Geoheritage (2021) 13: 24
https://doi.org/10.1007/s12371-021-00543-1

ORIGINAL ARTICLE

Inland Salinas in Spain: Classification, Characterisation, and Reflections on Unique Cultural Landscapes and Geoheritage

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Received: 25 September 2020 / Accepted: 29 January 2021 / Published online: 2 March 2021

Abstract

With over 500 salt-making sites in inland Spain, continental salinas constitute genuine cultural landscapes with strong cultural and natural heritage values. This paper presents inland or continental salinas using artisanal techniques for the production of salt based on solar evaporation and local materials for buildings and infrastructures. Together with the environmental features of the sites, these characteristics allow harmonic enclaves perfectly integrated into their territory to be configured. This study is intended to identify, characterise, and establish a typological classification of salt landscapes in Spain. The qualitative analysis applied—based on the Landscape Character Assessment approach—also reveals an important landscape diversity and a specific salt culture and concludes with some ideas for their safeguarding and adequate use.

Keywords Saltscapes · Cultural heritage · Characterisation · Inland Salinas · Saltworks

Introduction

Landscapes are mental constructions that result from the human interpretation of the physical and visible aspects of a territory. This includes both the perception of the shape of the territory and the meanings it generates for a group of people, all of it as a consequence of human and environmental dynamics. Jones and Stenseke (2011) present landscapes as morphology, as scenery and as polity, in accordance with European Landscape Convention that defines landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (Council of Europe 2000: Article 1a). Landscapes are therefore a cultural matter; they bring to light the interaction of natural and anthropic processes in a specific area (Tudor and England 2014; Fadamiro and Adedeji 2016). Having developed over a long period of time at a site, certain production activities configure what we know as cultural landscapes (Mitchell et al. 2009). They present environmental, sociocultural, historical, and aesthetic values and also heritage, but above all, they are capable of consolidating and maintaining territorial identity and the sense of belonging to the site. A good example is that of the so-called "saltscapes," which emerge as a result of the presence of this mineral in nature. This generates specific habitats referred to as saline environments. Humans have collected salt for centuries to ensure their survival and make use of it in multiple applications (Feldman 2011; Saile 2015). Those sites in which salt has been produced have given rise to a variety of landscapes, which we call cultural "saltscapes." Those sites are considered geoheritage too, because they are a type of natural heritage especially focused on their geological values. Geoheritage refers to sites that show landforms and elements that help us understand processes of the Earth's geological history. Therefore, inland salinas show unique landscapes derived from geological processes and their linkages to human activity, which must be preserved due to their environmental,

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historical, educational, and recreational values (Brocx and Semeniuk 2007; Venturini and Pasquaré 2019; Pasquaré Mariotto et al. 2020).

Common salt (NaCl) is an essential chemical compound for living beings. Salt is and has been a fundamental substance for humankind. Scientists speculate that it played a role in the sedentarisation of nomadic societies in Prehistoric times, as it allowed them to store food for longer periods. In the Antiquity, salt became the main method of food preservation (Moinier and Weller 2015; Stockinger 2015; Zant 2016) and it was mixed with fish juices to prepare sauces like the famous Roman *garum* (Mangas and Hernando 2011). It was also used as a medicinal product and in metallurgy (Denton 1984; Williams and Reid 2008; Stockinger 2015). This variety of uses caused salt to be highly thought of, politically and socially, and it was even assigned great symbolism and religious values, hence its use in many rituals, legends, and traditions (Latham 1982; Carusi 2008; Tsigarida 2012).

The relevance of salt gave way to strong control over its production, distribution, trade, and even taxation by authorities for a long time, as it was a state-owned product. It is therefore not strange to find manor houses, palaces, fortresses, watchtowers, monasteries, churches, fortified walls, etc. in the surroundings of the most important salt-making sites. In addition, salt distribution was closely related to the development of routes, particularly drover's roads, due to the need to trade and provide it to cattle, thus creating important communication axes which today vertebrate the territory. Some of these salt-trading routes are highly relevant historic routes, such as the *Camino Salinero*, which joined the saltworks of Imón with Negredo and Angón, or the *Camí Cardener* in the Pyrenees. In turn, the salt trade helped cities and towns flourish, such as Venice or Hamburg, and was connected to historic events such as the French Revolution or the Dandi March (Hocquet 1985; Menéndez 2008).

Spain is host to cultural "saltscapes" (Carrasco and Hueso 2008). In spite of their modest size, these highly singular landscapes are filled with ecological, historical, symbolic, and aesthetic elements. But, are there different types of saline landscapes? And what are their characteristics? Three types of saline environments contribute to generating "saltscapes": the coast, brine springs and saline wetlands, and rock salt deposits. This research, however, focuses on the study of inland "saltscapes," which are unique in Europe due to their technical, physical, and natural exploitation conditions (solar evaporation).

These sites typically have a continental Mediterranean climate, with low rainfall in the summer months and a high insolation rate. They occupy small, less organised drainage basins which favour the accumulation of a sheet of water in the lower-lying areas, leaving a crust of salt when the water evaporates. The vegetation in these areas is usually herbaceous and shrubby, with species adapted to the prevailing high salinity. But what makes these saline environments truly cultural "saltscapes" are the facilities, infrastructures, buildings, knowledge, and traditions linked to the production of salt for its trade and use. The combination of a saline environment with specific architecture and productive structures intended to facilitate the solar evaporation of salt from brine gives rise to aesthetic, yet fragile, spaces with a past life, charged with symbolism and identity.

But despite the environmental, cultural, and landscape values of these enclaves, events such as the abolition of the state's salt monopoly in the late nineteenth century, the improvement of means of transportation, and better connections with the coast, the rural exodus, and facilities that were poorly adapted for industrialisation explain why the production of inland salt went into crisis (especially as of the second half of the twentieth century), putting an end to production and condemning these landscapes to decay and oblivion. This makes this type of research necessary. Over 80% of inland salinas are no longer operational and their infrastructure deteriorates over time (Carrasco and Hueso 2008). This paper aims to identify and classify inland "saltscape" types in Spain with a view to locating and registering their existence and increasing the awareness of an almost vanished legacy, analysing possible strategies of recovery intended to promote local development in inland areas with an ageing population and low economic development.

Anthropic Ecosystems and Traditional Knowledge as a Basis for the Configuration of Inland "Saltscapes" and Salt Geoheritage in Spain

Inland "saltscapes" in Spain are conditioned by their physical environment, that is, geology, climate, topography, and hydrology. Spain enjoys a predominantly Mediterranean climate, with an irregular precipitation regime, high insolation, and high temperatures a few months of the year, which are favourable conditions for the production of salt by natural evaporation. But the exact location of "saltscapes"—the outcome of the creation of salt-making sites—is also related to the geological substrate and the hydrogeological system.

In the interior of the continents, salt is generally found underground, as a solid material. It is usually mixed with clay, gypsum, and marls. These formations are of sedimentary origin and date back to early geological periods, when part of Pangea was covered by seawater. By successive evaporation and tectonic processes (halogenesis), salt deposits were formed on the surface which over time were covered by other materials. In Spain, two main halogenesis periods have been identified. The first one, in the Upper Triassic, took place 200 million years ago and marked the origin of most inland deposits known today (Instituto Geológico y Minero de España

1997). The second one took place in the Upper Miocene, 5 million years ago.

These subterranean deposits occasionally come into contact with ground water and flow into the (sub)surface in the form of brine, in places where fissures allow phreatic ascent. If the brine is concentrated enough, it can be used to obtain salt by solar evaporation. Technically, water is considered brine when it has more than 50 g of salt per litre, but salt does not crystallise completely before reaching a concentration of 300 g per litre, when the dissolved mineral starts to precipitate. These sources of natural upflows of brine have given rise to temporary rivers, streams, and saline lakes such as Rambla Salada in Murcia. There are also endorheic saline lagoons, inside a closed basin. Examples of these are Salada de Chiprana in Zaragoza or the La Mancha lagoons in Toledo and Ciudad Real (Hueso and Carrasco 2009).

The presence of salt on the surface, by natural processes or due to human activity, plays a major role in the creation of the so-called "saltscapes." These can be defined as "landscapes whose elements are strongly influenced by the presence of salt and thus shape a defined (eco-) system" (Hueso and Carrasco 2006). Salt in the environment conditions life and subsequently the flora and fauna communities in the area. The survival of certain species in high-salinity conditions means "saltscapes" are very specific ecosystems that depend on the existence of salt. Saline environments are usually wetlands where, owing to different reasons, water has a salinity over 0.5 g per litre. This type of enclave differs from other types due to their nature and biodiversity (Batlle 1995). Biocenoses in these sites are fragile and highly specialised, which explains the presence of endemisms (Hueso and Carrasco 2009).

Dissolved salts are incorporated into the vegetation through the trophic network and perform essential metabolic functions for organisms. There are no clear historical references about the conscious decision to ingest salt by humans, who physiologically need it. According to some hypotheses, it was discovered by chance; others argue that it came as a consequence of observing animals licking the salt precipitated on the banks of streams or saline lakes to meet the organic need for sodium chloride (Iranzo 2005). In any case, the use of salt by humans gave rise to numerous manifestations that today can be seen in these cultural "saltscapes."

Materials and Methods

Geographic Information Systems (GIS), historic documents, literature review, interviews with local stakeholders, and fieldwork allowed us to identify and locate inland saltpans and to analyse salt landscape types. GIS was fundamental as a tool. ArcGIS 10.2 software and digital cartographic information from public organisations such as Spain's National Geographic Institute (Instituto Geográfico Nacional de España) and Geological and Mining Institute (Instituto Geológico y Minero de España, IGME) were used. A Digital Terrain Model was implemented with 200-m grid size, ETRS89 geodetic reference system, and UTM projection in the spindle corresponding to each province. This DTM200 was obtained by interpolating digital terrain models from the National Plan of Aerial Orthophotography (Plan Nacional de Ortofotografía Aérea, PNOA). Spain's land occupation map from the Corine Land Cover European project, 2006, was also used, ETRS89 geodetic system, UTM projection, spindle 30. IGME provided the Geological Map of the Iberian Peninsula, the Balearic and Canary Islands, scale 1:1,000,000, 1995 edition. As regard documentary and bibliographical sources, different national, regional, and local historic archives were consulted (*Archivo Histórico Nacional, Archivo de la Real Chancillería de Valladolid, Archivo General de Simancas, Archivo de la Corona de Aragón, Archivo del Reino de Valencia*) and papers and research work related to salt-water wetlands, salt economic history and trade, and salt industry and architecture were collected and studied: Le sel et le pouvoir (Hocquet 1985), Los orígenes de la producción de sal: evidencias, funciones y valor en el Neolítico europeo (Weller 2004), or La sal en la Hispania romana (Mangas and Hernando 2011).

The methodology applied to achieve the objectives followed the Landscape Character Assessment (LCA) approach (Swanwick 2002; Jellema et al. 2009). As Tudor and England (2014) explains, LCA is "the process of identifying and describing variation in the character of the landscape. It seeks to identify and explain the unique combination of elements and features that make landscapes distinctive." Thus, our methodology covered the following phases: (1) Identification and mapping of saline environments and salt-production sites in inland Spain using documentary sources; (2) identification of former salt sites using GIS analysis, combining geological information, documentary references, and toponymy; (3) GIS analysis to define landscape typologies for the identified saltworks; (4) verification of location, and on-site data collection through fieldwork; and (5) final inventory and landscape-heritage characterisation for each salina. Fieldwork and data provided by local agents helped to identify sites where saltworks may have existed in the past, where archaeological techniques would be necessary. To classify "saltscapes," types were determined based on environmental features, morphostructures, and dominant land-occupancy patterns. The work carried out by Mata and Sanz (2003), Junta de Andalucía (2012), and Molinero et al. (2013) was used as the basis of our taxonomy. The criteria applied were as follows: first, the physical environment, climate, and immediate landscape patterns where the saltworks are located, and second, its internal morphology, production techniques, and size (Román 2014). In addition to identifying broad landscape categories, three sub-categories can be distinguished

based on their physiography: salinas on flatlands, salinas at the bottom of a ravine or a valley, and hillside salinas.

Results

Production Techniques and Operation of Inland Saltpans in Spain

Different salt-production methods can be used. Choosing one method or another largely depends on the geographical conditions of the site and access to resources (Hocquet 1994; Weller 2004; Iranzo 2005). In Spain, three salt-production strategies can be identified: physical extraction of rock salt by mining techniques, collecting salt deposits after the evaporation of salt water, and the application of a mixed method combining rock salt dissolution by a water mass and subsequent evaporation (Iranzo 2005). Evaporation takes places either naturally, by the combined action of the wind and the sun—as is the case with most inland Salinas—or using fuel, to boil the brine. This method was used by a few saltworks in northern Spain, e.g. in Léniz in Guipuzcoa, but also at other sites that needed to speed the process up, like Salinas de Jaraguas (Valencia). The mixed technique—mining, dissolution, and evaporation—was traditionally applied in Poza de la Sal, Burgos, and in industrial facilities like the Remolinos mine in Zaragoza.

Traditional salinas work like a natural ecosystem: the exchange of matter, energy, and information with the environment is ongoing, with a tendency to close the cycle of matter and make internal processes efficient, this resulting in almost zero waste. Their structure seems simple, but they are indeed complex systems. They are designed in such a way that salt water flowing from a spring, a river, a stream, or a well is circulated by gravity into an evaporation pond through irrigation ditches, lock-gates, and canals. Salinity is slowly increased throughout this journey. Lastly, the final product is obtained by evaporation in very shallow ponds to favour salt crystallisation (Fig. 2). Once the salt has been obtained, the product is stored at the *alfolí* next to the salina or in the nearby towns, to proceed to market and distribute it.

Salt production, storage, and trade require a number of facilities and premises, which are part of the built salt-production heritage. Although salt pans were usually not far from towns, everyday access was difficult, and the seasonality of the activity—which required hiring workers from other areas—led to the construction of worker's dwellings next to the salina, this giving way to autonomous and dispersed settlements in the territory typical of rural architecture. It also led to more complex urban systems such as "saltworks settlements." A clear example of this can be seen in Salinas de La Olmeda, Guadalajara. The buildings combined living areas with offices and warehouses. This type of construction can be found in Salinas de Chillar, in Hinojares (Jaén), with living spaces and offices upstairs and the warehouse on the ground floor. Another mixed-use case is the alfolí of Gerri de la Sal (Lleida), in the centre of town.

Identification and Classification of 'Saltscapes' in Inland Spain

The salinas in inland Spain were located in those areas where sedimentary materials from the Late Triassic surfaced (Fig. 1). These materials are composed of clayey-evaporitic lithologies typical of the Keuper facies; they make up sedimentary formations where salt deposits build up, consisting of marl, gypsum and variegated clays with very bright colours (red, grey, green, and white). When plastic Keuper materials surface through cracks and crevices, their composition causes intense denudation. Surface runoff results in intense gullies whose topography has an impact on the layout of the saltworks and the structure of the landscape. The analysis of the areas with surfaced Keuper materials allowed us to confirm that we do not always find salt making sites in them. A water mass must seep into Keuper deposits to dissolve the salts present and for these to surface out as a salt spring. In other cases, we observed that the salt water in the aquifer was obtained by means of a well.

Having identified and inventoried more than 500 inland salinas in Spain (Carrasco and Hueso 2008), a taxonomy of inland "saltscapes" was tested. The resulting typological classification is summarised in Table 1.

The basic features of each category and subcategory tested for inland salinas are shown next (Román 2014):

Salinas in Natural and Rural Landscapes

This category encompasses most continental saltworks in Spain. They are located in natural and rural environments: mountain areas, countryside, etc. They can be further divided into five types.

"Saltscapes" on High Plains and Dry Inland Areas

There are few examples in this typology; they are primarily found in eastern Andalusia, particularly in the provinces of Jaén (Fig. 2), Granada and Almería, as well as in the drier areas of Castile and Aragón. The landscape in these areas is subject to very arid weather conditions, with low rainfall, intense solar radiation, and irregular but heavy rainstorms. The most characteristic feature of the salinas in these areas is the bright luminosity associated with the whiteness of the evaporation ponds, and the simplicity and scenic power of the surroundings, which makes them vulnerable to exogenous disturbance.

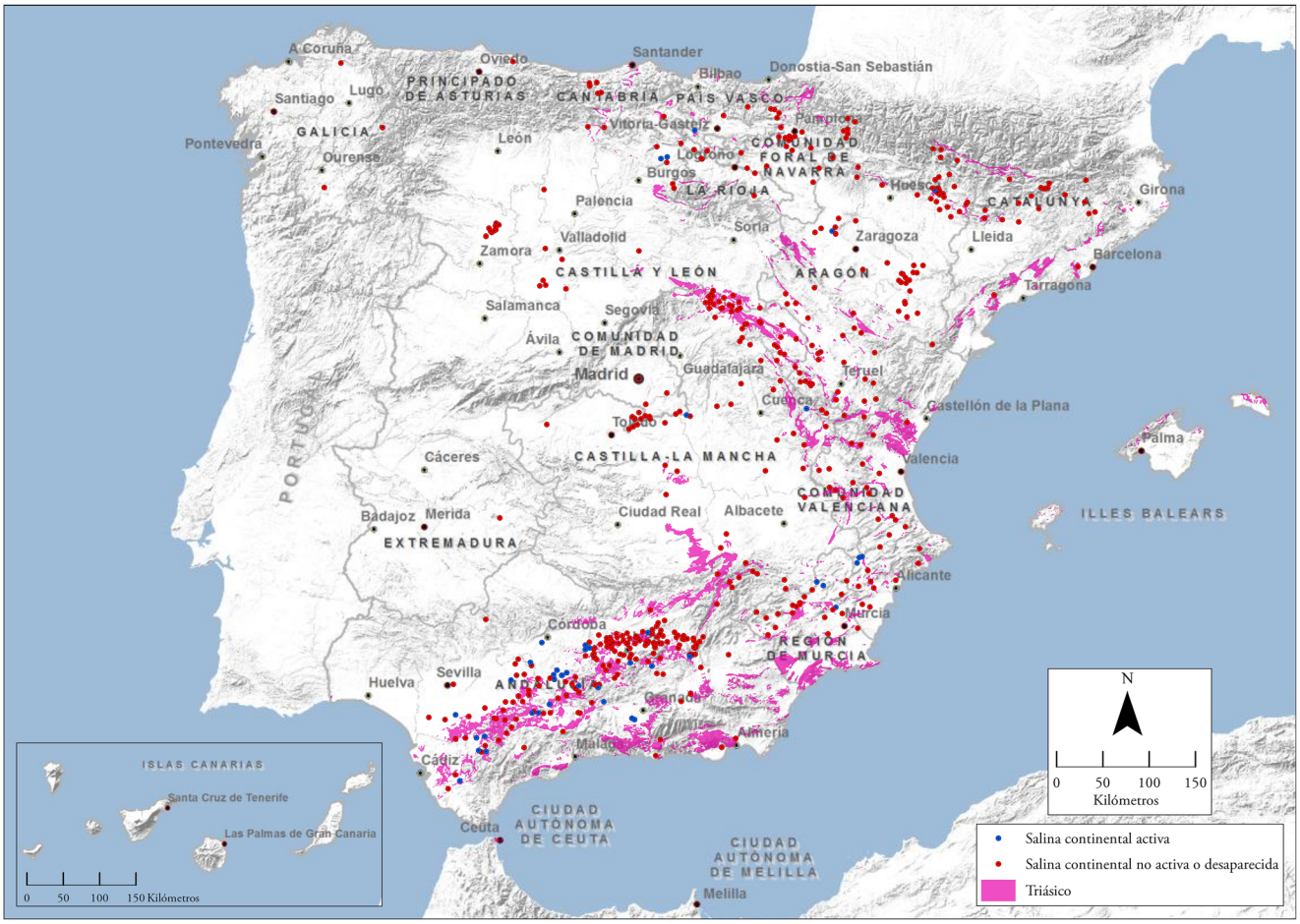

Fig. 1 Map of Spain with relationship between Triassic Keuper materials and the presence of inland salt pans

Countryside 'Caltscapes'

This category includes the vast majority of inland salinas in Spain. They are found in rural settings primarily associated with extensive olive or cereal crops. In many cases, monoculture generates homogeneous and monotonous landscapes where the presence of saltworks brings in a significant change in both the landscape and its associated biodiversity, particularly if the site is in production. The altitude of these saltworks is lower than that of the high plains and mountain areas, they are more regular in shape and have a bigger size due to the more favourable topography. Examples of this category are found in El Borreguero in Ecija (Seville), La Milagrosa and Reonal in Peal de Becerro (Jaén), Imón and Olmeda in Guadalajara (Fig. 3), and Rambla Salada (Murcia). In Rambla Salada, brine is obtained from a salt water course; the salina was named after it.

"Saltscapes" on Mountains and Mountain Ranges

In this rugged scenery, saltworks are characterised by the way they adapt to existing topographies. Due to the geomorphological peculiarities of these areas, considerable technical efforts are frequently made in order to adapt to irregular shapes and counteract steep slopes. This explains why the sites are usually smaller than countryside salinas. Some of them, like Hórtola in Requena (Valencia) or Montejícar (Granada), have an area of just 60 m^2 (Quesada 1995; Iranzo 2005), being arranged over small horizontal terraces built on the hillside. This category is not so numerous due to adverse weather conditions and geomorphological features, but some saltworks are outstanding, particularly in the north of Spain: Poza de la Sal (Burgos), Peralta de la Sal (Huesca), or Salinas de Oro (Navarra).

"Saltscapes" in Calleys, Alluvial Plains, and Marshes

These "saltscapes" are the result of salinas located at low-altitude, usually in irrigated farming areas. This category also includes landscapes linked to salinas in areas with marshes. Some examples are the marshes of Cádiz and Huelva, but there are also other sites associated with endorheic basins, such as Salinas de la Laguna de Fuente de Piedra, in the province of Málaga (currently not in operation and flooded under salt water). Although they belong to the same landscape category, morphological differences have been found between valley and alluvial plain salinas

Table 1 Types of 'saltscapes' in Spain Source: Román 2014

MAJOR LANDSCAPE CATEGORIES		PHYSIOGRAPHY		
		Flatlands	Ravine/valley bottom	Hillside
A. NATURAL AND RURAL LANDSCAPES	High plains and dry inland areas	Salinas on high plains and dry inland areas on flatlands	Salinas on high plains and dry inland areas at bottom of ravine/valley	Salinas on high plains and dry inland areas on hillside
	Countryside	Countryside salinas on flatlands	Countryside salinas at bottom of ravine/valley	Countryside salinas on hillside
	Mountains and mountain ranges	Mountain salinas on flatlands	Mountain salinas at bottom of ravine/valley	Mountain salinas on hillside
	Valleys, alluvial plains, and marshes	Salinas in valleys, alluvial plains and marshes on flatlands	Salinas in valleys, alluvial plains and marshes at bottom of ravine/valley	Salinas in valleys, alluvial plains and marshes on hillside
	Atlantic coast	Atlantic coast salinas on flatlands	Atlantic coast salinas at bottom of ravine/valley	Atlantic coast salinas on hillside
	Mediterranean coast	Mediterranean coast salinas on flatlands	Mediterranean coast salinas at bottom of ravine/valley	Mediterranean coast salinas on hillside
B. URBAN AND PERIURBAN LANDSCAPES	Urban	Inland Urban inland salina on flatlands	Urban inland salina at bottom of ravine/valley	Urban inland salina on hillside
		Coastal Urban coastal salina on flatlands	Urban coastal salina at bottom of ravine/valley	Urban coastal salina on hillside
	Periurban	Periuban salina on flatlands	Periurban salina at bottom of ravine/valley	Periurban salina on hillside

on the one hand (they are similar to those described in the countryside category) and those related to salt marshes (similar to coastal salt pans).

Salinas in Urban and Periurban Landscapes

These "saltscapes" are part of urban and periurban landscapes as a consequence of the development and growth of towns and their associated infrastructure. In general terms, saltworks in this category existed prior to urban development but, over time, they became integrated or merged into them. In these cases, the landscape is more anthropised mainly because the territory caters for multiple uses: residential, industrial, tourism, intensive farming, etc. Therefore, their condition as boundaries make them rank last on the priority list after residential estates, golf courses, urban area developments, greenhouse agriculture, large infrastructures, etc. These adverse circumstances, together with property speculation particularly in the Mediterranean region, have caused many salt-production sites to disappear.

Urban 'Saltscapes'

These "saltscapes" are based on the integration of the salt facility with the developed space. Salinas in this category are

Fig. 2 Salinas de Chíllar, Hinojares (Jaén). Photograph by Emilia Román López (2012)

Fig. 3 Aerial view of Salinas de Imón, Guadalajara. Photograph by Katia Hueso (IPAISAL) (2006)

either next to urban areas or are part of them. The most significant feature in these landscapes is the profound changes and rapid transformation of environmental conditions, which makes them highly vulnerable at environmental and structural levels. Although these landscapes are protected in many cases, they have been de-contextualised and have lost their "natural-rural appearance," usually being surrounded by elements of everyday urban life that spoil the enclave. In inland areas, this salina type has been absorbed by urban development but they originally had the typical features of "saltscapes" in the countryside, mountain areas, valleys, or plains. This is the case of Salinas de La Malahá, in La Malahá (Granada). Other examples of salinas next to a town are Añana (Álava) and Gerri de la Sal (Lleida).

Periurban "saltscapes"

These "saltscapes" are linked to salinas located in areas between urban areas and rural-natural areas. Although these sites were originally in rural-natural settings, due to large urban-industrial development in recent years, they are now found next to industrial facilities, infrastructure or intensive-agricultural farms.

Discussion

Communities living in a particular area use existing resources interact with it and make it their own, thus giving it added value over and above it merely supporting economic activities. With their gaze, people "shape" places, and when they feel identified in such landscapes, they "patrimonialise" them (Tilley 2006; Bertrand 2008). Landscape is said to become heritage when the elements, structures, and processes that articulate it are recognised by the society that resides within it (François et al. 2006; Di Méo 2008). Inland saltworks are much more than a facility in which a commodity is produced. Their significance comes from the fact that their environmental conditions, architecture and infrastructure, the know-how of its people, the equipment used, and the traditions and legends about them are genuine landscapes of remarkable beauty and unique aesthetics.

The study allowed us to identify most of Spain's inland saltworks and the structures and techniques used in salt production and to make a typological classification of landscapes linked to saltworking (Román 2014). "Saltscapes" are unique. We could even speak of a specific geoheritage and landscape type filled with values and meanings. But the study also helped us realise how fragile the sites are and the difficulty these landscapes face in order to survive. The fact that most saltworks are non-operational and have been abandoned jeopardises their very existence over time. This entails not only cultural losses but also impacts on the conservation of the specific flora and fauna adapted to this environment (Béchet et al. 2009).

Therefore, action must be taken in three areas: social initiatives (raising awareness), legal actions (inclusion in catalogues; protection and coordination by administrations), and proposals (capitalisation, reactivation with new uses) (Antrop 2005; Déjeant-Pons 2006).

The values of these salt-production sites depend on multiple environmental, social, and cultural factors. Together with the presence of salt water, the edaphic qualities generate

specific ecosystems whose flora and fauna are adapted to high salinity levels and strong ultraviolet radiation (Hueso 2015a). Saltwork-related ecosystems are significantly valuable because of their rarity and vulnerability; in fact, half of Spain's current salinas are included in the Natura 2000 network. Their fragility makes the study and understanding of their ecological values urgent, and the same applies to the analysis of possible changes in the vegetation and the behaviour of birds (Bouzillé et al. 2001).

Another value of inland "saltscapes" in Spain has to do with the existing typological variety, from which morphological, architectural and aesthetic values are in turn derived. Although salt production basically depends on solar evaporation, the site's topographical features and climatic conditions, the type of salt water uptake, the building materials used, and the techniques and tools utilised result in a remarkable variety of designs and architectures (Iranzo 2005). There is no doubt that saltworks introduce artificial elements and rectilinear shapes into the environment, but the use of local materials (wood, clay, gravel, dry-stone walls, slabs...) contributes to their perfect integration, making up harmonic landscapes where reflections and the mirror effect of water next to the white layers of salt deposits provide them with great aesthetic value (Román 2014).

Salinas also have historical, ethnographic, and sociocultural values. Salt production is an ancient activity that has remained important throughout history and across cultures. Likewise, reference is made to their historic value when it comes to explaining the role of salt in socioeconomic conflicts, wars, and territorial occupation (Hocquet 1994). Many Spanish towns and cities were founded, thanks to the production of salt, an activity that was stagnant from the Middle Ages to the final quarter of the nineteenth century. Other qualities are of an ethnological nature. The landscapes of inland saltworks are the result of know-how and the use of unique techniques and tools. As for social values, recovery and valorisation via educational, recreational, and tourist activities—like in Añana—can be found as the basis for preservation (Sanz et al. 2020).

And, of course, reference must be made to economic values. Inland "saltscapes" are the outcome of a traditional productive activity that lost ground as a result of competition from coastal salinas—more industrialised and market-accessible—but one that kept a small local market selling artisanal salt and making room for ecotourism products that use "saltscapes" and heritage as a resource. Several inland salinas have made the decision to focus on the design and marketing of a number of products: high-quality cooking salts, creams, soaps, bath salts, salt scrubs, and muds, among others.

We must take into account that an area with strong character such as a salina plays an important role in creating identity and a sense of belonging with the local community (Álvarez 2009; Van Der Valk 2014). Not only the rightful owners perceive salinas to be part of their own heritage. This is an aspect that should not be forgotten when identifying values. However, in most cases, current legislation is not enough to preserve the values of "saltscapes," decisions being made just by owners and their goodwill. Through partnerships, civil society can and should ensure research and the dissemination of the value of these salinas. They may even act as an authorised mediator between opposing parties or interests. From an academic perspective, support must be given through research in order to reinforce arguments for protection, management, and planning (Hueso 2015a). Some examples of coordinated action between different social partners intended to capitalise landscape—with heterogeneous results—can be found in the Salinas of Añana (Álava), Peralta de la Sal (Huesca), Poza de la Sal (Burgos), Rambla Salada (Murcia), and Gallocanta (Zaragoza) (Hueso 2015b).

Conclusions

Salt-related culture and heritage have been forged since Antiquity with the exploitation of sodium chloride as a resource. "Saltscapes" in inland Spain are no longer productive landscapes, but given their diverse values and appreciation by communities, they are also cultural geoheritage. Yet, these sites—plagued with history and culture—underwent a deep crisis in the twentieth century, one that only a few saltworks managed to overcome. Many of them were closed down due to the lack of profitability, abandonment inevitably brought along deterioration and the disappearance of salt-related architecture and landscapes, and the loss of a salt-related culture and a way of making a living. Everyone knows that developments in history determine territorial processes that shape the landscape. Landscapes change and evolve; they are made and remade. But some landscapes, like those of inland salinas, with their altered dynamics, have natural and heritage values that do legitimise our interest in protecting and managing them. Unfortunately, this landscape of "the useful," a landscape based on an economic activity which is now in decline, runs the risk of vanishing, with the subsequent loss of heritage.

Again, the problem lies in the different situations. We are talking about managing more than 500 salt-production sites and their associated landscapes; each of them has a particular size and economic situation, specific environmental conditions and regulations, historical developments, architecture and unique structures, and an identity of their own. This makes a specific analysis necessary in each individual salina and their landscape to be able to identify and project their qualities and characteristics. It is also necessary to take actions that ensure conservation and sustainability, inviting local players to participate in both the consolidation of sensitivities

and identities, and the structuring of new uses and the design of products.

Author's Contribution Not applicable.

Code Availability Not applicable.

Data Availability Not applicable.

Declarations

Conflict of Interest Not applicable.

References

Álvarez JG (2009) Lugares, paisajes y políticas de memoria: una lectura geográfica. Boletín de la Asociación de Geógrafos Españoles 51: 175–202

Antrop M (2005) From holistic landscape synthesis to transdisciplinary landscape management. In: Tress B, Tress G (eds) From landscape research to landscape planning. aspects of integration, education and application. Springer, Wageningen, pp 27–50

Batlle J (1995) A holistic approach to Salt-affected lagoon ecosystems: development and ecology. Salt-affected soils in central Spain. International Symposium on Salt-Affected Lagoon Ecosystems, ISSALE, 95. Universidad de Valencia, Valencia

Béchet A, Germain C, Sandoz A, Hirons GJ, Green RE, Walmsley JG, Johnson AR (2009) Assessment of the impacts of hydrological fluctuations and salt pans abandonment flamingos in the Camargue, South of France. Biodivers Conserv 69(6):1575–1588. https://doi.org/10.1007/s10531-008-9544-8

Bertrand G (2008) Un paisaje más profundo. De la epistemología al método Cuadernos geográficos 43:17–27

Bouzillé JB, Kernéis E, Bonis A, Touzard B (2001) Vegetation and ecological gradients in abandoned salt pans in western France. J Veg Sci 12(2):269–278. https://doi.org/10.2307/3236611

Brocx M, Semeniuk V (2007) Geoheritage and geoconservation-history, definition, scope and scale. J R Soc West Aust 90(2):53–87

Carrasco J, Hueso K (2008) Los paisajes ibéricos de la sal 1. Salinas de interior. Asociación de Amigos de las Salinas de Interior, Guadalajara

Carusi C (2008) Il sale nel mondo greco (VI aC-III dC): luoghi di produzione, circolazione commerciale, regimi di sfruttamento nel contesto del Mediterraneo antico (Vol. 15). Edipuglia, Bari

Council of Europe (2000) European Landscape Convention. https://rm.coe.int/1680080621. Accessed 10 Feb 2020

Junta de Andalucía (2012) La Estrategia de Paisaje de Andalucía. http://www.juntadeandalucia.es/medioambiente/portal_web/web/temas_ambientales/evaluacion_integracion_planificacion/planificacion_ambiental/estrategias/estrategia_paisaje/Estrategia_de_Paisaje_de_Andalucia_2012.pdf. Accessed 28 Jan 2020

Déjeant-Pons M (2006) The European landscape convention. Landsc Res 31(4):363–384. https://doi.org/10.1080/01426390601004343

Denton D (1984) The hunger for salt. An anthropological, physiological and medical analysis. New York, Springer

Di Méo G (2008) Processus de patrimonialisation et construction des territoires. In: Colloque Patrimoine et industrie en Poitou-Charentes: connaître pour valoriser. Geste éditions, Poitiers, pp 87–109

Fadamiro JA, Adedeji JA (2016) Cultural landscapes of the Yoruba of South-Western Nigeria demystified as solidified time in space. Space Cult 19(1):15–30. https://doi.org/10.1177/1206331215595751

Feldman SR (2011) Sodium chloride. Kirk-Othmer Encyclopedia of Chemical Technology. Wiley Online Library. New Jersey, EEUU. Doi: https://doi.org/10.1002/0471238961.1915040902051820.a01.pub3, Sodium Chloride

François H, Hirczak M, Senil N (2006) Territoire et patrimoine: la co-construction d'une dynamique et de ses ressources. Revue d'Économie Régionale & Urbaine 5:683–700. https://doi.org/10.3917/reru.065.0683

Hocquet JC (1985) Le sel et le pouvoir. Editions Albin Michel SA, Paris

Hocquet JC (1994) Le sel anime le monde. Journal of Salt History 2

Hueso K (2015a) Sal en el salero. Gestión del patrimonio y los paisajes de la sal en el siglo XXI. IPAISAL, Collado Mediano

Hueso K (2015b) Gente salada. Las salinas de interior, ¿un patrimonio vivo? IPAISAL, Collado Mediano

Hueso K, Carrasco JF (2006) Las salinas de interior, un patrimonio desconocido y amenazado. De re metallica: revista de la Sociedad Española para la Defensa del Patrimonio Geológico y Minero, 6: 23–28

Hueso K, Carrasco JF (2009) Los paisajes ibéricos de la sal. 2. Humedales salinos de interior. Asociación de Amigos de las Salinas de Interior, Guadalajara

Instituto Geológico y Minero de España (1997) Inventario nacional de recursos minerales de cloruro sódico y sales potásicas. IGME, Madrid

Iranzo E (2005) Las salinas continentales de la provincia de Valencia. Departament de Geografía, Valencia

Jellema A, Stobbelaar DJ, Groot JC, Rossing WA (2009) Landscape character assessment using region growing techniques in geographical information systems. J Environ Manag 90:S161–S174. https://doi.org/10.1016/j.jenvman.2008.11.031

Jones M, Stenseke M (2011) The issue of public participation in the european landscape convention. In: Jones M, Stenseke M (eds) The European Landscape Convention. Challenges of Participation. Springer, Dordrecht, pp 1–23

Latham JE (1982) The religious symbolism of salt. Col. Théologie Historique, 64. Editions. Beauchesne, Paris

Mangas J, Hernando M (2011) La sal en la Hispania romana. Arco Libros, Madrid

Mata R, Sanz C (2003) Atlas de los paisajes de España. Ministerio de Medio Ambiente, Madrid

Menéndez E (2008) Las rutas de la sal. Netbiblo SL, A Coruña

Mitchell N, Rössler M, Tricaud PM (2009) World heritage cultural landscapes. A handbook for conservation and management. World Heritage Papers 26. UNESCO World Heritage Centre

Moinier B, Weller O (2015) Le sel dans l'Antiquité ou les cristaux d'Aphrodite. Ed. Les Belles Letteres, París

Molinero F, Tort J, Ojeda F, Ruiz E, Martínez E, Silva R, Mata R (2013) Atlas de los paisajes agrarios de España. Tomo I. Ministerio de Agricultura, Alimentación y Medio Ambiente, Madrid

Pasquaré Mariotto F, Bonali FL, Venturini C (2020) Iceland, an open-air museum for geoheritage and Earth science communication purposes. Resources 9:14. https://doi.org/10.3390/resources9020014

Quesada T (1995) Las salinas de interior de Andalucía Oriental: ensayo de tipología. In: Cara L, Malpica A, Agricultura y Regadío en al-Andalus, síntesis y problemas: actas del II Coloquio de Historia y Medio Físico. Instituto de estudios almerienses, Almería

Román E (2014) Paisajes de la sal en Andalucía. Tesis doctoral. E.T.S. Arquitectura (UPM). http://oa.upm.es/cgi/export/36487/. Accessed 20 Jun 2020

Saile T (2015) Competing on unequal terms: saltworks at the turn of the Christian era. In: Brigand R, Weller O (eds) Archaeology of Salt: Approaching an invisible past. Sidestone Press, Leiden, pp 199–210

Sanz J, Zamalloa T, Maguregi G, Fernandez L, Echevarria I (2020) Educational potential assessment of geodiversity sites: a proposal

and a case study in the Basque Country (Spain). Geoheritage 12:23. https://doi.org/10.1007/s12371-020-00432-z

Stockinger U (2015) The salt of Rome. Remarks on the production, trade and consumption in the north-western provinces. In: Brigand R, Weller O (eds) Archaeology of Salt: Approaching an invisible past. Sidestone Press, Leiden, pp 183–198

Swanwick C (2002) Landscape character assessment—guidance for England and Scotland. Countryside Agency, Cheltenham and Scottish Natural Heritage, Edinburgh

Tilley C (2006) Introduction identity, place, landscape and heritage. J Mater Cult 11(1-2):7–32. https://doi.org/10.1177/1359183506062990

Tsigarida I (2012) Zur Bedeutung der Ressource Salz in der griechisch-römischen Geschichte. Eine Einführung. In: Olshausen E, Sauer V (dir) Die Schätze der Erde – Natürliche Ressourcen in der antiken Welt. Stuttgarter Kolloquium zur Historischen Geographie des Altertums 10, 2008. Geographica Historica 28, Stuttgart, pp 377-396

Tudor C, England N (2014) An approach to landscape character assessment. Natural England, UK

Van Der Valk A (2014) Preservation and development: The cultural landscape and heritage paradox in the Netherlands. Landsc Res 39(2):158–173. https://doi.org/10.1080/01426397.2012.761680

Venturini C, Pasquaré MF (2019) Geoheritage Promotion Through an Interactive Exhibition: a Case Study from the Carnic Alps, NE Italy. Geoheritage 11:459–469. https://doi.org/10.1007/s12371-018-0299-7

Weller O (2004) Los orígenes de la producción de sal: evidencias, funciones y valor en el Neolítico europeo. Pyrenae 35(1):93–116

Williams M, Reid ML (2008) Salt, life and industry: excavations at King Street. Middlewich, Cheshire, 2001-2002. British Archaeological Reports British Series 456. BAR Publishing.

Zant J (2016) Excavations on a Roman Salt-working Site at Jersey Way, Middlewich, Cheshire. Archaeol J 173(1):56–153. https://doi.org/10.1080/00665983.2015.1119637