

The Exceptional Fossil Site of Las Hoyas (SPAIN) from an Educational Perspective

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Abstract The paleontological heritage of the fossil site of Las Hoyas (Early Cretaceous of Cuenca, Spain) is becoming a relevant part of the sociocultural identity of Castilla-La Mancha autonomous community in general, and of Cuenca province in particular. The most recent scientific advances, including several fossil findings that have had high scientific impact, have made Las Hoyas to regularly be the center of attention in the local, national, and international media, especially since the reinterpretation of the paleoecosystem represented by the locality published in 2010. These results have led to a *renaissance* of the interest of the society for this unique site. As a consequence, Las Hoyas has been declared

Site of Cultural Interest by the regional government, in the form of paleontological zone. This recognition, which grants the locality with the highest level of protection, sets a legal framework for the educative initiatives developed at this locality, which can be categorized as non-formal education, formal education, and Social Paleontology.

Keywords Education · Las Hoyas · Paleontological heritage · Site of Cultural Interest · Social Paleontology

Introduction

The paleontological heritage of the Spanish region of Castilla-La Mancha is, like everywhere else, strongly linked to the geology of the region. In this sense, Castilla-La Mancha presents a great geological diversity, with outcrops dating back from the end of the Precambrian, over 540 million years ago, and up to the Pleistocene and Holocene (Buscalioni 2005). As a whole, the fossil record of Castilla-La Mancha forms a relevant representation of the Paleozoic, the Mesozoic, and the Cenozoic Eras.

All the Paleozoic periods are well represented in Castilla-La Mancha (Aguirre and Rábano 1999; Nuche del Rivero 2003). The oldest fossils known from this community, and in fact the oldest fossils of the whole Spanish record, come from the province of Toledo. These fossils are mostly imprints of the activity of vermiform organisms, as well as rests of cellular aggregates. These fossils have been dated as Alcludian, just in the transit between the Precambrian and the Cambrian (Prado et al. 1855). The most characteristic fossils from the Cambrian to the Devonian are those of marine invertebrate faunas, including trilobites, graptolites, brachiopods, conodonts, and eurypterids. The fossil site of Puertollano, located in the Province of Ciudad Real and known as the Paleozoic Pompeii, constitutes the most remarkable record from the Carboniferous period. This site is,

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in fact, one of the most important fossilized Carboniferous forests worldwide, since its record includes plant parts that have never been found elsewhere (Wagner et al. 2003). Shark and acanthodian fossils are also abundant in the Carboniferous of this region. Finally, the Permian is represented by a record of large coniferous trees.

During the Triassic, the Tethys sea level rose, and the subsequent transgression process covered previously emerged areas. As a consequence, the Triassic of Castilla-La Mancha is mostly represented by marine faunas, including many bivalves, but also marine reptiles such as notosaurs and placodonts. The Jurassic is mainly represented by an abundant record of ammonites, brachiopods, and bivalves. Although the Jurassic is usually best known for the dinosaurs, these are not well represented in this region. The Cretaceous outcrops are located in the provinces of Albacete, Guadalajara and, mainly, Cuenca. At this time, the regression of the Tethys Sea gave origin to large coastal platforms, as well as freshwater systems relatively isolated from the marine influence. The fossil record of this period includes the most important fossil sites of Castilla-La Mancha, such as Buenache de la Sierra (Buscalioni et al. 2008), Lo Hueco (Cambra-Moo et al. 2012; Ortega et al. 2015), and, especially, Las Hoyas (Sanz et al. 1988; Meléndez 1995; Buscalioni and Fregenal-Martínez 2010; Poyato-Ariza and Buscalioni 2016).

The Castilian Cenozoic landscapes were constituted by more or less large fluvial basins encased in extensive plateaus. The Paleogene and Neogene of this region present a high fossiliferous richness, especially concerning Oligocene and Miocene mammals (mastodons, rhinoceros, equids), and the fossil record also includes fishes, amphibians, and reptiles. Some of the most representative sites of this time are those of Córcoles (province of Guadalajara; Alférez et al. 1999), Yuncos (Toledo; Mazo and Alberdi 1974), and Las Higuieruelas (Ciudad Real; Alberdi et al. 1984). The Quaternary record of Castilla-La Mancha contains mammals from the Pleistocene and Holocene, including equids, elephants, hippopotamuses, the last pantherine cats to inhabit the Iberian Peninsula, and even hominid remains (Arribas and Jordá 1999, Cuenca-Bescós et al. 2016).

But among all the rich localities of Castilla-La Mancha, the site of Las Hoyas clearly stands out. Las Hoyas is a fossil *konservat-Lagerstätte* located in the Serranía de Cuenca, in the Southwestern Iberian Ranges. This locality belongs to the La Huérguina limestone Formation (Vilas et al. 1982) and is Upper Barremian (Early Cretaceous) in age (Vicente and Martín-Closas 2013). The fossil site of Las Hoyas was found around 1985, and since then, nearly 30 excavation campaigns have produced an incredible large collection of fossils, with over 19,000 specimens cataloged and still housed at the Sciences Museum of Castilla-La Mancha in Cuenca.¹ The

exceptional preservation characteristic of the fossils and the completeness of its floral and faunal association have placed it among the most renowned fossil localities of the world from a scientific point of view, which have been subject of numerous scientific publications. However, the last advances developed around Las Hoyas have caused it to be more and more relevant not only for the scientists but also for the society and public administrations of Castilla-La Mancha.

Recent Scientific Advances on Las Hoyas

The first sedimentological analyses of the association of facies bearing the fossiliferous laminated limestones of Las Hoyas led to interpret them as deposited in the basin of a deep lake (Sanz et al. 1988). From that early interpretation on, 20 years of stratigraphic and sedimentological study of the locality and its integration into the regional framework (e.g., Fregenal Martínez 1998; Fregenal-Martínez and Meléndez 2000; Buscalioni et al. 2008) have progressively modified the regional paleogeographical reconstructions, as well as the environmental reconstruction of the lacustrine sediments of Las Hoyas.

The integration of the stratigraphical, sedimentological, paleogeographical, and paleobiological data, both regional, and local from Las Hoyas, has allowed the reinterpretation of Las Hoyas fossiliferous laminated limestones as a shallow marginal lacustrine environment with frequent, seasonal water-level oscillation, and filled with layered microbial mats, in the framework of a regional-scale subtropical inland wetland (Fregenal Martínez and Buscalioni 2009; Fregenal-Martínez and Meléndez 2000).

Such environment has been more recently reconstructed by Fregenal Martínez and Meléndez (2016) as shallow lacustrine pools filled with microbial mats, developed in small depressions, and integrated into a larger wetland complex. Pools were located at the distal and terminal reaches of an environmental belt, where the dominant process was the slow unconfined drainage of vegetal remains, bioclasts, and carbonate sediments.

The locality of Las Hoyas is, in fact, the best known among the very few known ecosystems of the past to be comparable to extant wetlands (Buscalioni and Fregenal Martínez 2010).

With this new interpretation, the biota of Las Hoyas was finally contextualized from an ecological point of view, which opened up new prospects to a deeper understanding of the paleoecology of taxa and new findings. In this sense, the last years have witnessed the discovery and publication of numerous fossils and studies of high scientific relevance, renewing the interest of the paleontological community on this *Konservat-Lagerstätte* (Fig. 1).

In 2010, *Concavenator corcovatus* Ortega et al. 2010, a 6 m long carcharodontosaurid theropod dinosaur, was

¹ <http://pagina.jccm.es/museociencias/>

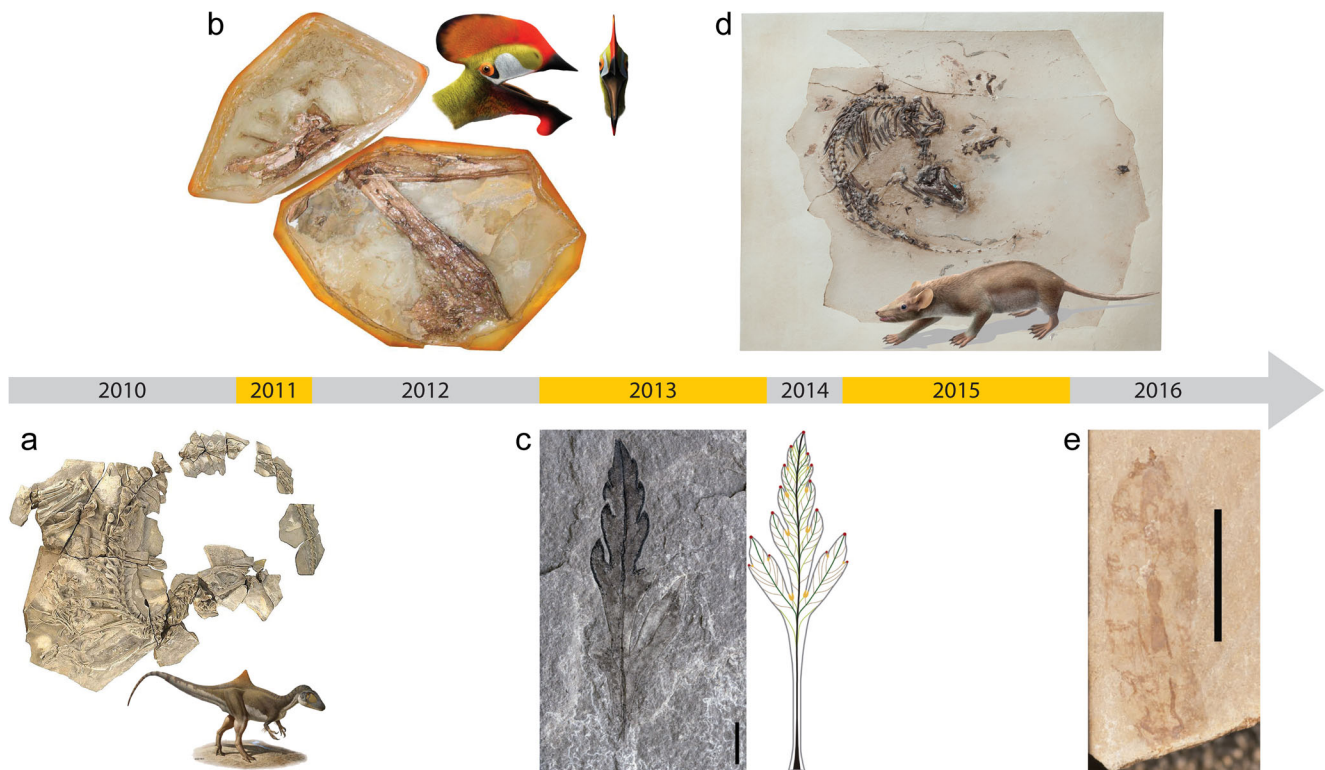


Fig. 1 Some of the most relevant fossil findings at Las Hoyas since 2010. **a** The theropod dinosaur *Concavenator corcovatus*. **b** The tapejarid pterosaur *Europejara olcadesorum*. **c** The angiosperm *Iterophyllum*

lobatum. **d** The mammal *Spinolestes xenarthrosus*. **e** A representative of the highly diversified association of worms. Modified from the publications cited in the text

described. The presence of a characteristic lumbar crest on the back of this dinosaur, from which the new species takes its name, has made him to be known worldwide.

In 2011, the paleohistology of different tetrapods from the locality was studied, showing that these fossils preserve the microstructure of the bones. The bone growth rate of the different tetrapods suggests that an ecological filter favored small-sized species to inhabit the ecosystem (Bailleul et al. 2011), providing thus a hypothesis to answer one of the most intriguing questions regarding Las Hoyas, the unusual small size of the vertebrates. Also in 2011, an analysis of the isolated feathers of avian and non-avian theropod dinosaur was carried out (Marugán-Lobón and Vullo 2011). This study showed that even the coloration patterns of the feathers, such as stripes or patches, are preserved at Las Hoyas.

In 2012, the first tapejarid pterosaur from Europe, *Europejara olcadesorum* Vullo et al. 2012, was described from Las Hoyas. It was the oldest tapejarid known to date, suggesting a euroasiatic origin for the group. It also represents the oldest toothless pterosaur, which is a feature associated to the development of new feeding strategies. The same year, a new tiny lizard, *Jucaraseps grandipes* Bolet and Evans 2012, was also described. The exceptional preservation of the fossils of this taxon has provided meaningful information for the understanding of the history of the small-size trait in

squamates, since fossils of this group are usually not well-preserved.

In 2013, the underlying causes for the exceptional preservation of the fossils at Las Hoyas were explored by means of actinotaphonomical experiments using modern microbial mats (Iniesto et al. 2013). These experiments showed how the organization, structure, and activity of the mats are interrelated and favor the exceptional preservation. Also in 2013, one of the first known terrestrial angiosperms, *Iterophyllum lobatum* Barral et al. 2013, was newly described from Las Hoyas. The study of its leaf architecture and ecophysiology suggests that it might have been an opportunistic species in early ecological succession stages after wildfires. This same year, a new probable spelaeogriphacean, *Spinogriphus ibericus* Damià et al. 2013, was described from Las Hoyas. It is only the third spelaeogriphacean known from the fossil record, and possibly represents the oldest stygobiont (groundwater dwelling organism) crustacean recorded to date (Fregenal-Martinez et al. 2014).

In 2015, a detailed redescription of *Montsechia vidalii* (Zeiler) Teixeira, 1954, a primitive aquatic angiosperm, was carried out on the basis of more than 1,000 specimens from Las Hoyas (Gomez et al. 2015). This study highlighted the phylogenetic relevance of this Spanish taxon in the evolution of the first angiosperms, as well as the relevant role that

aquatic environments played in the distribution of some of the most basal lineages of this group. Also in 2015, the podotheca, that is, the structure of scales covering the foot of *Concavenator corcovatus*, was interpreted by Cuesta et al. (2015), showing a very similar pattern to that of birds, and an arthral position of the plantar pads. This fossil represents the first evidence of this type of structure on a non-avian theropod, and it is thus key to understand the origin and phylogenetical distribution of this structure in this group of dinosaurs. This same year, the integuments and connective structures associated to the insertion of feathers in the wing of an enantiornithe from Las Hoyas were studied (Navalón et al. 2015). The presence of an essentially modern connective structure allows interpretation that these primitive birds were capable flyers. Finally, also in 2015, the only mammal known to date from this locality, *Spinolestes xenarthrosus* Martín et al. 2015, a gobiconodontid, was described. The exceptional preservation of its soft tissues extends the known fossil record of typical mammalian features to the Early Cretaceous, such as the presence of pelage, mane, pinna, and several skin structures: keratinous dermal scutes, protospines composed of hair-like tubules, and compound follicles with primary and secondary hairs. This specimen also preserves rests of the lungs and the liver, and their disposition suggests the presence of a muscular diaphragm, which is a key structure for respiration in modern mammals. Together with the presence of other gobiconodontids in the Early Cretaceous of the Iberian Peninsula (Cuenca-Bescós et al. 2014), *Spinolestes xenarthrosus* extends the knowledge of this rare group of Mesozoic mammals.

The year 2016 has also been fruitful for the paleontological site of Las Hoyas. The highly diversified association of worms recovered at this locality (Timm et al. 2016), revealed the presence of several different families. The fossil record of this locality contains the oldest known remains of aquatic oligochaete worms, and, due to the low potential for preservation of these soft-bodied organisms, provides a unique opportunity to study the morphology of early oligochaetes and to understand their evolution, phylogenetic relationships, and historical biogeography. Also in 2016, the isolated scales of three diverse amiiform fish taxa have been studied in comparison to the scales of articulated specimens, showing that amiiform scales are much more different from each other than previously reported in the literature (Martín-Abad 2016). This suggests that isolated scales found in other localities could be identified on the basis of a number of anatomical characters. One of these three amiiform taxa has also been described in detail this year (Martín-Abad and Poyato-Ariza 2017). Also, as a result of all, these recent advances in our understanding on the paleoecosystem of Las Hoyas, and to celebrate the 30th anniversary of the locality, a monography has been edited which includes all the knowledge gathered on the locality since the 1980s (Poyato-Ariza and Buscalioni 2016). A short paper

summarizing and presenting the contents of this book was published earlier this year (Buscalioni and Poyato-Ariza 2016).

While some of these findings and their interpretation are probably of restricted interest to the paleontological community, most of them have had a high relevance to call the attention of the general public and have repeatedly appeared in local, national, and international media, including reviews on some of the most popular magazines (e.g., National Geographic: Laelaps 2015). As a consequence, the interest of the society of Castilla-La Mancha, and particularly that of Cuenca, for this important part of their rich paleontological heritage has remarkably grown in the last decade. This society demands a major effort to be done to include this heritage into their cultural identity, something that the government clearly agrees on.

Las Hoyas Is Declared Site of Cultural Interest

The government of Castilla-La Mancha has proven to be very supportive to the progress of the paleontological heritage of its Autonomous Community, especially during the last years. The creation of a new Museum of Paleontology in the city of Cuenca, as well as the so-called *Ruta de los Dinosaurios* (Dinosaurs Route), including two new interpretation centers in the localities of Cañada del Hoyo and Fuentes,² also in the province of Cuenca, are the most visible proofs of it to the general public. However, other initiatives have also helped pushing forward this advancement, especially the annual calls for funding for research projects on the archeological and paleontological heritage of Castilla-La Mancha, which have been taking place since 2014. The culmination of this support on behalf of the government materialized on the 15 March 2016, when the fossil site of Las Hoyas was officially declared as a Site of Cultural Interest (or BIC, from the Spanish *Bien de Interés Cultural*) with the category of Paleontological Zone (Castilla-La Mancha 2016).

The exceptional value of Las Hoyas has been recognized in the past. In 2001, this locality was listed as one of the exceptional sites within the Spanish paleontological heritage (Meléndez and Molina 2001). It was also included in the Geosites Project as part of the Spanish contribution to the World Paleontological Heritage (Carcavilla and Palacio 2010). Las Hoyas is also in the catalog of Spanish Geosites of international relevance in the category of fossils and ichnofossils from the Iberian Peninsula, included by the Instituto Geológico y Minero de España (IGME) in the Geosites Global Project developed in 2011. Finally, this locality was also included in the inventory of sites of geological interest of the Iberian Ranges (García-Cortés et al. 2012). In

² <http://www.dinosauriosdecuenca.es/>

this last inventory, the fossil site of Las Hoyas occupies the sixth position of a total of 343 sites, with a score of 18.38 out of 20 possible points. This punctuation is based on commonly used criteria to evaluate the importance of a geological site: scientific value, sociocultural exploitability, and risk of deterioration (Alcalá 2002; García-Cortés et al. 2012; García-Cortés and Carcavilla 2013). According to these criteria, Las Hoyas has a very high scientific value, a high educational value, and a high touristic value. On the other hand, it has a high fragility as well, since all the paleontological information is concentrated in a very small geographical extension, and it is subject to spoliation. Finally, it is moderately vulnerable, because it is located within the boundaries of a protected Natural Monument called Palancares y Tierra Muerta (Castilla-La Mancha 2001); however, this area has already been included in a touristic route, and the limestones that outcrop in this area, precisely those containing the fossils, are exploited for the construction sector.

The importance of the declaration of Las Hoyas as a Site of Cultural Interest becomes especially meaningful taking into account all these criteria. Yet, the scientific community cannot but feel a slight discontent regarding the law that was applied for this declaration. In Spain, the paleontological heritage is regulated by two different laws at the national level: the Law 16/1985 of Spanish Historical Heritage and the Law 42/2007 of Natural Heritage and Biodiversity. The controversy of the legislation concerning the paleontological heritage in Spain has been repeatedly highlighted in the past by the scientific community (e.g., Meléndez and Soria 1997). In the end, the former law has usually been the one used to regulate the paleontological heritage. According to some authors, this legislation is in conflict with particular aspects of the scientific praxis (López-Martínez 1995). Regarding the paleontological heritage in particular, the Law of Historical Heritage is especially controversial due to its articles 1.2 and 40.1, which fail to address exactly what is part of the Spanish paleontological heritage (see Morales 2010). Moreover, this law establishes two types of protection figures under the category of Site of Cultural Interest: Historical Site or Archeological Zone, none of which is, obviously, adequate for a paleontological site. In contrast, the Law 42/2007 of Natural Heritage and Biodiversity establishes a new figure of protection, the Natural Monument, which actually considers paleontological localities, which is usually seen by scientists as a more appropriate figure.

Nevertheless, as discussed by Morales Romero et al. (1999) and Morales (2010), whether it is the law of Historical Heritage or the law of Natural Heritage the one used for the protection of the paleontological heritage, it is responsibility of the paleontologists to integrate into their professional activities the non-strictly scientific values of the heritage: educational, sociocultural, and socioeconomic. But at the same time, it is important that the governmental agents take care of the exceptional paleontological sites and safeguard

them under a legal protection figure, since from that moment on, any activity developed around the protected heritage resources will be clearly framed from a legal point of view.

The regulation of the paleontological heritage in Spain ultimately corresponds to each autonomous community. In the particular case of Castilla-La Mancha, it is thus regulated by the recent Law 4/2013 of Cultural Heritage. As a novelty, this law defines the category of Paleontological Zone within the figure of Site of Cultural Interest established by the national law. According to the articles 36 and 37 of this new law, any BIC shall benefit from the maximum level of protection, and its usage shall always be subordinated to the conservation of the site and its values. The article 41 dictates that the designation as a Paleontological Zone implies the maintenance of the values defined by the declaration as a BIC, as well as the protection of the resources themselves. Additionally, the local government of the municipality where the Paleontological Zone is located shall develop a plan of special protection of the affected area.

The society in general, and particularly that from Castilla-La Mancha and Cuenca, have always supported the scientific praxis, while at the same time demands to take part in the paleontological development itself. The fossil site of Las Hoyas has been for many years a scenario where students and the general public have been protagonists of the paleontological praxis, and its educational and formative values have only been promoted with recent initiatives.

Educational and Formative Potential of Las Hoyas

As soon as the first excavation campaigns took place in the late 1980s, it was clear the high potential that the locality presented for educational and formative purposes. This potential is also acknowledged in the declaration of Las Hoyas as BIC, which states that “undoubtedly this set of particularities make the paleontological heritage of Las Hoyas an exclusive element for developing educative, formative and, obviously, scientific outreach activities, since its contributions and studies usually have a high mediatic impact” (our translation from the Spanish; Castilla-La Mancha 2016: 7287). The educational and training activities that have been developed at Las Hoyas can be divided into three categories: non-formal education, formal education, and Social Paleontology.

Non-Formal Education

The paleontological heritage of Las Hoyas is a cultural and natural heritage value of the citizens of Castilla-La Mancha, and ultimately of the entire world, who continually demand a deeper understanding of the life on Earth in the past. This is demonstrated by the high social repercussion of news concerning new fossil discoveries and ideas about evolution, whether they believe or not in the theory of Evolution itself; in

fact, this controversy somehow helps the dissemination of the paleontological heritage (Poyato-Ariza and Buscalioni 1992; Buscalioni and Martín-Rojo 2013). For this reason, the main objective of Las Hoyas Project has always been to communicate the richness, importance, and history of the life represented by this paleoecosystem to the public. With this purpose, the team regularly collaborates with different media, especially during the fieldwork campaigns. Likewise, seminars have been organized with the aim of training professionals from the education and tourism sectors. Expositions and guided tours have been offered to school groups at different museums of Castilla-La Mancha as well. Finally, “open-doors” events have also been organized to showcase special exhibitions of Las Hoyas heritage to commemorate particularly relevant findings (Fig. 2). This type of non-formal education is characterized by being non-systematic, which implies that its effectiveness can only be fragmentary. Nonetheless, the importance of this kind of approach for the valuation of the heritage of exceptional fossil sites such as Las Hoyas should not be underestimated. While a series of polls carried out in 2010 showed that a relatively large proportion of the population of Cuenca did not know Las Hoyas, we expect the last advances and initiatives to have reunited the society of this province with its heritage. A second series of polls will be developed during the next years to check to what extent and how the opinion of the general public has shifted in the last decade.

Formal Education

Since the first fieldwork campaign in 1987, students from different universities have been involved in the research project of the site of Las Hoyas. While it was not a regulated education, the locality was organized mainly as an educative space, focused on the training and professionalization of future paleontologists. The students that participate in the experience of Las Hoyas are mainly part of Biology and Geology educational programs, although students of Environmental Sciences, Journalism, and Tourism have also joined the fieldwork often. Master and PhD students in programs of Paleontology, Geology, and Biodiversity have also regularly participated in the campaigns, as well as in the research process; in fact, eight different PhD theses have been undertaken or are currently in progress in the frame of the research project of Las Hoyas, which states the great training potential of the site. While most students attending Las Hoyas come from Spanish universities, there is a small proportion of participants every year that come from abroad. Since that first campaign in 1987, the activities that constitute the fieldwork have naturally converged over time into the objectives and competences established in the Educational Tuning Project of the European Union (Tuning Educational Structures in Europe, started in



Fig. 2 Photographs taken during the “open doors” event organized at the Museo de las Ciencias de Castilla-La Mancha (Cuenca province) in July 2012. The presentation of the pterosaur *Europejara olcadesorum* included an exhibition of the best fossils housed at the Museum collection in a session where the audience interacted with researchers. The holotypes (fossils with a dot in red) were exposed, and the scientists showed some of the techniques of study. **a** Paleontologists and politicians presenting the “open doors” event. **b** One of the paleontologists showing and explaining some fossils to the public. **c** Fossil fishes from Las Hoyas fossil site

2000). In this sense, we have learned to join together knowledge, its application, and the acquisition of aptitudes, skills, competences, and responsibilities, within the learning process. From this perspective, the spaces and times of students in the fossil site have been organized to combine the so-called *three dimensions of the educational act*: intellectual, sensory, and emotional (Fernández-Pérez 1994). In this sense, each dimension of the learning process is produced in a connoted space: teamwork in the excavation spots; regular interaction with researchers and specialists; technical work in the site office (preparation, identification, ordination, cataloging, documentation, photography, etc.); and finally, daily responsibilities and compromise with the support of the team. The consolidation of the formal education function

Fig. 3 Photographs showing the different activities developed during the second edition of the “Course on paleontological excavations in an exceptional fossil site: the diversity of life 125 million years ago,” July 2016. **a** Visits to museums and interpretation centers. **b** Formal seminars about the diversity and ecology of the Cretaceous life. **c** Geological routes. **d** Systematic work in the field. All these activities combine the so-called three dimensions of the educational act: intellectual-sensory-emotional



of the site took place in 2015, with the First Edition of the “Course on paleontological excavations in an exceptional fossil site: the diversity of life 125 million years ago.” This course is included in the Program of Continuous Education, approved by the Graduate School at the Autonomous University of Madrid,³ and counts with the official recognition of academic credits. The feedback from the students is very important when developing new academic projects, especially when attempting the integration of the different aspects of the formative and professionalization processes. Taking this into account, the feedback received from the students of the first edition of the course were used to create an improved second edition, which took place in the summer of 2016. This second edition included four types of activities to generate a more complete and integrative experience for the students: geological routes to understand the evolution and the aspect of the landscape where the paleoecosystem originated; visits to museums and centers of interpretation to help the visitors know and understand the system represented by the locality, and the socioeconomic and sociopolitical implications of its study; formal seminars to learn about the diversity and ecology of the paleoecosystem of Las Hoyas; and systematic work in the field to gain excavation experience and undergo the abovementioned professionalization process (Fig. 3). One last important thing worth mentioning is that, during the duration of the course, the students share every activity with the professors, researchers, and specialists, who are always available for discussion in an informal environment,

³ http://www.uam.es/ss/Satellite/es/1242652866332/1242694947494/cursocortaduracion/cortoCortaDuracion/Excavaciones_paleontologicas_en_un_deposito_excepcional:_La_diversidad_de_la_vida_hace_125_millones_.htm

notably contributing to the assimilation of the knowledge and competences.

Social Paleontology

The concept of Social Paleontology was first defined from the activities developed at the Spanish locality of Somosaguas (Miocene of Madrid, Spain) to disseminate its remarkable paleontological heritage to the general public (Castilla Cañamero et al. 2006), and has been thereafter developed in other localities (e.g., González et al. 2011). The main objective of Social Paleontology is to manage the educational potential of Paleontology at any education level (Torices et al. 2004; Castilla Cañamero et al. 2006). Despite its great potential, the Social Paleontology experiences have only been slightly exploited at Las Hoyas. Guided tours to the fossil site for the general public (Fig. 4) are offered every year, mainly during the fieldwork campaigns, but the difficult access to the site prevents a large audience from visiting it. Visits of special



Fig. 4 Guided tour to Las Hoyas fossil site held by the participation of students and predoctoral fellows (July 2013)

groups, such as the *Ruta Quetzal* (which visited Las Hoyas in 2008), are organized when the opportunity arises. The creation of a web page,⁴ a blog,⁵ and a Facebook account⁶ for Las Hoyas, usually managed by students, are interesting initiatives that will be explored to a greater extent in the future.

Conclusions and Future Prospects

More than 30 years after its discovery, the fossil site of Las Hoyas forms part, now more than ever, of the sociocultural identity of Castilla-La Mancha, and particularly of Cuenca. The recent findings and studies continue to call the attention of the scientific community and the general public, who demand from the researchers and the government a continuous effort and commitment to value this part of their rich paleontological heritage. The autonomic government has successfully answered to this demand these last years, with a remarkable investment aimed to improve the protection of the values of its heritage. The last step has been the declaration of Las Hoyas as a Site of Cultural Interest in 2016. This recognition provides an added value and a legal framing to all the future initiatives to be developed by the scientists. The scientists, in turn, are committed to continue improving our knowledge on the life in the past in this region, and to communicate this knowledge to the society. The high scientific value of the fossil discoveries and the fragility of the quarry are the most important aspects that shape the development of its heritage qualities. The fossil site of Las Hoyas has great potential in the areas of training and education guided by scientists but with the support of academic institutions and regional administrations. In this sense, a stronger focus will be made both in the formal education aspect as well as in the Social Paleontology approach. From the formal education point of view, the near future will witness the transformation of the course of excavation at Las Hoyas into an officially recognized International Course; the International Relations Office at the Autonomous University of Madrid, through its numerous educative agreements with other foreign universities, will collaborate with the researchers in order to internationalize the value of this part of the Spanish Paleontological Heritage. The new International Course at Las Hoyas will continue to focus on promoting the values of co-responsibility, integration, and interdisciplinarity between the different agents involved: students, professors, researchers, and professionals of the heritage management. Regarding the Social Paleontology approach, a major effort will be developed by the researchers to make the site more appealing and accessible for the general public, and to promote the participation of the society in the paleontological

process. The Cretaceous terrestrial ecosystems of the Iberian Peninsula, among which the fossil site of Las Hoyas stands out, are a very relevant and representative part of the Mesozoic fossil record worldwide. The continuous and close collaboration between the government and the researchers, who must make an effort to understand and complement the necessities of each other, is paramount to continue promoting the scientific, socioeconomic, and sociocultural values of the already rich Paleontological Heritage of the Iberian Peninsula in general, and of Castilla-La Mancha in particular.

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⁴ <http://www.yacimientolashoyas.es/>

⁵ <http://lashoyas.blogspot.ch/>

⁶ <https://www.facebook.com/Amigos-de-Las-Hoyas-174258259255226/>

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