarily have to be considered natural elements. Stones arranged by humans, planted trees (such as in botanic gardens or commercial forests), and animals used for commercial purposes or in captivity (i.e. in farms, zoos, wildlife parks, etc.) should not be considered natural elements but additions to the landscape made by humans. Nevertheless, there is often considerable debate regarding what should or may be considered a natural element, issues which must be addressed during the characterisation phase. For example, although *Opuntia ficus-indica* was brought from Hispanic America and introduced to Spain's Mediterranean landscapes by humans, it now grows wild here and is commonly considered to be a natural feature of the region.

In terms of the main sources for analysing the natural environment, we may distinguish between four main types:

- Basic maps, which include topographic maps showing the basic aspects of the territory, such as relief, hydrology, infrastructure and population centres; and thematic maps covering aspects such as geology, rainfall and forests.
- Physical geography manuals and specific monographs on the natural environment.
- Area and town development plans, which are often available on the internet.
- Works of various kinds (books, paintings, films, etc.) which provide information on the various perceptions of the physical elements in a landscape.

As with other aspects involved in landscape characterisation, the natural environment should not be studied by simply gathering geographic information. Instead, the aim should be to identify the most relevant aspects of each natural component within the landscape and its role in shaping it. This was the approach used in The Landscape of the Gor Valley's Megaliths ∠, found in the Register of Landscapes of Cultural Interest in Andalusia ∠. Here, the main aspects of the physical environment are briefly described (including climate, geology, hydrology, biology, etc.) for the purpose of subsequently explaining their specific influence on the character of the landscape.

Geomorphology

Geomorphological features (or orography) are one of the most basic and visible aspects of a landscape. Flat, open areas with a wide viewshed and few landmarks to offset the background scenery result in landscapes with poorly defined boundaries, gradual transitions and areas that cannot be easily distinguished. Conversely, in mountainous regions, the boundaries of areas with different char-

acteristics are naturally defined for us, something which often results in sharp contrasts between one side of a mountain range and another. These regions frequently have landforms that stand out and naturally become symbolic landmarks in the landscape (examples being Moncayo, Monte Hacho, Montserrat, etc.).

When working with landforms, certain basic information involves quantitative values used in the analysis of landscapes in general, not just cultural landscapes. As such, a series of basic concepts should be considered to begin with, namely:

· Elevation: this is represented by dots (spot heights) indicating the height of a feature that stands out in a landscape (generally summits and elevated areas). However, where there are depressions with no evident outflow to an external body of water (i.e. endorheic areas, which tend to have lagoons, sinks or pit caves), the spot height given is the lowest point of the basin.
· Contours: these are lines used on topographic maps which connect points of equal elevation. Maps with a scale of 1:50,000 (where the contour interval is twenty metres) and maps with a scale of 1:25,000 (where the contour interval is ten metres) are the most common.
· The average height of the landscape being studied: this is the mean of the highest and lowest points.
· The main slopes (which tend to be given as a percentage) and their distribution: i.e. whether they are generally uniform in nature or whether there are different types in the various areas that make up the landscape. Slopes can be steep or gentle. Steep slopes (such as escarpments) have a percentage of above 40%, whereas that of moderate

slopes ranges from 10% to 40% and that of gentle slopes is below 10%.

There are a series of other aspects relating to orography, which, despite not lending themselves quite so less well to being measured quantitatively, contribute to shaping cultural landscapes. These include the following:

• The main landforms (hills, rugged mountains, endorheic basins or areas, crests, etc.). Peaks may be represented by front profiles as seen from a given point in the landscape.
• Aspect: the direction a slope faces can significantly influence its climate (see below).
Valleys: shaped by rivers, these are made up of two opposing walls and a floor where they meet. They are generally U or V shaped, although they are often very wide or very narrow (as is the case with canyons, which are deep clefts between escarpments or cliffs). Surrounding the lower course of a river are the largest floodplains it passes through. These plains are often very fertile due to the deposition of alluvium.
• Open areas with flat landforms: these are sometimes due to a build-up of river-borne sediment, this being the case for most of the Ebro and Baetic depressions in Spain, the Po Valley in Italy, the Nile Delta in Egypt and the Mississippi Delta in the USA. On other occasions, they may have belonged to sedimentary basins that once formed part of the seabed and rose up due to isostatic movements (either because of tectonic uplift or changes to sea levels). This is the case with plateaus and, despite being smaller and more local in nature, moors.

Coastal geomorphology is a branch of geomorphology in which the focus is on the areas where the
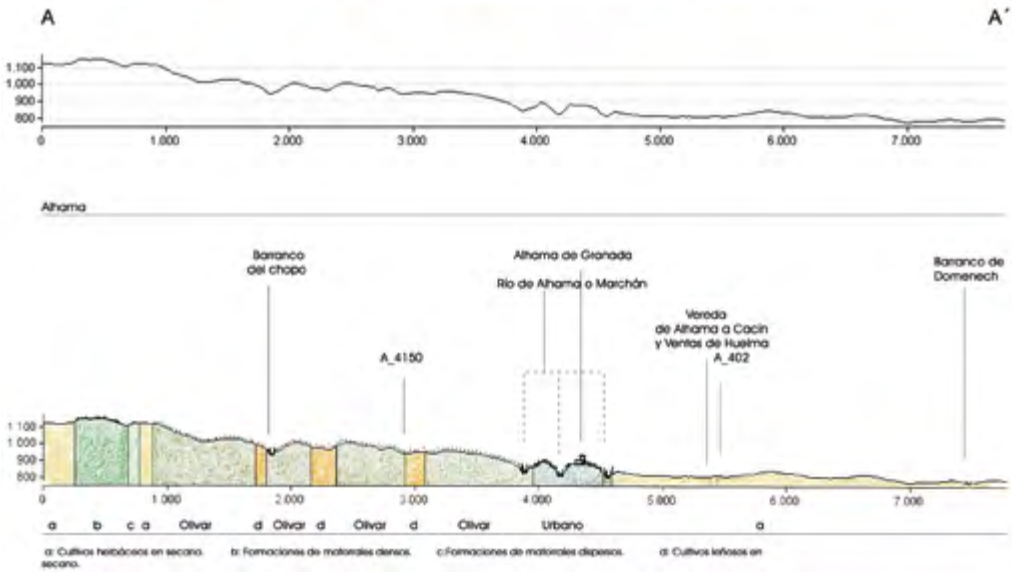
world's two most opposing ecosystems, i.e. marine and terrestrial, meet in a clear and distinguishable manner (although with certain transitions). They have their own features, which involve not only their landforms but also their rate of formation and particular physical characteristics (climate, biology, etc.). Here, we may distinguish between two types of coastline. The first is high coastlines, where cliffs and sharp relief by the sea are predominant. Examples include the Costa Brava in Spain, the White Cliffs of Dover in the UK, the French Riviera, most of Japan's coastline and the Amalfi Coast in Italy.

The second is low coastlines, which are made up of extensive sand formations on long beaches, each connected to one another. Examples include the coastline of Mauritania, Aquitaine in the South of France and the province of Huelva in Spain. Coastlines also offer a whole range of intermediate areas, which are difficult to define and where the transition between land and sea presents in a number of different ways. As such, processes such as tides (more visible in some areas of the world than others) and the presence of marshes, with their own physical processes and amphibian lifeforms, give rise to extremely rich regional diversity.

Rias and estuaries are coastal areas with their own specific features (they are not rivers, as they are visibly affected by the tides). Essentially, a ria is a long narrow area of water formed when a river valley floods and an estuary is the wide part of a river where it flows into the sea. Another related coastal area are deltas. Formed by sediments and river-borne material, these are where a river splits into several smaller rivers (branches) before entering the sea or ocean. These types of areas tend to give rise to marshes and complex ecosys-

Analysing the natural components of a cultural landscape allows us to establish to what extent they shape its character and decide on how best to protect them, manage them and monitor changes to them so that their heritage value is not diminished or jeopardised in any way.

tems. As such, it is not surprising that areas with such varied features have led to a wide range of processes of physical appropriation and identity formation amongst humans, who have turned them into cultural landscapes with profound meaning. These areas are also amongst those most at risk from the effects of climate change, something that threatens their values and in particular their heritage values (see chapter eight).

Water

Water is one of the most important forces that shapes a landscape. Its presence (which may be abundant, scarce or practically non-existent), movement (or lack of) and state (liquid, snow, ice, etc.) help explain landforms and the existence of certain species of flora and fauna, in addition to changing perceptions of landscape. As such, water (hydrology) plays a key role in physically shaping landscapes and often leads to them becoming cultural landscapes. For the purposes of our work, where water in a landscape is shaped more by climate than by hydrology, the criteria offered in the following subsection should be followed.

The elements of a landscape relating to water may be analysed in the following order:

• Springs: these represent ἀρχή (*arche*) or the origin of everything in the philosophical language of ancient Greece, given that water is essential for animal (including human) and plant life. Few things, natural or man-made, are so intrinsically linked to the idea of source and eternity as springs, which are held in particularly high regard in areas where water is a scarce resource. All mythologies and religions have created motifs, allegories and rituals based

on springs, these giving areas meaning and often resulting in them becoming cultural landscapes.

• Rivers: these are one of the biggest forces that shape the land, sequestering, carrying and depositing material (mainly sediment and pebbles) through erosion. They enlarge valleys, cut through mountains, and fill and form floodplains. As such, they must be thoroughly analysed in order to understand the morphology of any landscape. On occasions, in alpine and high-latitude climates, glaciers are mainly responsible for shaping the relief. In fact, in many places where these frozen rivers disappeared thousands of years ago, their mark can be seen in the region's orography (moraines, basins, rounded mountains, etc.). There are various types of fluvial systems, ranging from those which only flow for a few months or short periods over the year (i.e. ephemeral or intermittent streams) to those that have a constant flow (notwithstanding any seasonal variations due to climate).

• Lakes: in contrast to the constant movement of rivers (something that, according to classical sources, led Heraclitus to conclude that it is not possible to step into the same river twice), lakes and lagoons project an image of serenity and calmness. Although they are often formed by glacial activity, as described above, this is not always the case, as seen with endorheic basins (which have no outflow to other external bodies of water) and oases, to give just two examples. Lakes vary greatly in size, ranging from ponds to the Great Lakes of Canada and the USA, the latter having more in common with small seas than lakes. Having said that, where cultural landscapes are related to lakes, they tend to be medium or small in size.

• Wetlands and fens: these are areas where the presence of water (although not necessarily continuous in nature) gives rise to poorly defined areas

that do not lend themselves well to human settle-ment due to the fact that they are generally not compatible with farming and provide the perfect breeding ground for endemic diseases. Despite being extremely important places for biological processes (which is why the Ramsar Sites interna-tional network ⊾ was set up to protect them), due to the reasons explained above, in many countries they have undergone mass drainage over the past two centuries and particularly over the last century. Marshland, mentioned in the previous subsection, is very similar in nature to these kinds of areas. However, their unstable nature, which makes them unsuitable for human activity, has not stopped them from often becoming cultural landscapes.

An analysis of water resources must be combined with an impact and threat assessment due to the

Images taken from the analysis of the course of the Guadalquivir river in *A Guide to Seville's Historic Urban Landscape*

fact that, as in the previous case, various processes, and particularly climate change, may have a direct impact on the values they bring to cultural landscapes.

Climate

Before continuing with this section, it is important to note that the term 'climate' should not be confused with the term 'weather'. Climate refers to the atmospheric conditions that characterise an area, and involve averages and other statistical measurements based on data collected over a significant period of time. Based on this, conclusions such as 'it rains a lot in the North of England' or 'Rome has long, hot summers' can be drawn. Weather, however, can be defined as the atmospheric conditions present or expected at a specific time and place. Remarks such as 'it was icy in Madrid last night' or 'it is going to rain in Buenos Aires tomorrow' would be referring to the weather. When working with landscapes, our focus should be on climate.

Climate is a fundamental aspect of landscapes, shaping their characteristics and giving rise to a range of different perceptions, particularly depending on the time of day and year (i.e. season). Within the context of landscapes, particularly when it comes to their characterisation, the importance of climate stems more from the effects it has on their physical components (morphological, botanical, etc.) than the climate itself as a stand-alone phenomenon. It should be pointed out that the very definition of landscape, which implies a certain degree of stability, does not appear to go particularly well with the changing climatic conditions that affect them, even less so when we are dealing with the differences between summer and winter, or night

and day. That is why, as part of the characterisation process, we recommend identifying and focusing on more stable aspects of the climate that affect the landscape in question. Here, indicators that provide information covering at least a full year should be used (precipitation in cubic millimetres, average temperatures in degrees Celsius, humidity as a percentage, etc.). Based on the above, and particularly due to the important role they play in terms of the heritagisation of certain landscapes, changing climatic conditions that add variety, wealth and meaning to the cultural dimension of a territory must not be overlooked, even if they are not present all the time (for example, the rain in Santiago de Compostela, the wind in Chicago or the snow in Saint Petersburg).

In terms of climatic aspects that may be relevant to a cultural landscape, the following stand out: temperature, precipitation, humidity, wind and light conditions. Each one is briefly described below:

• Temperature has a direct impact on how a landscape is perceived, particularly where this involves extreme cold or extreme heat. However, above all it has an indirect impact on the speed and rhythm of certain processes, such as erosion and plant life cycles. Here, data can be obtained fairly easily. Average temperatures are relevant for most cultural landscapes, although monthly temperatures given on climographs are even more useful, as these combine data on temperature and precipitation. This allows us to build a much more detailed picture of the role climate plays in terms of the presence of water in a particular landscape as well as the flora and fauna present at different times of the year (given that many species migrate). For example, the intense heat in Seville from June to September

has resulted in a particular style of architecture and conditioned the flora present in its numerous parks. These were looked at in a specific study ⤡ carried out as part of the publication A Guide to Seville's Historic Urban Landscape ⤡.

· The amount of precipitation does not only impact upon light conditions (see below), it also gives rise to a particular kind of environment and has a clear effect on mood. For example, those that live in locations where it rains a lot (which include many well-known places) are more prone to be introspective and melancholic. Nevertheless, it should be noted that the effect of precipitation is different depending on its type. As such, a landscape where it drizzles a lot is not the same as a landscape where snow, hail and electrical storms are common. An objective piece of data when analysing a landscape is the number of millimetres of precipitation it receives (one millimetre corresponds to one litre per square metre of water on the surface), as well as its annual distribution, for which climographs are used.

· Humidity refers to the amount of water vapour present in the air. Although this may lead to the formation of fog, mist and other low-lying clouds, it does not cause precipitation. As such, it is closely linked to visibility conditions, which are often affected not just by water vapour but also by other particles suspended in the air, such as dust and sand (lithometeors), these causing haze. Humidity is also closely related to air temperature. As such, chilling air can cause the water vapour to condense and warming air can cause it to evaporate. It is no surprise that a landscape's climate and thus the type of clouds it tends to get play an important role in shaping it. In fact, in certain landscapes, these represent some of their defining features. This is because not only do they affect the mood of local people, they also limit and establish the boundaries

of viewsheds, and result in certain elements being given more importance and different meanings than in sunny, less obstructed landscapes. For the purpose of landscape analysis, average monthly humidity levels as well as the average number of days of fog per month are both useful pieces of data.

• Wind also has a direct and extremely varied impact on how a landscape is perceived. For example, it shapes landforms, plays an important role in erosion and affects how humid or dry a region is, in addition to influencing its agrological conditions and economic activities. In fact, wind plays such an important role in how certain landscapes are perceived that the term 'wind landscapes' has been coined. The majority of such landscapes have significant cultural associations, examples being Emporda, Menorca and the Strait of Gibraltar. Information on wind can be easily obtained from weather stations, although, as with the data discussed above, it is important to look at seasonal and monthly variations. This aspect was evident in the study of the heritage and socio-economic context of Bolonia Bay, a coastal area in the province of Cádiz whose character has been and continues to be shaped to a significant degree by the levant. Here, the intensity of this easterly wind that blows in the western Mediterranean conditions tourism in the area and makes it an ideal place for water sports that depend on the wind.

• Light conditions (sunshine) can present slight or extreme differences due to location as well as differences between day and night, the effect of mountain ranges and the influence of air masses of various kinds. Broadly speaking, changes can be seen gradually over large areas. It is pretty evident that light conditions vary greatly in different parts of the world, mainly as a result of the dominant

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climate. As such, the Mediterranean or subtropical climate is characterised by its abundant and intense light whilst oceanic climates, such as those seen in Atlantic Europe and the Pacific coast of a large part of the USA and Canada, are characterised by an abundance of clouds as well as dark autumn and winter days. A useful, objective piece of data related to this is yearly sunshine duration (or sunshine hours). Also relevant due to its direct impact on a climate is how the duration of days and nights varies over the year. In the middle latitudes, where the majority of European countries lie, this aspect plays a particularly important role in how landscapes are perceived, especially when combined with other climate variables (rain, fog, etc.).

Whatever the case may be, it is important to establish impacts and threats relating to these variables as well as their potential effect on the heritage values of the landscape being analysed. Here, it goes without saying that the foreseen effects of climate change as well as its potential and varying impact on the variables analysed must be thoroughly considered.

In terms of cultural landscapes, it is also useful to study past climate conditions. In *The Landscape of the Gor Valley's Megaliths*, found in the *Register*

Photographs relating to wind, from
A Guide to the Cultural Landscape
of Bolonia Bay

of Landscapes of Cultural Interest in Andalusia, this aspect was analysed and an understanding of the area's climate when its dolmens were built was gained. As well as looking at its past climate, the assessment also looked at its current climate for the purpose of explaining the impact it has on how the landscape is perceived nowadays.

Biogeography

Living things are a uniquely important part of landscapes. As such, the presence, scarcity or absence of vegetation is a defining feature when it comes to the physical makeup of a landscape. By contrast, animal wildlife, despite having different meanings in different landscapes, generally plays a less defining role given that its presence is more fleeting in nature (sometimes being hidden altogether) and it tends to change over space and time. However, that does not mean that in certain cases one of the most defining aspects of a landscape may be a certain species of animal, examples being the giant tortoise in the Galápagos Islands and the monarch butterfly in Michoacán and other parts of Mexico.

a) Flora

When analysing the importance of flora in a landscape, the following aspects should be covered:

• Size: from small to big, we may differentiate between herbaceous plants, shrubs and trees. In certain landscapes, all three types may be interspersed or overlap (the Mediterranean *dehesas* and forests, broadly speaking), whereas in others some are more common than others (meadows, maquis, forests, etc.).

• Plant density: where the density of vegetation is high, this means that cover is continuous and dense, an example being trees with large crowns that together form a canopy. Conversely, low-density vegetation is typically associated with landscapes where the land is mostly barren and where, when vegetation does appear, it is smaller, sparse and has less leaves. Clearly, many landscapes fall somewhere in between these two extremes. When analysing a landscape, it is important to establish the overall density of its vegetation as well as areas that are outliers, such as clearings in forests and gallery forests by rivers.

• Variety of species: no less landscape value should be given to areas with little variety in terms of plant formations. Conversely, no greater landscape value should be apportioned to areas with plenty of variety in this regard. Nevertheless, the number of species present, the percentage each one accounts for and their distribution should be established for the purpose of establishing the extent to which they contribute to the character of the landscape in question.

• Plant species which, due to their intrinsic characteristics, shape the colours and textures of the landscape (which should also be recorded): many of these appear during certain times of the year, this particularly being the case for deciduous and herbaceous species that dry out in the summer. This is an extremely important fact to bear in mind during the landscape characterisation process given that forests with various deciduous species offer their most impressive range of colours in autumn, these changing on a weekly basis.

• Other aspects: other very important aspects, not just for characterisation but also for landscape assessment, include the health of the various species present (are they suffering from diseases caused by

fungi, insects or other parasites?) as well as threats and other circumstances that may jeopardise the value brought by the vegetation to the landscape in question (in particular climate change but also wildfire, invasive species, urban development, the replacement of native species, etc.).

b) In terms of fauna, the following should be done:

• A list of all the species present in the landscape should be created, organised by order, family and species (as a bare minimum).
• The degree of visibility of the landscape's fauna should be established. This involves establishing if its presence is seasonal or linked to migratory or hibernatory processes.
• As with the previous point, other aspects that influence the characterisation and assessment of the landscape should be identified. These include the health of the various species identified as well as any threats to and impacts on them.

Heritage resources associated with the natural environment

Once the natural processes that have given rise to the physical environment of the landscape are known, the heritage resources associated with these processes should be identified. These re-sources should be approached from two angles, namely as elements that physically make up the landscape and as elements that give it meaning in an intangible sense. It is important to note that, despite being natural components of a landscape, these kinds of heritage resources are considered as such because they have taken on significant and symbolic values. To illustrate this point, think of a mountain landscape. It will often have numer-

Examples of resources associated with the natural environment in cultural landscapes

	Resources	Examples
General geomorphology	Mountains Caves Fossil tracks/ Ichnites	Mount Ararat (Turkey)* Batu Caves (Malaysia) Dinosaur tracks in Walmadany (Australia)
Coastal geomorphology	Capes Bays Beaches and low-lying coastlines Cliffs Rivers and estuaries Deltas Marshes	Cape Finisterre (Spain) Ha Long Bay (Vietnam) Navagio Beach in Zante (Greece) Costa da Morte (Spain) Mar da Palha, Tagus estuary (Portugal) Nile Delta (Egypt) Camargue (France)
Hydrology	River sources and springs Rivers and streams Lakes Wetlands	Source of the Yellow River in Tibet (China) The Ganges (India and Bangladesh) Lake Titicaca (Bolivia and Peru) Iberá Wetlands (Argentina)
Climate	Temperature Precipitation Humidity Wind Light conditions	Moscow (Russia) Belém (Brazil) San Antonio de Ureca (Equatorial Guinea) Punta Arenas (Chile) Aswan (Egypt)
Biogeography	Flora Fauna	Horsh Arz el-Rab / Forest of the Cedars of God (Lebanon) Wildlife Reserve in Al Wusta (Oman)

(*) Although Mount Ararat is in Turkey, it has a deep symbolic meaning for the people of the neighbouring country of Armenia, which has always claimed it as its own.

ous mountains but not all of them will be heritage resources, even if they are closely related to one another in terms of the makeup of the landscape. This is the case, for example, of Huayna Picchu, a mountain rising above Machu Picchu in the Cusco region of Peru.

Information on such resources may also be organised using a system of classification or standardised terminology (see chapter two).