



The negligence and lazy of the Administration: the greatest danger to the conservation of unique sites of exceptional preservation

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ABSTRACT

An example is given of one of the most important sites in the Spanish fossil record, such as the almost a hundred moulds of ancient jellyfish of hydrozoan Medusozoa, Cnidaria, exceptionally preserved in an arkosic greywacke bedding plane of the Corduban/Terreneuvian Epoch (lowermost Cambrian) in the municipal district of Constantina (Seville). In spite of its scientific-patrimonial importance and the fact that it has been brought to the attention of the Andalusian autonomous administration for more than twenty-five years, it has still not been the object of an adequate legal protection figure. This lack of interest or bureaucratic slowness is causing an irreparable loss in many of its elements affected by erosion and the passage of time.

A series of urgent actions are also proposed to mitigate the current deterioration of the site and favour its conservation.

Keywords: Palaeontological heritage, administrative inaction, fossil jellyfish, Lower Cambrian, Terreneuvian, Constantina (Seville).

RESUMEN

Se expone el ejemplo de uno de los yacimientos más importantes del registro fósil español como son los casi cien moldes externos de antiguas medusas de Medusozoa, Cnidaria, tipo hidrozoo, conservadas en el techo de un estrato de grauvacas arcósicas de edad Cordubiense/Terreneuviense (Cámbrico inferior temprano), en el término municipal de Constantina (Sevilla). A pesar de su excepcionalidad científico-patrimonial y de haber sido puesto en conocimiento de la administración autonómica andaluza desde hace más de veinticinco años, todavía no ha sido objeto de una figura de protección legal adecuada. Esta falta de interés o de lentitud burocrática está ocasionando una pérdida irreparable en muchos de sus elementos, afectados por la erosión y el paso del tiempo.

Palabras clave: Patrimonio paleontológico, inacción administrativa, medusas fósiles, Cámbrico inferior, Terreneuviense, Constantina (Sevilla).

1. INTRODUCTION

The Lower Cambrian jellyfish site from Constantina, 540 Ma in age, located in the Sierra Norte de Sevilla Natural Park has been known for 27 years when Liñán & Mayoral (1992) studied it for the first time. This publication highlighted the enormous interest in such a discovery, which contained almost a hundred specimens, some of the exceptional size and great value, both because of their biostratigraphic and because of their taphonomic and preservation attributes.

Considering the importance of the discovery, Mayoral (1996) proposed to the Department of Education and Science of the Regional Government of Andalusia, the realization of a project entitled Study and Recovery of the Medusoid Site of the Lower Cambrian from Constantine (Province of Seville), which was approved by the General Direction of Universities and Research.

More detailed studies concerning stratigraphic, sedimentological and taphonomic observations were subsequently carried out, which led to a second project focusing on the protection and conservation of the site (Mayoral, 2001). Because of this intervention, new data were later published (Gámez-Vintaned *et al.*, 2001; Mayoral *et al.*, 2004, 2008) and there was the need to establish a conservation program including cleaning, access and preservation of the place.

The relevance of the site together with other points of geological and palaeontological interest located in Sierra Norte de Sevilla Natural Park has been one of the decisive arguments for UNESCO to declare it a World Geopark in 2015.

Precisely and urged by this proclamation, the Governing Board of the Sierra Norte de Sevilla Natural Park has analysed the proposal presented by the Counseling of Environment and Territorial Planning to declare the site as Natural Monument of Andalusia. In this line, Gil-Toja *et al.* (2016) presented the proposal for this figure of protection in the framework of the 7th International Conference on UNESCO Global Geoparks, held that same year in Torquay (United Kingdom).

2. THE SITE, A GEOLOGICAL APPROACH

This unique palaeontological site is near the village of Constantina (Seville province), located in the Sierra Morena, southern Spain, 91 km north of Seville city (Fig. 1a).

In this region, the Cambrian consists of three major lithological units: lower terrigenous (early Lower Cambrian), middle carbonate (Lower Cambrian) and upper terrigenous (Lower-Middle? Cambrian). In Constantina area, the three units are respectively the Torreárboles Formation, Campoallá series and Alanís beds. The Campoallá series contains Ovetian to Marianian

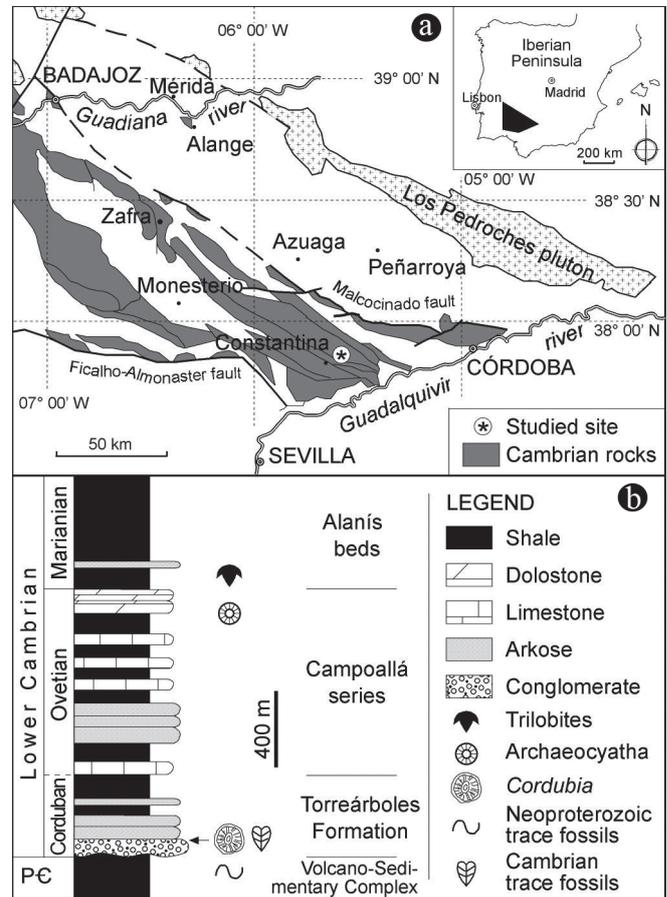


Figure 1. a) Geological sketch map with location of the palaeontological site. b) Synthesis of the stratigraphy of the area (after Mayoral *et al.* 2004).

(Atdabanian-Botoman) archaeocyathan (Perejón, 1986), and the Alanís beds provided Marianian (Botoman) trilobites of the *Saukianda* fauna (Richter & Richter, 1941; Sdzuy, 1962).

The Torreárboles Formation, containing the biota studied here is 0–400 m thick, consisting of conglomerate and sandstones of the lower La Tierna Member and reddish shales and sandstones of the upper Julia Member. Abundant trace fossils (Fedonkin *et al.*, 1985; Liñán, 1984) suggest a Cordubian age for this formation, the parastratotype of the Terreneuvian Series for the Mediterranean Area. The biota occurs at the lower part of the La Tierna Member, and a Lower Cordubian age (Fortunian) is inferred (Fig. 1b).

This palaeontological site shows one of the highest concentrations of discoid soft bodies known from the Phanerozoic fossil record. Ninety specimens of discoid fossils up to 88 cm in diameter are recorded on a single, well-exposed top-bedding plane of ca. 120 m² (15 m x 8 m) dipping 20° S (Figs. 2a–b, 3). The taphonomic study of the abundant discoid impressions, as well as their morphology and ontogeny allow interpreting these fossils as outer moulds of ancient jellyfishes of hydrozoan Medusozoa,

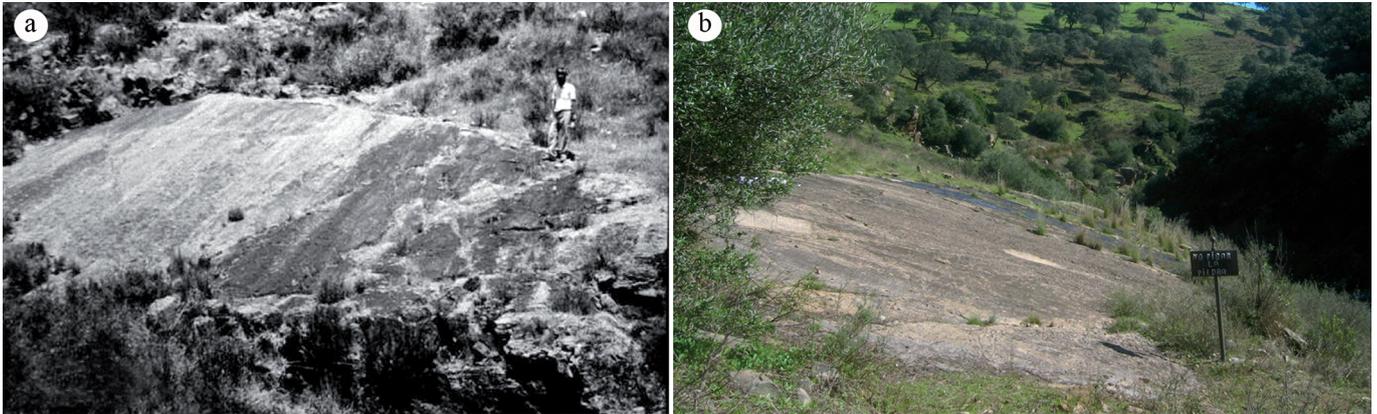


Figure 2. General view of the outcrop. a) June 1992. b) At present.

Cnidaria, named as *Cordubia gigantea* (Mayoral *et al.*, 2004), from which it has been possible to identify twenty specimens of subumbrellar side and seventy of exumbrellar side (Fig. 3). *Cordubia gigantea* from Constantina (Sevilla) is the oldest Cambrian impression of medusozoan known and probably coeval with the embryonic form of medusozoan phosphatized discovered in the Terreneuvian of South China (Wang *et al.*, 2017).

3. CURRENT STATE OF CONSERVATION

3.1. Main causes of deterioration

Several factors contribute to the continuous erosion and destruction of the site over time, with the consequent loss of palaeobiological and palaeoecological information. One of the most important is the climate. The climate

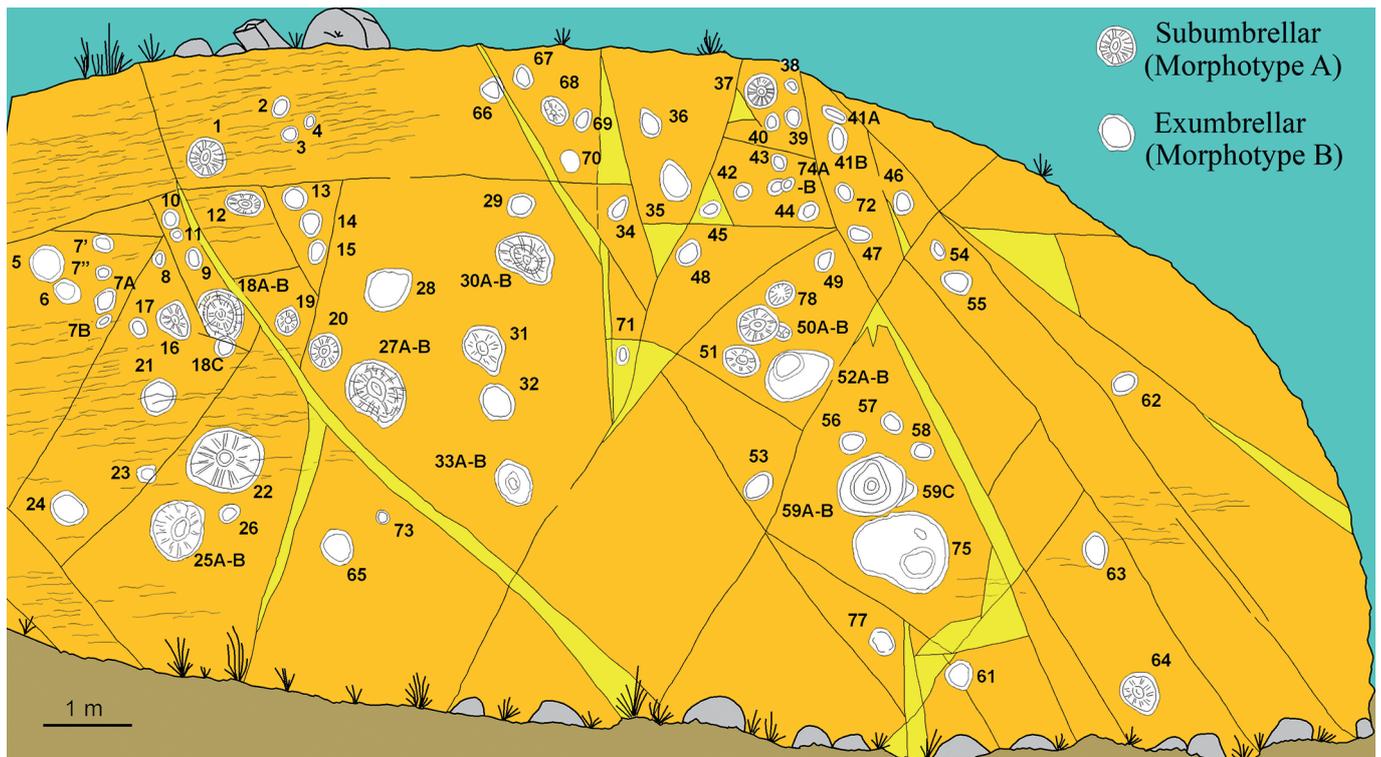


Figure 3. Sketch of the bedding surface containing *Cordubia gigantea* Mayoral *et al.* 2004. Specimen 1: holotype. Specimens 12, 16, 37 and 50A: paratypes of morphotype A. Specimens 2, 42 and 43: paratypes of morphotype B. The bedding surface dips towards the observer. Joints and wave ripple marks are also shown. Yellow areas represent the main parts with detachment or possibility of material loss caused by joints. Note the plasticity of the gelatinous medusozoan body by the different moulds present and the well-represented ontogeny (after Mayoral *et al.*, 2004).

in Constantina area is warm and temperate. During the year, the temperature generally varies from 2 °C to 33 °C and rarely falls below -3 °C or rises above 37° C, with an average annual temperature of 15.5 °C. Winters are rainier than summers. In addition, it is located in one of the domains with the highest rainfall in Andalusia, whose average rainfall is approximately 681 mm, which is next to the highest average value of Sierra Morena [750 mm, Department of the Environment and Territorial Planning (Consejería de Medio Ambiente y Ordenación del Territorio), Regional Government of Andalusia]. These characteristics together with the surface conditions themselves actively cause the majority of the conservation problems of the outcrop.

Another problem is that the entire surface of the outcrop is now uncovered, without any protection. This state means that, given its 20° dip (Figs 2a-b, 4a, 5c), the drain water in periods of intense rainfall carries a large number of materials (fragments of rocks, trunks and plant remains) from the hillside located in the proximity (Fig. 4b).

On the other hand, this water penetrates through the many joint systems that is found along the surface (Figs 3, 4c-f, 5a-e) and affecting the bedding plane favours a slow collapse of the part near to a cliff, which has two significant consequences. Also, they increase the direct erosion of the rocks and can favour their breakage and disintegration due to the action of freezing/thawing cycles in winter. On the other hand, they are seed-carrying agents that are implanted inside the groves and give rise to the growth of plants whose roots increase the previous destructive power (Figs 5c-e).

Another critical aspect of weathering is the lichen colonisation that damage specimens and cover the vast majority of them, which in many cases, prevents even their correct observation (Figs 4c-f, 5f).

3.2. Proposals for action

The main lines of action can be summarized in three phases:

1. Cleaning the vegetation cover: removal of lichens and plants. The different procedures tend to remove all adhering substances from the substrate surface. The original appearance must be respected in these operations, and the surface stability must be carefully controlled, fixing the areas in danger of detachment before starting any restoration process. Cleaning is a delicate process because it is irreversible, and the state of the surface to be reached and the adequate way to apply the available knowledge and resources are essential.

Many species of lichens cause deterioration on a wide variety of substrates through chemical or mechanical action. By this reason, to remove dust particles or bacteria, fungi, lichens, algae, etc., superheated dry steam

is used together with the possibility of using detergents. Subsequently, treatment with specific biocides (fungicides, algicides and bactericides) keeping in mind at all times the legal protection of the flora in this Natural Park can also be applied.

To facilitate the cleaning of the substrate can also be washed with soap and water using a bristle brush. The operation must be repeated until the desired degree of cleanliness is reached.

2. Surface consolidation and conservation. The work of consolidation necessarily requires prior knowledge of the substrate and particularly of the environment in which it is exposed to select products that remain unchanged over time.

Conservation studies consist of field (in situ) and laboratory tests. These studies give information on the state of deterioration and the behaviour of the rocks before and after treating them with commercial consolidation products (to keep them cohesive) and hydrofugation (so that the water does not affect them).

An efficient consolidant must have easy penetration, be compatible with the substrate, not decrease the initial porosity in general and not affect the surface appearance.

Currently, the most commonly used products are silicones, silicic esters, acrylic resins and fluosilicates according to the desired properties. The application of these techniques should be focused on the filling and sealing of joints, fractures and fissures.

3. Physical protection of the outcrop. It is essential, urgent, and necessary, an action that leads to the protection of the site against the meteorological agents described above.

Clamping of the slope is necessary since the lower zone of the outcrop constitutes a small cliff that is near to a creek that is excavating and gradually eroding its base. This state has originated small displacements and the opening of joints with the consequent detachment of material.

At the same time, the construction of peripheral drainage channels it is required to control surface water and infiltration. It is also imperative the exterior fencing of the upper zone of the outcrop to avoid dragging and collapse of rocks coming from the adjacent hillside. Finally, the construction of a roof that serves to protect the surface from the severity of the weather, as is usual in the majority of the dinosaur ichnites sites from the Spanish fossil record, would be the final step.

Also and as an additional measure, it would be necessary to provide an access way to the site with the construction of at least two observation platforms that would allow appreciating in its entire extension the unique characteristics of this outcrop always taking into account the environmental protection laws.

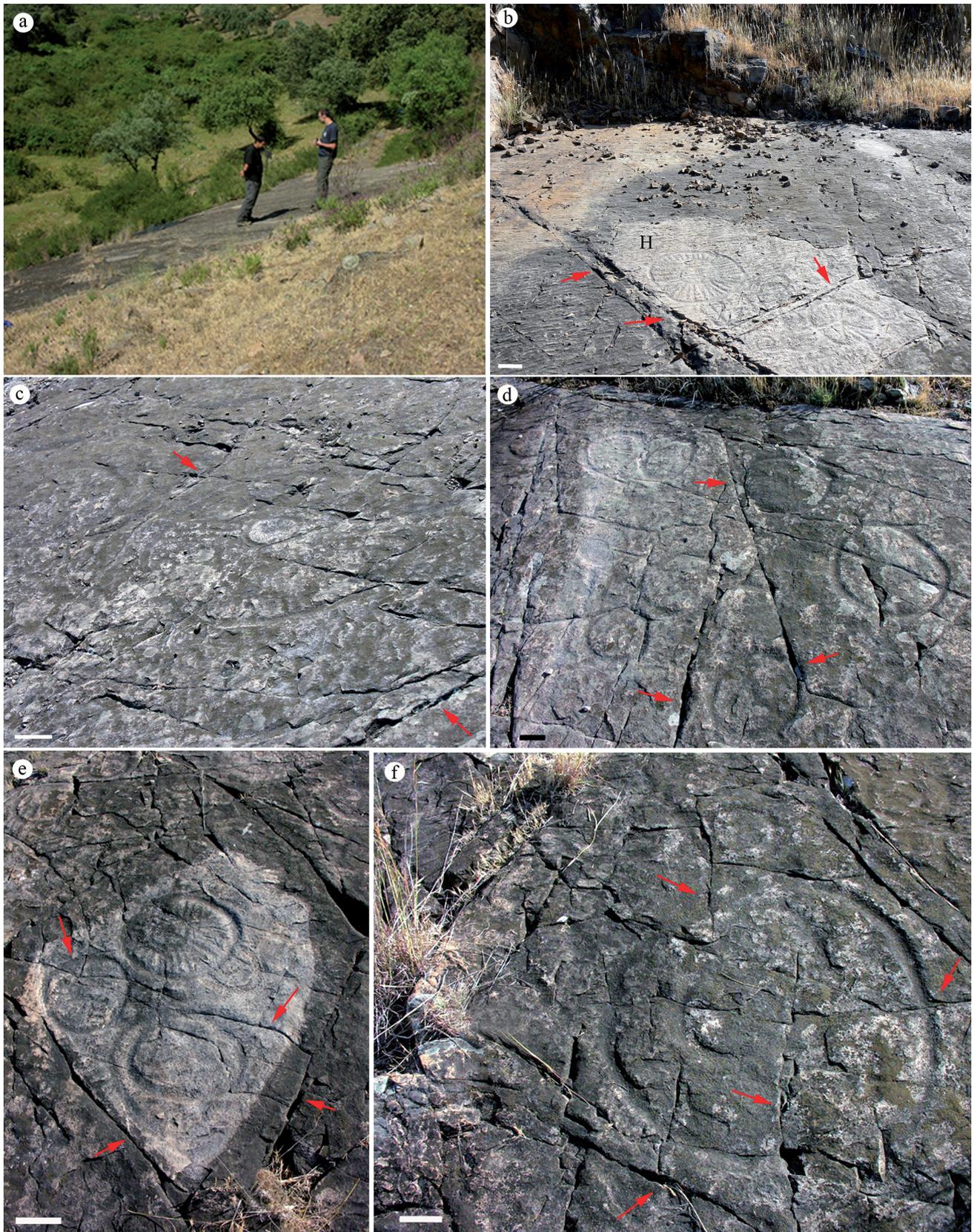


Figure 4. **a)** Surface view showing dip angle (20°SW). **b)** Upper part of the outcrop where the holotype (H) is found (number 1 in figure 3), affected by detachments of stones and open joints (red arrows). Scale bar = 10 cm. **c)** The largest specimen of the site (n° 22 of figure 3) close to several joints and covered by a layer of lichens. Scale bar = 10 cm. **d-f)** Several specimens in exumbrellar and umbrellar sides affected by an important network of joints (red arrows) and lichens. Scale bars for d and f = 8 cm. Scale bar for e = 15 cm.

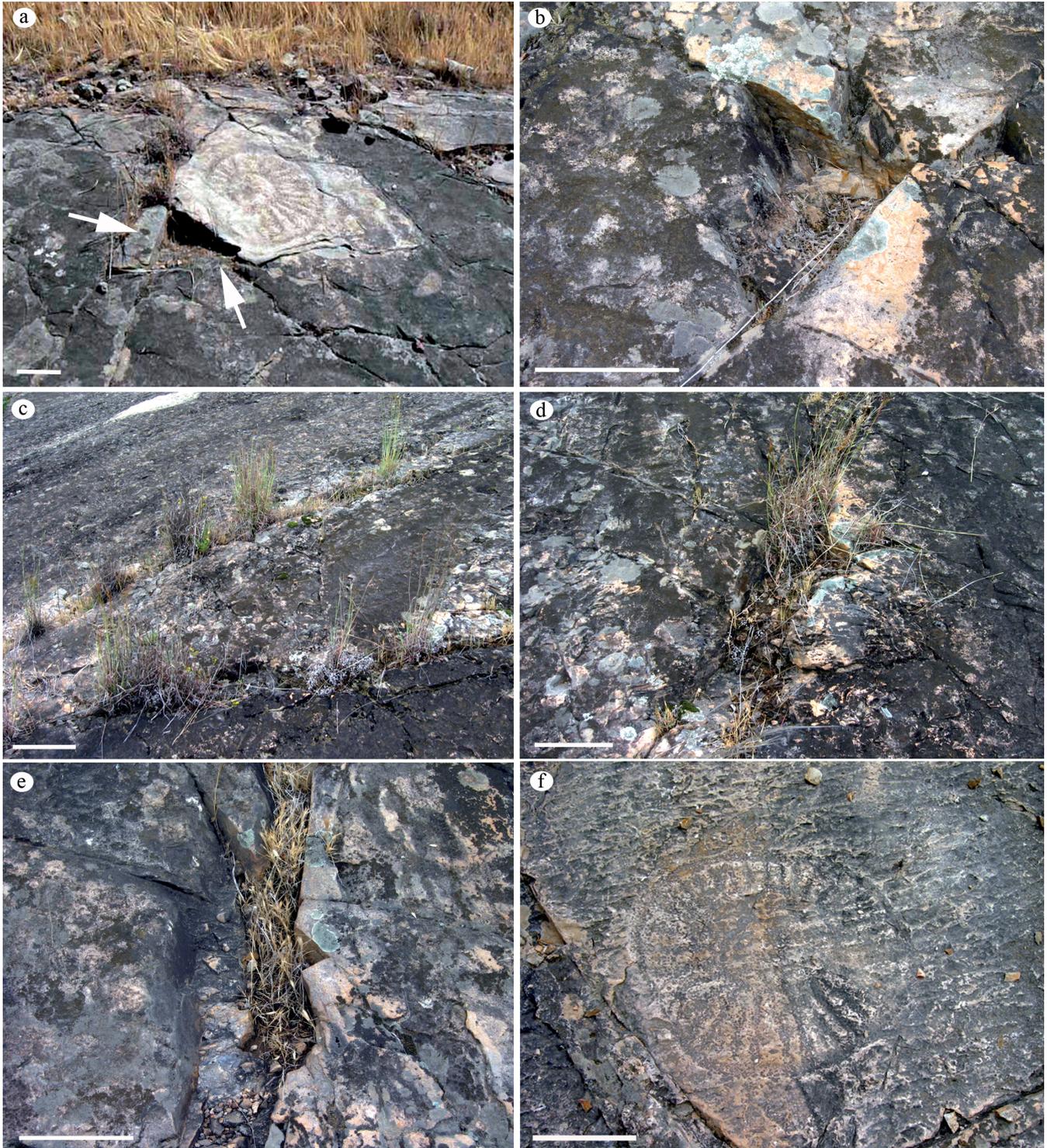


Figure 5. **a)** Paratype of subumbrellar side (specimen 37 in Fig. 3) affected by a network of joints with material detachment. **b)** Detail of another detachment caused by the joints. **c-e)** Plant development and growth in favour of joints. **f)** Lichen cover over holotype and ripple marks. Scale bars = 15 cm.

4. LEGAL PITFALLS

In Andalusia, the word “palaeontological” was included in the old Ley 1/1991 of Historical Heritage of Andalusia, now not in force, as: “The Andalusian Historical Heritage

is composed of all cultural resources, in any of its manifestations, as they are in Andalusia and reveal an artistic, historical, palaeontological, archaeological, ethnological, documentary, bibliographic, scientific or technical interest for the autonomous community”. This

law did not subsequently include any other reference to items of palaeontological interest. As for the protection of palaeontological sites, only those of anthropological interest were taken into account, and no figure for special protection was mentioned.

Subsequently, Ley 14/2007 of the Historical Heritage of Andalusia considers the concept “palaeontological” as different typologies: Monument, Historic Site, Historical Site or Archaeological Zone. All of them can be registered for their interest for the Autonomous Community, as a Good of Cultural Interest (Bien de Interés Cultural, BIC) within the General Catalogue of Andalusian Historical Heritage.

It is also considered together with the geological elements, an integral part of the previous Heritage, as long as it is related to the history of humanity and its origins and antecedents. Finally, palaeontological remains are also viewed as objects of study in archaeological excavations and their destruction as a serious or severe infraction.

All this lack of adequate legislation, with specific protection figures, has led to significant legal distress and that is having, as is the case here, severe and irreparable consequences.

Palaeontology has been subject in the legal framework to the Regulation of Archaeological Activities, which has also gone through several stages regarding its consideration. Thus, according to Decreto 32/1993, the Andalusian Palaeontological Heritage could be the object of research by palaeontologists, (“Authorization may be requested by physical persons, national or foreign, who hold the academic title of Graduate, and accredit archaeological or palaeontological training, or with an analogous degree obtained in foreign Universities, whose degrees have been homologated by the Spanish State”). This research could be carried out through the application of General Research Projects (6 years), Superficial Archaeological (Palaeontological) Prospections and Urgent Stratigraphic Probes.

Even at this stage, where the palaeontological was under the protection of the Department of Culture, there were confusing situations, arising from the inaccuracy, ambiguity and inadequacy of the law itself. The first project for the protection and conservation of the site (Mayoral *et al.*, 2001) could not be reported by the Archaeological Advisory Commission (as theoretically stated in the law) and was transferred to the Historical Heritage Conservation Service and the Director of the Sierra Norte de Seville Natural Park. The Culture managers themselves saw environmental management as more appropriate.

Subsequently, Decreto 168/2003 approved the new Regulation of Archaeological Activities that only contemplates palaeontology related to human culture, although it considered the possibility of carrying out Research Activities related to “Non-Human Palaeontology”, the director could only be a graduate in Humanities. This

person had to prove theoretical and practical training in Archaeology or with a similar degree obtained in foreign Universities, whose degrees have been homologated by the Spanish State.

Until now, Palaeontology has been the subject of legislation by the Department of Culture (Ley 14/2007 of the Historical Heritage of Andalusia) and the Department of the Environment (Ley 2/1989 of the Inventory of Protected Natural Spaces of Andalusia). Indeed, this Law contemplates the possibility of four protection figures, Natural Park, Natural Monument, Natural Park and Natural Reserve. Also for the moment, in the Declaration of Goods of Cultural Interest (Bien de Interés Cultural, BIC) related to palaeontological records, priority has been given to the incorporation of spaces of anthropological interest.

A first step towards the development of future protection of palaeontological heritage was the Andalusian Inventory of Georresources published by the Department of the Environment of the Junta de Andalucía, which collected 109 points of palaeontological interest throughout the community. Afterwards, this Department prepared the Andalusian Strategy for the Integrated Management of Geodiversity (Dirección General de Gestión del Medio Natural, 2008, 2011), which in its 2008 draft, as well as in the 2011 final document, only alludes to palaeontological and geoarchaeological diversity (yet another reflection of the subordination to archaeology). This consideration resulted in a list of geosites, where except for the Pliocene and Pleistocene vertebrate sites, the rest of the invertebrate sites are generically included in only two geological contexts. One is the Lower and Middle Paleozoic Stratigraphic Series of the Iberian Massif, with the mention of a geosite, the Paleozoic of the Synclinal del Valle (Cazalla de la Sierra, Sevilla). The other, the Mesozoic Series of the Bética and Iberian Cordilleras, with two palaeontological geosites, the Lower Cretaceous of the Sierra de Segura (Jaén) and the Ammonitico Rosso Facies (Subbética de Córdoba).

5. FORWARD-LOOKING ALTERNATIVES

Despite the distress and legal confusion regarding the protection and conservation of the palaeontological heritage in Andalusia, not everything is lost. The Direction General of Cultural Goods of the Junta de Andalucía created the Network of Cultural Spaces of Andalusia (Red de Espacios Culturales de Andalucía, RECA), which integrates the archaeological sites and, consequently, the palaeontological ones. This Network contemplates the opening of Cultural Parks and Andalusian sites with the provision of essential services, focused on enhancing the custody, conservation, diffusion and public access to the sites.

The need to conserve the Geological Heritage and Geodiversity, valuing their potential as a natural, socioeconomic and tourist resource is the basis for integrating the protection figures, either using existing ones or creating new ones that are more adjusted to the particularities of the palaeontological sites. Furthermore, Ley 2/1989 reinforced the treatment of Geodiversity and Geological Heritage in the Network of Protected Natural Spaces of Andalusia, through the incorporation of specifically geological Natural Monuments, where the palaeontological component is in some of them, of great importance. In the Community of Andalusia, there are 37 elements declared as Natural Monuments, of which only one is exclusively palaeontological, the dinosaur footprints of Santisteban del Puerto (Jaén). Precisely, this is the figure that has been in the process for several years for the site of the fossil jellyfish of Constantine, but until when?

6. CONCLUSIONS

The bureaucratic inaction of the Andalusian autonomous administration in the matter of protection of the palaeontological heritage is putting at risk the conservation of one of the best fossil jellyfish beds in the lower Cambrian. More than twenty-five years have passed since the importance of the site was known, and everything is yet to be done, which is causing this emblematic and unrepeatable site to be lost without remission. Likewise, the absence of an adequate legal protection figure has undoubtedly contributed to this deterioration. It also proposes a few simple steps to initiate urgent actions to save, as far as possible the current situation.

ADDENDUM

After the writing of this article, the Junta of Andalusia, at the meeting of its Governing Council held on 23 April 2019, has inscribed the site of the fossil jellyfish of Constantine in the Network of Protected Natural Areas of Andalusia (Red de Espacios Naturales Protegidos de Andalusia, RENPA), granting it the category of Natural Monument. Undoubtedly, this step is important because it can serve as an example of the future management of palaeontological sites focused from the perspective of natural heritage and therefore, using figures such as “natural spaces” to conserve them. The palaeontological community and the general public, we are in congratulations and what is expressed in this paper should serve as an accusation of what should never happen if we want our immense and rich palaeontological heritage not to be irreparably lost forever.

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