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The oldest Quaternary turtle remains from the Basque-Cantabrian Basin (Atxoste, Álava, Spain)



Les plus anciens restes de tortues du Quaternaire du Bassin basque-cantabrique (Atxoste, Álava, Espagne)

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ABSTRACT

References to fossil remains of turtles from the Quaternary record of the Spanish Basque-Cantabrian Basin are almost non-existent, and are limited to a problematic report from a Mesolithic Age site. Here, we report remains of turtles in the Mesolithic levels of the site of Atxoste (Álava), the oldest reference, and the only one so far confirmed, to turtles in the Quaternary record of that Basin. The abundance of well-preserved specimens of turtles from Atxoste permits a precise systematic attribution. All this material is attributed to a single taxon: the European Pond Terrapin *Emys orbicularis*. Therefore, this material represents the oldest known reference to an emydid in the Basque-Cantabrian Basin.

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R É S U M É

Dans le Quaternaire du Bassin basque-cantabrique (Espagne), la seule référence de tortues fossiles connue jusqu'ici était une référence douteuse provenant d'un site de Mésolithique. La présence de restes de tortues dans les niveaux mésolithiques du site d'Atxoste (Álava) est reconnue ici. Par conséquent, cette découverte représente la plus ancienne référence, et la seule à ce jour justifiée, de tortues dans les niveaux quaternaires du Bassin. La bonne conservation et l'abondance relative des spécimens de tortues d'Atxoste nous permettent de réaliser une attribution systématique précise. Tout ce matériel est attribué à un seul taxon : la Cistude d'Europe, *Emys orbicularis*. Par conséquent, ce matériel représente la plus ancienne mention connue d'un émydidé dans le Bassin basco-cantabrique.

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1. Introduction

Reports of turtles in the paleontological and archaeological record of the Spanish Basque-Cantabrian Basin are very scarce and, generally, they provide limited information. However, several taxa have been recognized there, ranging in age from the Early Cretaceous to the Holocene.

The Basque-Cantabrian Basin is situated in the western end of the Pyrenees Mountain Range. The oldest record of fossil turtles in this basin consists of isolated plates attributed to an indeterminate freshwater member of Eucryptodira, which differs from all taxa currently identified in the Iberian Peninsula (see Pérez-García and Murelaga, 2014). It comes from Hauterivian-Barremian levels (Early Cretaceous) of the area of Vega de Pas, in Cantabria (Pérez-García and Murelaga, 2014). No other reference to Early Cretaceous turtles has been cited in this basin. In the Late Cretaceous of the basin, remains of fossil turtles have been identified in several deposits. Bardet et al. (1993) noted remains of a scapular girdle that they attributed to a probable member of Chelonidae, identified as cf. *Allopleuron* sp. This material came from the Santonian of San Pantaleón de Losa (Burgos). The other specimens from the Late Cretaceous come from sites of Campanian and Maastrichtian age (see references below). The most relevant findings are those from the Late Campanian-Maastrichtian sites of Laño (Burgos). Hundreds of post-cranial elements of turtles, most of them consisting of disarticulated plates, have been recognized there. The study of the material from Laño allowed the clades *Dortokidae* and *Solemydidae* to be defined, as well as the taxa *Dortoka vasconica* Lapparent de Broin and Murelaga, 1996 (*Dortokidae*), *Solemys vermiculata* Lapparent de Broin and Murelaga, 1996 (*Solemydidae*) and *Polysternon atlanticum* Lapparent de Broin and Murelaga, 1996 (*Bothremydidae*) (see Lapparent de Broin and Murelaga, 1996, 1999; Pérez-García et al., 2012a). Although Lapparent de Broin and Murelaga (1996) indicated that the *Bothremydidae* *Elochelys* may also be present in Laño, recent studies, based on the analysis of new material, have questioned this identification (see Pérez-García et al., 2010, 2012b). The remaining findings from the other Campanian and Maastrichtian sites of the Basque-Cantabrian Basin consist of fragmentary material. Some fragments of plates of an indeterminate solemydid, and others that were preliminarily assigned to the *Bothremydidae* cf. *Polysternon* sp., were recognized in the Campanian-Maastrichtian of Korres (Álava) (Pereda-Suberbiola et al., 1999). Fragments of plates of indeterminate members of both clades, as well as some elements of the pelvic girdles, were identified in the Middle to Late Maastrichtian of Quecedo de Valdivielso (Burgos) (Berreteaga Escudero, 2006; Murelaga et al., 2005). Recently Pereda-Suberbiola et al. (2015) referred to the discovery of an isolated peripheral plate belonging to a probable member of Pan-Cryptodira, and a costal plate of a bothremydid, from the Late Maastrichtian site of Albaina (Burgos).

The record of fossil turtles in post-Mesozoic sites of the Basque-Cantabrian Basin is extremely limited. Rare plates attributed to an indeterminate aquatic turtle were recognized in the Late Eocene of Zambrana (Álava) (Astibia et al.,

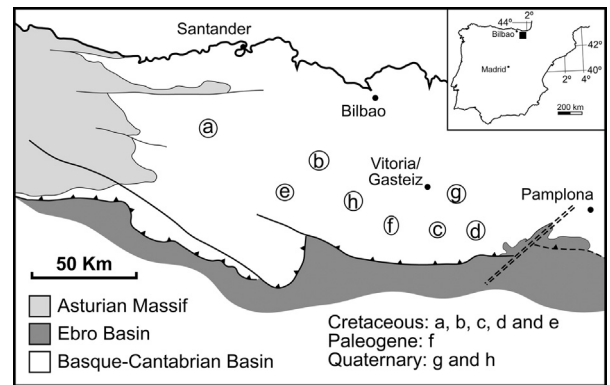


Fig. 1. Map of the Basque-Cantabrian Basin (northern Spain) in which the localities where fossil turtles have been found are indicated. a, Vega del Pas (Cantabria), Hauterivian-Barremian; b, San Pantaleón de Losa (Burgos), Santonian; c, Laño (Burgos), Late Campanian-Maastrichtian, and Albaina (Burgos), Late Maastrichtian; d, Korres (Álava), Campanian-Maastrichtian; e, Quecedo de Valdivielso (Burgos), Middle to Late Maastrichtian; f, Zambrana (Álava), Late Eocene; g, Atxoste (Álava), Quaternary; h, Castro de Berbeia (Álava), Quaternary.

Fig. 1. Carte du Bassin basco-cantabrique (Nord de l'Espagne), dans laquelle les localités où les tortues fossiles ont été trouvées sont indiquées. a, Vega del Pas (Cantabrie), Hauterivien-Barrémien; b, San Pantaleón de Losa (Burgos), Santonien; c, Laño (Burgos), Campanien supérieur-Maastrichtien et Albaina (Burgos), Maastrichtien supérieur; d, Korres (Álava), Campanien-Maastrichtien; e, Quecedo de Valdivielso (Burgos), Maastrichtien moyen-supérieur; f, Zambrana (Álava), Éocène supérieur; g, Atxoste (Álava), Quaternaire; h, Castro de Berbeia (Álava), Quaternaire.

2000). The other reference comprises a problematic reference of a humerus to *Emys orbicularis* (see Discussion), from Castro de Berbeia (Álava), in levels that were dated between 490 BC and 400 BC, indicated as belonging to the Iron Age (Altuna, 1978) (Fig. 1).

Currently, three endemic taxa of Western Europe are part of the turtle fauna of this region. All of them are Testudinoidea. One comprises a terrestrial testudinid (*Testudinini* sensu Lapparent de Broin, 2001): *Chersine hermanni* sensu Bour and Ohler (2008) (a species traditionally referred as *Testudo hermanni*). The other two are freshwater forms: the Geoemydidae *Mauremys leprosa* and the emydid *E. orbicularis*. All these taxa, in addition to the Testudinini *Testudo graeca*, have been recognized in Iberian Quaternary sites (Cebrià et al., 1981; Hain, 1982; Morales and Liesau, 1995; Morales and Sanchiz Serra, 2009; Pérez-García et al., 2011a). Only *E. orbicularis* and *M. leprosa* are currently present in the North of the Iberian Peninsula (Blanco and González, 1992). However, because none of them has been mentioned so far in archaeological sites of the Cantabrian Region, doubts about its possible autochthony can be raised (Fig. 1).

The presence of turtles in the Holocene site of Atxoste is recognized here for the first time. Atxoste is a rock shelter, formed in Paleogene limestones, and located in the town of Virgala (Álava) (Fig. 2). The archaeological excavations conducted there began in the late 1990s and ended in 2006 (Alday, 2002; Alday and Cava, 2006; Alday Ruiz et al., 2011). Approximately 6 m of sediment, preserving a record that extended from the Upper Paleolithic (about 12,000 years

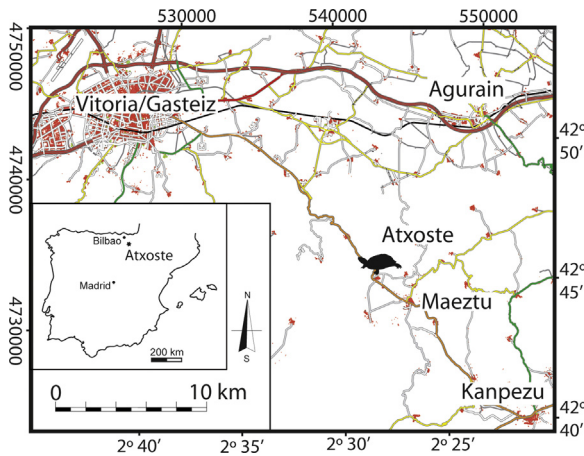


Fig. 2. (Color online.) Geographical location of the Quaternary site of Atxoste (Virgala, Álava, Basque-Cantabrian Basin, Spain).

Fig. 2. (Couleur en ligne.) Situation géographique du site quaternaire d'Atxoste (Virgala, Álava, Bassin basco-cantabrique, Espagne)

BP) to the Chalcolithic (about 3360 year BP), were present there (Fig. 3). Abundant remains of macromammals, especially species hunted by the humans, were found at this site (Alday Ruiz et al., 2011). Two other sites of similar chronologies, located at a distance less than 1 km, have also been excavated (Kanpanoste and Kanpanoste Goikoa). However, no turtle remains can be recognized in those sites. The systematic study of the material of turtles from Atxoste is presented in this paper.

2. Material and methods

One hundred and three specimens of turtles from the site of Atxoste have been identified. They correspond to fragments of disjointed plates or fragments of plates, both from the carapace and the plastron. All these elements can be attributed to a single taxon (Discussion). They comprise adult or subadult specimens (Fig. 4).

The turtle remains from Atxoste have been found exclusively in the Mesolithic levels V (GrA-13447 8670–8510 cal BP to GrA-13448 9100–8700 cal BP) and VI (GrA-15700 9570–9450 cal BP to GrA-15699 9940–9500 cal BP) (Fig. 3). At both diachronic levels, the plates were present in the vicinity of the walls of the rock shelter. The greater abundance of remains is recorded in the level V (Fig. 3).

Only one specimen corresponding to some specific anatomical elements has been recognized (e.g., nuchal, pygal). Other elements have not been identified (e.g., suprapyrgals). However, the discovery of several remains of the same element (e.g., five right epiplastra and five left xiphiplastra), together with the difference in size between some individuals, and their presence in more than one level, demonstrate the presence of several individuals (NMI = 5). Evidence of human predation has not been hitherto recognized in these fossils of turtles.

The characters used to refute the attribution of the taxon from Atxoste to *M. leprosa*, and to confirm that it belongs to *E. orbicularis*, are based on personal observation of osteological specimens in museum collections, especially of the collections of the Muséum national d'Histoire naturelle (Paris, France), as well as in the data provided

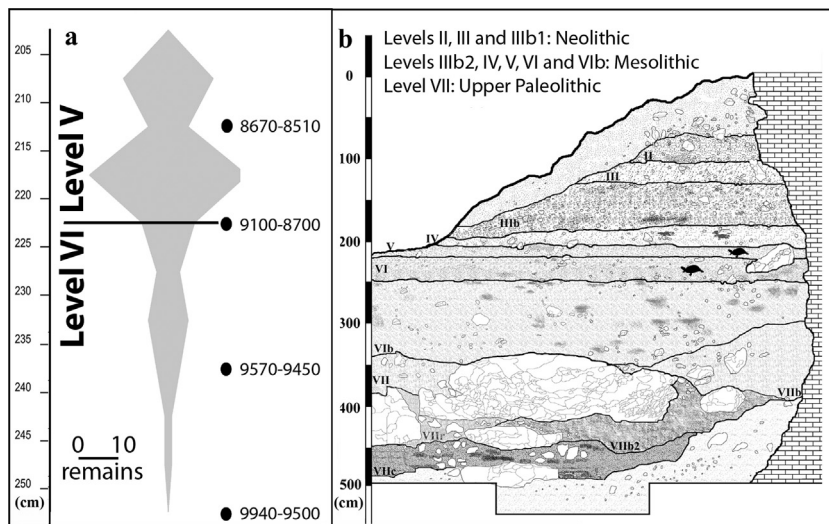


Fig. 3. Location of the turtles remains at the site of Atxoste (Virgala, Álava, Basque-Cantabrian Basin, Spain). a: location of the specimens of turtles in the sedimentary sequence. On the left, the scale indicates the depth relative to the reference plane. The different widths of the vertical line are proportional to the number of findings of turtle remains. The horizontal dashed line corresponds to the boundary between the levels V (upper area) and VI (lower area). The points indicate the depths at which the C14 samples were collected, and the numbers are the results in years cal BP; b: location of the specimens of turtles in the stratigraphic section.

Fig. 3. Emplacement des restes de tortues dans le site d'Atxoste (Virgala, Álava, Bassin basque-cantabrique, Espagne). a: emplacement des restes de tortues dans la séquence sédimentaire. Sur la gauche, l'échelle indique la profondeur par rapport au plan de référence. Les différentes épaisseurs de la ligne verticale sont proportionnelles au nombre de restes de tortues. La ligne horizontale en pointillés correspond à la limite entre les niveaux V (zone supérieure) et VI (zone inférieure). Les points indiquent la profondeur à laquelle les échantillons de C14 ont été collectés, et les chiffres correspondent au résultats, exprimés en années cal BP; b: emplacement des restes de tortues dans la colonne stratigraphique.

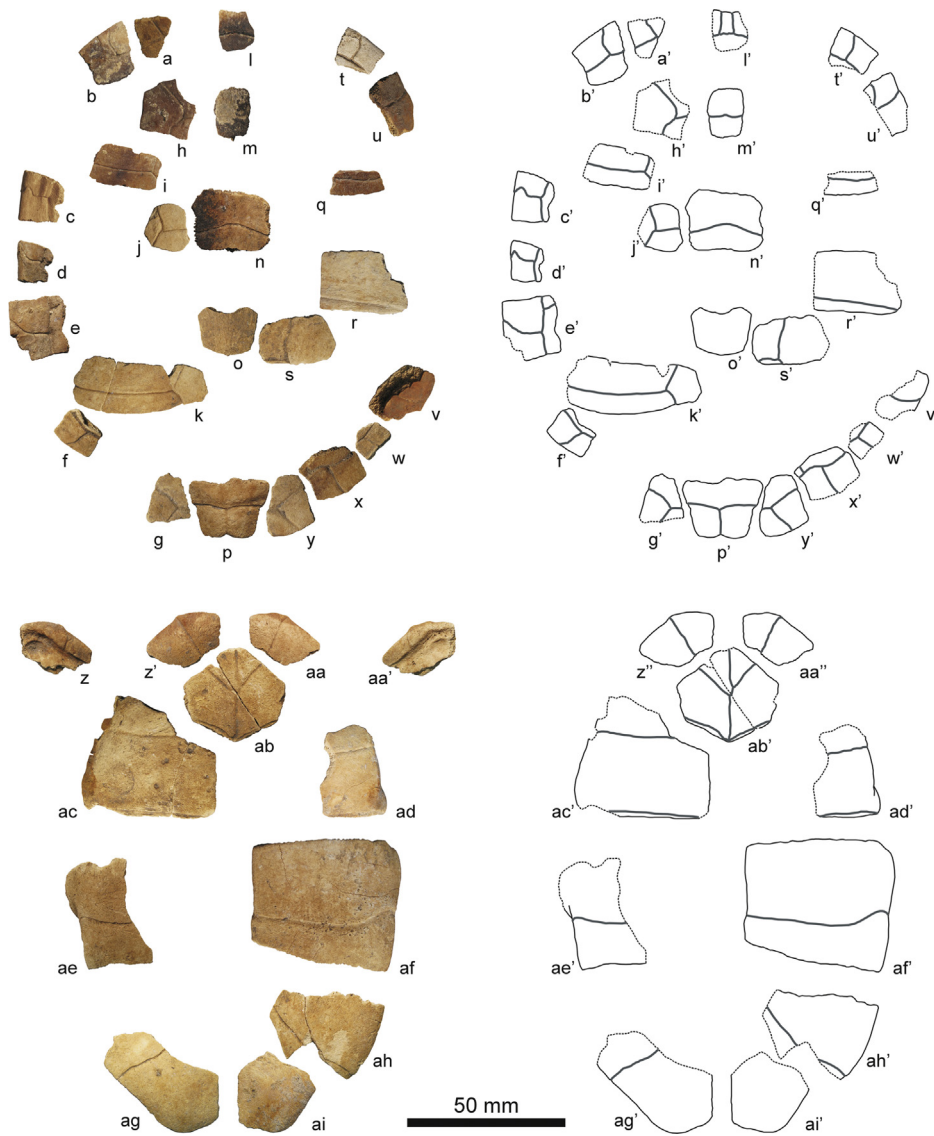


Fig. 4. (Color online.) Plates of the carapace (a–y) and of the plastron (z–ai) of several specimens of *Emys orbicularis*, from the Mesolithic levels of Atxoste (Virgala, Álava, Basque-Cantabrian Basin, Spain). a–g, left peripherals (AZ.B6.215.39–258, AZ.Z4.220.d, AZ.B6.220.304, AZ.Z4.220.f, AZ.Z4.220.e, AZ.B4.220.238, AZ.A4.250.84); h–k, left costals (AZ.Z2.220.559.j, AZ.Z4.220.c, AZ.A4.230.79, AZ.Z2.230.372–373); l, nuchal (AZ.Z4.220.b); m–o, neurals (AZ.Z4.220.g, AZ.B6.245.332, AZ.B6.215.a); p, pygal (AZ.A4.255.22.b); q–s, right costals (AZ.B6.210.a, AZ.B6.235.62, AZ.A4.255.22.d); t–y, right peripherals (AZ.Z2.220.36.d, AZ.Z2.225.633.c, AZ.B4.210.71.a, AZ.B6.220.133.a, AZ.A4.225.241, AZ.A4.255.22.c); z, right epiplastron (AZ.C6.210.88.b); aa, left epiplastron (AZ.B6.215.b); ab, entoplastron (AZ.C6.210.88.a + AZ.A4.174.c); ac, right hypoplastron (AZ.Z2.220.559.k); ad, left hypoplastron (AZ.B6.235.98.c); ae, right hypoplastron (AZ.Z4.210.14.b); af, left hypoplastron (AZ.B6.230.3); ag, right xiphiplastron (AZ.B6.230.284–287); ah–ai, left xiphiplastra (AZ.A4.174.d, AZ.B6.225.1133). All the plates of the carapace are in dorsal view and those of the plastron in ventral view, except z and aa', in dorsal view.

Fig. 4. (Couleur en ligne.) Plaques de la carapace (a–y) et du plastron (z–ai) de plusieurs spécimens d'*Emys orbicularis*, des niveaux mésolithiques d'Atxoste (Virgala, Álava, Bassin basque-cantabrique, Espagne). a–g, périphériques gauches (AZ.B6.215.39–258, AZ.Z4.220.d, AZ.B6.220.304, AZ.Z4.220.f, AZ.Z4.220.e, AZ.B4.220.238, AZ.A4.250.84); h–k, costales gauches (AZ.Z2.220.559.j, AZ.Z4.220.c, AZ.A4.230.79, AZ.Z2.230.372–373); l, nuchale (AZ.Z4.220.b); m–o, neurales (AZ.Z4.220.g, AZ.B6.245.332, AZ.B6.215.a); p, pygale (AZ.A4.255.22.b); q–s, costales droites (AZ.B6.210.a, AZ.B6.235.62, AZ.A4.255.22.d); t–y, périphériques droites (AZ.Z2.220.36.d, AZ.Z2.225.633.c, AZ.B4.210.71.a, AZ.B6.220.133.a, AZ.A4.225.241, AZ.A4.255.22.c); z, épipastron droit (AZ.C6.210.88.b); aa, épipastron gauche (AZ.B6.215.b); ab, entoplastron (AZ.C6.210.88.a + AZ.A4.174.c); ac, hypoplastron droit (AZ.Z2.220.559.k); ad, hypoplastron gauche (AZ.B6.235.98.c); ae, hypoplastron droit (AZ.Z4.210.14.b); af, hypoplastron gauche (AZ.B6.230.3); ag, xiphiplastron droit (AZ.B6.230.284–287); ah–ai, xiphiplastrons gauches (AZ.A4.174.d, AZ.B6.225.1133). Toutes les plaques de la carapace sont en vue dorsale et celles du plastron en vue ventrale, sauf z et aa', en vue dorsale.

by Bailón (2010), Gmira (1995), Hervet (2000, 2004), and Pérez-García et al. (2011b).

3. Systematic paleontology

CHELONII Latreille, 1800

CRYPTODIRA Cope, 1868

TESTUDINOIDEA Batsch, 1788

EMYDIDAE Rafinesque, 1815

Emys Duméril, 1805

Emys orbicularis (Linnaeus, 1758)

Fig. 4

Material: One hundred and three disarticulated elements of the carapace and plastron. They are part of the collection of the Bibat Arabako Arkeologia Museoa/Bibat Museo de Arqueología de Álava (Álava, Spain).

Locality and horizon: Mesolithic levels V and VI of the site of Atxoste (Virgala, Alava, Basque-Cantabrian Basin) (Figs. 2 and 3).

Description: The external bone surface of all the plates identified is smooth. The nuchal plate demonstrates that the carapace of this taxon lacks nuchal notch (Fig. 4l). It also lacks medial keel. This is also the case with the neurals and in the pygal (Fig. 4m–p). The first neural is rectangular, longer than wide (Fig. 4m). The other neurals are hexagonals, with the latero-anterior margins shorter than the latero-posterior ones (Fig. 4n–o). The pygal plate is trapezoidal and is wider at its anterior margin than at the posterior one (Fig. 4p). It is slightly wider than long. This plate has a shallow posterior notch. The distal margins of the peripherals situated in the bridge region are slightly dorsally directed, but those of the remaining peripherals and of the pygal are not (Fig. 4a–g, t–y).

A single cervical scute is present (Fig. 4l). Dorsally, it is almost twice as long as wide. Its visceral length is shorter than its dorsal length. The fifth vertebral scute overlaps all the anterior half of the pygal (Fig. 4p). It overlaps the antero-medial region of the tenth pair of peripheral plates (Fig. 4x). This taxon lacks overlap or contact between the marginal scutes and the costal plates (Fig. 4a–g, t–y). A well-developed anterior curvature of the lateral end of the sulci between the marginals is present. Furthermore, it lacks supracaudal scute but possess two separated posterior marginal scutes (Fig. 4p).

The anterior lobe of the plastron is interpreted as shorter than the posterior one, and both lobes are longer than the plastral bridge (Fig. 4z–ai). Both the anterior and the posterior lobes are subrounded. The epiplastral lips are low in the medial region, but they are more developed laterally (Fig. 4z–aa). All the identified entoplastra are subhexagonals (Fig. 4ab). Their greatest widths are situated in the anterior half. The sutures between the epiplastron and the hyoplastra are latero-anteriorly directed. A hinge is present between the hyoplastra and the hypoplastra (Fig. 4ac–af). Therefore, this taxon lacks a sutured contact between the hyoplastra and the peripheral plates. The plastral buttresses are low. The hypoplastra are wider than long. A wide but shallow anal notch is present (Fig. 4ag, ai).

The gulars overlap the anterior half of the entoplastron (Fig. 4z–ab). Medially, the humero-pectoral sulci are

situated on the most posterior region of the entoplastron, very close to the sutures between the entoplastron and the hyoplastra. The humeral scutes are markedly distant from the axillary notches (Fig. 4ac–ad). The pectoro-abdominal sulci are located on the most posterior region of the hyoplastra, very close to the plastral hinge. No intergular or inframarginal scutes have been recognized. Medially, the anal scutes are long, being located near the contact between the hypoplastra and the xiphoplastra (Fig. 4ag–ai). Therefore, the anal scutes are medially longer than the femorals.

4. Discussion

All the specimens of chelonians found in Atxoste can be attributed to a single taxon. Characters such as the absence of intergular and inframarginal scutes, the posterior reduction of the epiplastra, and the latero-anteriorly directed epi-hyoplastral sutures allow their attribution to Testudinoidea. This taxon differs from the representatives of Testudinini, the clade that includes terrestrial forms (e.g., *Chersine hermanni*), in characters, such as: smooth external bone surface; absence of medially short and laterally long costals, alternated with medially long and laterally short costals; relatively shallow sulci between the scutes; absence of overlap between the pleuro-marginal sulci and the costo-peripheral sutures; presence of lateral margins of the humero-pectoral sulci markedly distant from the axillary notches; medially poorly-developed epiplastral lip; hexagonal second to, at least, sixth neurals, with short latero-anterior margins but long latero-posterior ones. However, all these characters are shared with both the members of Emydidae (e.g., *E. orbicularis*) and Geoemydidae (e.g., *M. leprosa*) (see Gmira, 1995; Hervet, 2000; Chesi et al., 2009).

The taxon of Atxoste can be attributed to *E. orbicularis* and differs from *M. leprosa* by: absence of a medial keel on the pygal plate; pygal not remarkably wider than long; presence of a small postero-medial notch (being generally absent in *M. leprosa*); fifth vertebral scute overlapping onto the anterior half of the pygal and the last pair of peripherals; short posterior marginal scutes; first to third pleural scutes wider than the vertebrals; the sulcus between the second and third pleurals in contact with the central region of the medial margin of the seventh marginal; the sulcus between the pleural and the marginal scutes always distant from the suture between the costal and the peripheral plates; markedly anteriorly directed lateral end of the sulci which delimit the marginals; anterior lobe of the plastron shorter than the posterior lobe, with the bridge shorter than both lobes; subrounded anterior margin of the epiplastra; relatively low epiplastral lips; subhexagonal entoplastron, with the greatest width situated in the anterior half; presence of a hinge between the hyoplastra and the hypoplastra; lateral edges of the hyoplastra not sutured to the peripherals; low and short plastral buttresses; wider than long hypoplastra; rounded lateral margins of the posterior plastral lobe; wide and very shallow anal notch; gular scutes reaching about the middle part of the entoplastron; humero-pectoral sulci located on the posterior edge of the entoplastron, being almost superimposed on the sutures

between the entoplastron and the hyoplastra; pectoro-abdominal sulci located in the most posterior region of the hyoplastra; short abdominal scutes; absence of axillary and inguinal scutes; medially long anal scutes.

Considering all the discussed characters, all the material of turtles from Atxoste so far recognized is attributed to the emydid *E. orbicularis*. As indicated, the only reference in an archaeological site of the Basque-Cantabrian Basin to this taxon is that from Castro de Berbeia (Álava) (dated as deposited between the years 490 BC and 400 BC) (Altuna, 1978). Therefore, that reference comes from more recent levels than those present in Atxoste. The reference to the possible presence of *E. orbicularis* in Castro de Berbeia was exclusively based on a bone cited as a humerus, the only element that Altuna (1978) attributed to a turtle. That element was not described or figured, and was not referred using an inventory number. In fact, no anatomical characters were used for its determination. Altuna (1978) indicated that the length of the bone was 33 mm. He justified that attribution based solely on the current presence of this species in the area, indicating that, however, the specific determination could be considered questionable. All the material found in that locality is deposited in the Bibat Arabako Arkeologia Museoa/Bibat Museo de Arqueología de Álava (Álava, Spain). The entire collection of this site, including the indeterminate elements, has been reviewed by us. However, no turtle remains have been found. Therefore, both the reference to the species *E. orbicularis* in Castro de Berbeia, and the report of turtles in this locality are considered doubtful.

The site of Atxoste is located very close to the Berrón River. This river is a tributary of the Ega, a river that flows into the Ebro River. The presence of *E. orbicularis* has been previously cited in several Mesolithic sites of the Ebro Basin, from several ages (see Bosch et al., 2000; Félix, 2002; Millán and Blanch, 1989). Therefore, these rivers, which connect the regions where the emydids from the Ebro Basin and Basque-Cantabrian Basin lived, may have facilitated the spread of this species.

5. Conclusions

The record of post-Mesozoic fossil turtles of the Basque-Cantabrian Basin is extremely limited. In addition to the identification of an indeterminate aquatic turtle in the Late Eocene of Zambrana (Álava), a single report to a Quaternary turtle had been published: a putative humerus of the European Pond Terrapin *E. orbicularis*. This identification was not justified. The attribution of material from that locality (from the Iron Age) to turtles cannot be confirmed. This lack of information contrasts with the relatively abundant, but so far little known, record of three clades of Testudinidae in Quaternary sites of other regions of the Iberian Peninsula: the terrestrial Testudinini, and the aquatic Geoemydidae and Emydidae.

The presence of turtles at the Mesolithic levels of the site of Atxoste (Álava), in the Basque-Cantabrian Basin, is referred here for the first time. More than one hundred elements of turtles have been found there. These consist of disarticulated plates and fragments of these elements.

Systematic study of this material allows us to attribute it to the emydid *E. orbicularis*.

The identification of remains of turtles is common in contemporaneous sites in other regions of Spain (Bosch et al., 2000; Félix, 2002). However, this group of reptiles had not been recognized in this region. Atxoste is the site with the northernmost remains of Quaternary turtles identified in the Iberian Peninsula. The turtles that lived there probably came from the Ebro Basin, because Atxoste is located in the Ebro drainage basin. The Cantabrian drainage basin is situated very close to Atxoste, approximately 20 km to the north. Most of the Pleistocene and Holocene sites of the North of the Iberian Peninsula are situated in Cantabrian drainage basin. The boundary between the two basins probably represented a barrier to the dispersal of these reptiles. This may explain the absence of turtles in all these sites. Due to the existence of this potential natural barrier, and taking into account the absence of their record, the identification of the aquatic turtles *E. orbicularis* and *M. leprosa* as autochthonous taxa in this region (see Blanco and González, 1992) cannot be confirmed.

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