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A "shell-midden" dated to the Middle Ages in Northern Spain: The church of San Juan Bautista in Colindres

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ABSTRACT

Bioarchaeological evidence of subsistence strategies during the Middle Ages is scarce in the Cantabrian region (Northern Spain). In the excavations carried out at the church of San Juan Bautista in Colindres (Cantabria), a 'shell-midden' composed almost exclusively of archaeozoological and anthracological remains was documented, and then dated between the second part of the 12th century and the beginning of the 15th century CE. The animal remains belong mainly to invertebrates, with the marine bivalve *Cerastoderma* sp. (cockle) being the most abundant taxon. The acidic pH of the sediment, however, has meant that vertebrate remains are scarce and of very small size, with the documentation of freshwater fish teeth (Cyprinidae) standing out. The anthracological data indicate the use of various types of wood as fuel (including fruit trees), which points to an anthropised landscape. This accumulation of remains has been interpreted as a waste tip resulting from the daily activities (shellfishing, fishing, plant cultivation) of the people who lived around the church. Finally, the importance of this type of resource in the Cantabrian region and nearby areas during the Early Middle Ages is assessed, taking into account both the bioarchaeological information and the scarce historical data available.

1. Introduction

Archaeological excavations carried out in the last two decades are succeeding in adding to our understanding of the Middle Ages in Northern Spain, mainly through the use of techniques that have been developed and applied to prehistoric sites (e.g. Grau-Sologestoa, 2015; Peña-Chocarro and Pérez Jordá, 2023). These include the practice of systematic sampling, the use of sieves with less than 2 cm mesh size, recommendations from specialists for the collection of archaeozoological (macro- and micro-mammals, molluscs, fish, etc.) and archaeobotanic materials (anthracological and carpological), and the selection of samples for radiocarbon dating. Good examples of this are the studies of archaeological evidence in monographs about such sites as Ereñozar Castle (Bizkaia, Basque Country), with occupations dated

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between the 11th and the 13th centuries (Castaños Ugarte and Castaños de la Fuente, 2018) and Curiel Castle (Asturias), where levels were documented to establish phases dated between the 10th-11th centuries and the late 13th century CE (Phases II and III) (Gutiérrez González, 2003a; 2008). Similarly, some studies have focused on archaeozoological remains, such as the marine molluscs in the waste tip dated in the 12th to 15th centuries AD next to the city walls at Pontevedra (Galicia) (Álvarez-Fernández and Castro, 2010), the study of marine invertebrates (molluscs, crustaceans and echinoderms) and ichthyofauna from the settlement of Area in Viveiro (Lugo, Galicia), dated between the 11th and 15th centuries AD (Bejega-García et al., 2011; González Gómez de Agüero, 2014), and the ichthyofaunal analysis of

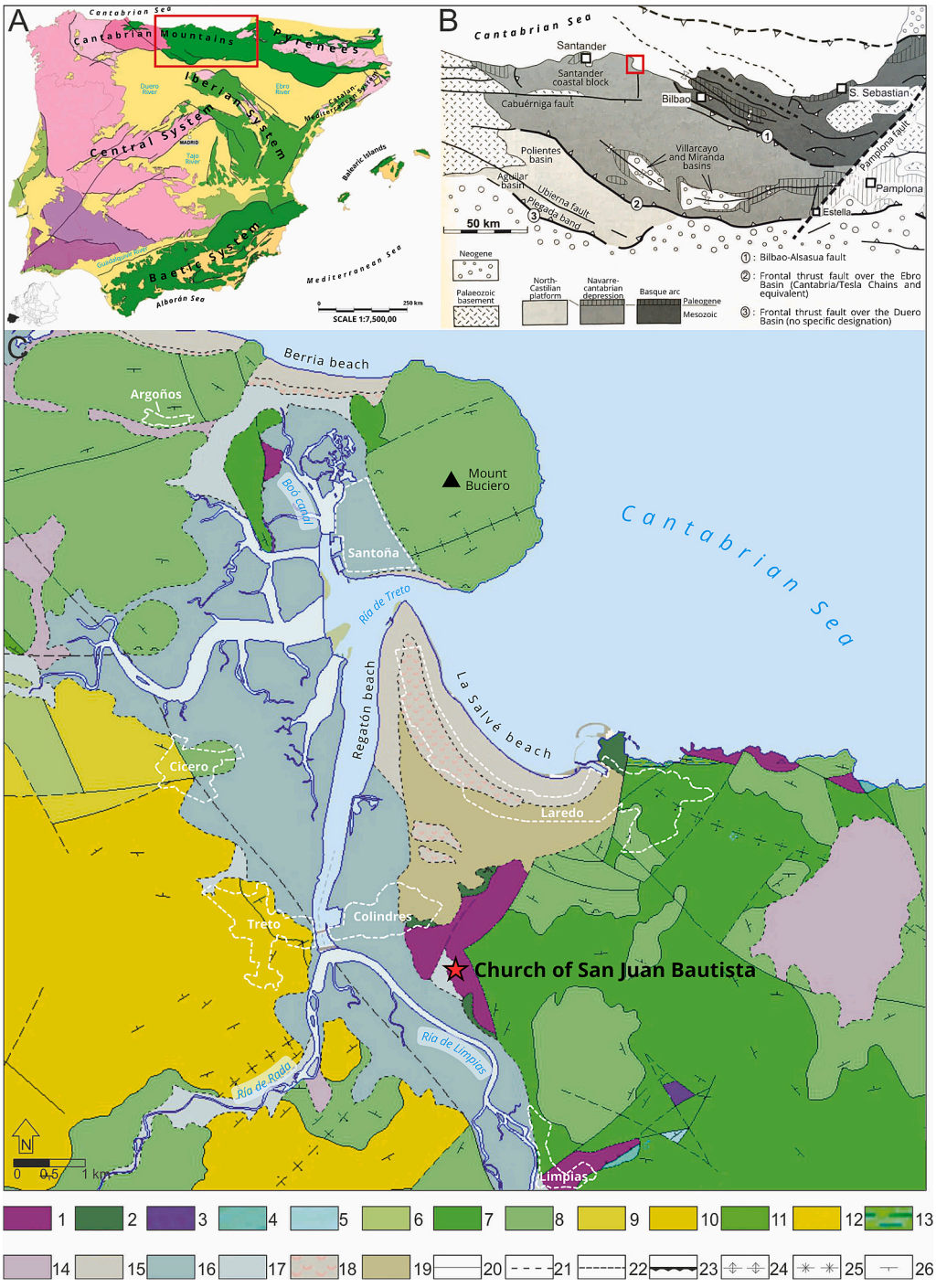

Fig. 1. Geological position of the Church of San Juan Bautista in Colindres (Cantabria) in the contexts of the Iberian Peninsula (A) (Vera et al., 2004), the Cantabrian range (B) (Barnolas and Pujalte, 2004) and its proximities (C) (GEODE, on-line). Key to the local geological map: 1 clay, gypsum and halite, Keuper facies; 2 Ophite; 3 Calcareous breccia, carniola, dolomite, oolitic and bioclastic limestone (Upper Triassic); 4 Bioclastic limestone and marls (Lower Jurassic); 5 Limestone, clayey limestone and marls (Middle Jurassic), 6 red lutite and sporadic beds of sandstone. Locally black lutite and grey and greenish limolite at the base. Vega de Pas Formation; 7 Sandstone and clayey silt; 8 Massive Urgonian micritic limestone and tabular calcarenite and marls. Asón Formation; 9 Limestone and marls with interbedded sand and sandstone; 10 Sandstone and lutite. Balmaseda Formation (Lower Cretaceous); 11 Calcarenite. Cerrazo Member; 12 Marls and clayey limestone, locally calcarenite; 13 Grey and red marls and hemipelagic limestone (Upper Cretaceous); 14 Reddish decalcification clay (Lower Pleistocene), 15 Beach sand and gravel, 16 Saltmarsh clay, silt and sand, 17 Littoral sand dunes, 18 Alluvial clay, silt, sand and gravel, 19 Anthropic buildings and waste (Holocene).

Levels EM1 and EM2 at the Tower of Hercules (A Coruña, Galicia), which are associated with domestic structures in a military space dated in the 11th-13th centuries (e.g., Bello Diéguez et al., 2008; Ferré, 2003; Ferré and Rey, 1997).

In this context, new archaeological fieldwork was carried out in 2008 around the church of San Juan Bautista in Colindres (Cantabria) (henceforward SJBC). It documented a level formed mostly of animal remains (nearly all marine molluscs) and plants: Stratigraphic Unit 6. Archaeofaunal and archaeobotanic studies have reconstructed the subsistence strategies followed at the mouth of the River Asón and the surrounding area in medieval times, particularly between the second part of the 12th century and the beginning of the 15th century CE (full and late Middle Ages). Hence, our objective is to present those findings and interpret the information obtained, by comparing it with other archaeological and historical data for sites dated in the same period of time in Cantabrian Spain.

2. Location and geological setting

The church of SJBC (WGS84 Zone 30, X: 464.248, Y: 4.803.996) is located to the south-east of the municipality of Colindres, on a small hill at 18.2 m above mean sea level.

Geologically, Colindres is located on the edge of the Navarre-Cantabrian Depression, geological unit of the Basque-Cantabrian basin, in the eastern sector of the Cantabrian range (Fig. 1.A and B) (Barnolas and Pujalte, 2004). Three main lithologies outcrop in this area: Mesozoic rocks, mostly carbonates, marls and lutites, Pleistocene clay sediments in the Liendo depression and finally the unconsolidated Holocene sediments in the saltmarsh, beaches, dunes and valley bottoms (IGME, on-line). Four geomorphological systems are developed in this area (slope processes, fluvial activity, karst landforms and littoral processes) and are responsible of the different forms in the area: the gentle relief on Mesozoic rock affected by small water-courses, karst forms seen especially in the Liendo depression and the coastal morphologies represented by cliffs, saltmarshes, estuary, dunes and beaches. The main rivers are the Asón and the Clarín, which are represented by their final courses before entering the estuaries and rias in the coastal system.

The coastal landscape is dominated by the estuary of the Asón River, which includes the main channel of the Asón, the Limpias saltmarsh, and the Rada channel and saltmarsh towards the south, the channel and saltmarshes of Argoños to the west, the muddy flatlands and sandy bay in the centre, the beaches of Regatón and La Salvé forming a barrier across the estuary and the lines of dunes associated with it, and the mouth of the river (Fig. 1C). It is a *meso*-tidal estuary (Flor et al., 2003), where the main river course converges with smaller ones, creating a number of rias occupied by the main channels and a large area of saltmarsh with muddy flatland and a sandy bay towards the river mouth. The bay is formed by the eastern shore of the barrier that connects with the headland at Laredo in the east, forming the estuarine Regatón beach and the La Salvé beach exposed to the sea. Additionally, to the north, the estuary is delimited by the Berria beach and Mount Buciero.

In this setting, the church of SJBC occupies a prominent position in the landscape of the Asón estuary, on a small hill formed by Triassic clay, gypsum and halite, on the right bank of the Ria de Limpias and overlooking the ria and the Santoña saltmarshes. In this context, the estuarine complex of the Asón offers optimal environmental conditions for marine molluscs and fishes, a circumstance which was undoubtedly a factor in the accumulation of the shell-midden around the church.

3. Archaeological excavation at San Juan Bautista's church in Colindres

The current church of SJBC was built in the 16th century (Ortiz Real and Brígido Gabiola, 2000), using some materials from an earlier construction. It is therefore very likely that the monastery of San Juan and San Jorge was located there. It is mentioned in the 11th century in the cartulary of the abbey of Santa María del Puerto, one of the most important monasteries in medieval Cantabria, in the nearby town of Santoña (Serrano y Sanz, 1919).

According to information provided by Colindres Town Hall, the modern cemetery located next to the church was used in the 19th century. It was most certainly located on a part of the old medieval cemetery (Ortiz Real and Brígido Gabiola, 2000: 180).

The wall around the church was rebuilt in 2008. It is located about 10 m from the rear of the present church. This involved dismantling the wall in an area of 48.2 m^2, which revealed stratigraphy of terracing on which the church was founded. Nine stratigraphic units (S.U.) were differentiated (Fig. 2).

- S.U. 1: superficial, with humus.
- S.U. 2: loose, greyish earth.
- S.U. 3: sandy soil with abundant stones, a level associated with the preparation of the terrain.
- S.U. 4: light brown earth with remains of bricks, in which two burials in situ (in anatomical connection) were documented in its lowest part, directly above S.U. 5. Other human remains, which would belong to another individual, were displaced towards the edge of the section.
- S.U. 5: blackish brown soil with fragments of bricks and very fragmented human remains with no anatomical connections.
- S. U. 6: abundant malacological remains forming what is known as a 'shell-midden'. The remains were in a clay matrix, dark brown in colour with remains of wood charcoal.
- S.U. 7: this corresponds to the wall that delimited the modern cemetery and adjoined S.U. 4 and 5.
- S.U. 8: disturbed level with abundant stones and remains of bricks on the other side of the wall corresponding to S.U. 7.
- S.U. 9: geological clay.

S.U. 4 and 7 represent the 19th century cemetery. Two burials *in situ* were found and other human remains that were displaced towards the edge of the stratigraphic section. Another level with anthropological remains (S.U. 5) was below this cemetery, but they were fragmented and had lost their anatomical connections. It is likely that the cemetery was in use from the late Middle Ages, probably in connection with the monastery of San Juan and San Jorge, before SJBC was built. Part of it might have been destroyed in about 1580, when the church was repaired (Bolado del Castillo et al., 2009; 2014). It is not possible to establish a date for the foundation of the cemetery with the available data although, as appreciated in S.U. 5, it must have been in use for several centuries. Everything seems to indicate, therefore, that the back of the present church was used as a cemetery from the late Middle Ages to the 19th century.

A level with abundant biotic remains (S.U. 6), the object of the present study, was found beneath this cemetery.

4. Stratigraphic unit 6: Context and analytical methodology

S.U. 6 is a level with very little sedimentary matrix, containing a large number of invertebrate remains together with some vertebrate remains and wood charcoal. This 'shell-midden' was in the form of a tongue, 2.36 m long and between 1 m and 60 cm wide. Its thickness varied between 3 and 5 cm. One square metre of this unit was excavated in order to document it.

The scarce sediment and the archaeological remains were wet-sieved with a metal screen with a 3 mm mesh size. All the remains were placed in plastic bags and deposited in the Museum of Prehistory and Archaeology of Cantabria (Santander), where they were studied and where they are currently stored.

All the biotic and abiotic remains retrieved have been studied for the present investigation. While most of the remains are shells of marine molluscs, other invertebrate and vertebrate remains, both marine and

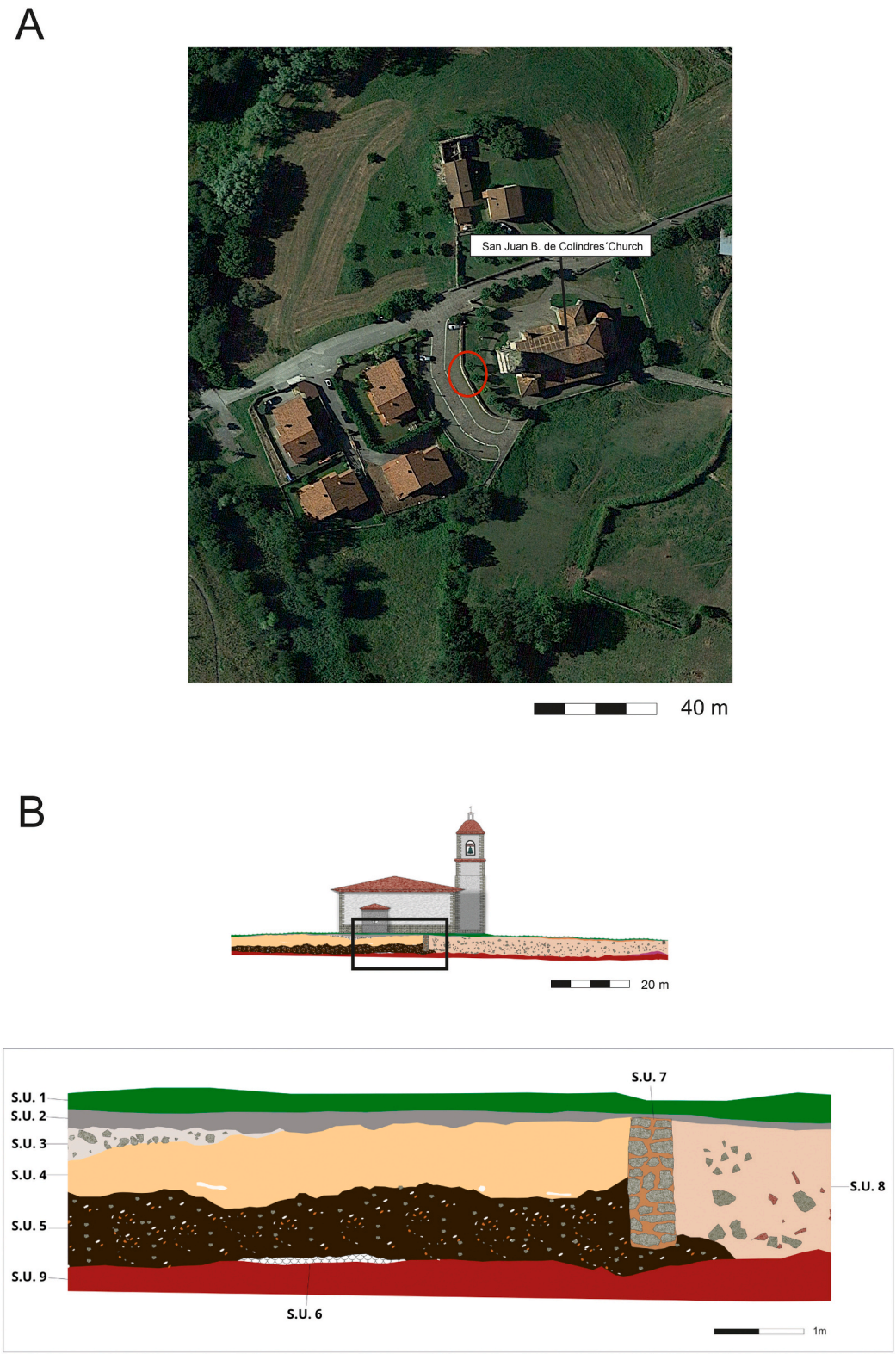

Fig. 2. A) View of the Church of San Juan Bautista in Colindres, showing the excavation area carried out in 2008 (modified from Google Earth Pro, 18/02/2025). B) Stratigraphic section documented by the archaeological excavation in 2008, marking the position of the stratigraphic unit studied here (S.U. 6).

terrestrial, were documented.

The archaeozoological remains were identified with reference collections in the Department of Prehistory, Ancient History and Archaeology at the University of Salamanca (marine invertebrates and vertebrates), in the Natural Science Museum in Madrid (terrestrial molluscs), at the IIIPC-University of Cantabria (large mammals), at the University of the Basque Country in Vitoria (small vertebrates), and the Laboratory for Archaeozoological Studies at the University of Leiden (fish).

The mollusc shells, the most abundant type of remains, were always identified to species level wherever possible, differentiating them into marine or terrestrial. This classification was based on their taxonomic

attributes (ornamentation, shape, etc.). Information about the habitat of the species has been taken from specific studies for marine (e.g., Palacios and Vega, 1997; Lozano Cabo, 1978; 1983) and terrestrial species (e.g., Welter-Schultes, 2012). The nomenclature in the World Register of Marine Species was used for marine molluscs (WoRMS; Ahyong et al., 2022), and in Fauna Europaea for terrestrial species (Fauna Europaea; De Jong et al., 2014). The method for the quantification of the mollusc shells follows Moreno (1994). The Minimum Number of Individuals (MNI) was calculated to avoid the over-representation of the most fragile species. The hinge was used to calculate the MNI of bivalves; the right and left valves were estimated separately and the largest number was taken as the MNI. For the fish, the quantification of the number of remains (NISP) and MNI follows the guidelines of Wheeler and Jones (1989).

Taphonomic alterations were taken into account in the study of the malacological and ichthyologic remains (e.g., Wheeler and Jones, 1989; Moreno, 1994).

Biometric data was collected with a digital calliper (with an error of ± 0.05 mm). The height of valves of well-preserved *Cerastoderma edule* were compared with data from the monitoring carried out each year in the Basque Country for mollusc species with a commercial interest (Bald and Borja, 2005). This aimed to determine whether the medieval shell-fishers selected specimens of a particular size and to explain the reasons for that selection.

Finally, to establish the chronology of the shell-midden, as mammal remains are very scarce, fragmented and damaged, a *Cerastoderma edule* valve was chosen for a radiocarbon date. The sample was sent to the Oxford Radiocarbon Accelerator Unit (University of Oxford, UK).

The study of the osseous remains was hindered by the great fragmentation of this sample and its poor state of conservation. The remains were studied at macro- and microscopic level (with a stereo-microscope) to identify the bone and possible anthropic and natural modifications.

The only archaeobotanic remains found were pieces of wood charcoal. They were separated from the rest of the material and studied with the usual methodology (Uzquiano, 1997; Badal et al., 2003). Charcoals are fractured by hand following the three anatomical plans: transversal, tangential and radial. They were identified with an anatomical atlas (Greguss, 1959; Schweingruber, 1990; Jacquiot et al., 1973; Vernet et al., 2001). They were observed with a reflected light microscope (Olympus BX60M). Their botanic classification followed the guidelines in Flora Europaea (Tutin et al., 1964).

5. Results

5.1. Radiocarbon chronology of the deposit

The *Cerastoderma edule* valve collected in S.U. 6 was dated to 1167 ± 25 BP, to the period between 1161 and 1412 cal. AD (95 %) (Table 1).

5.2. Archaeozoology

Marine and terrestrial invertebrates.

The documented invertebrate remains belong to organisms of marine (molluscs and echinoderms) and terrestrial (molluscs) origin.

Table 1
Radiocarbon date obtained at San Juan Bautista's Church in Colindres. The date was calibrated with Oxcal version 4.4 (Bronk Ramsey, 2001; 2009) and the Marine20 calibration curve (Reimer et al., 2020), using the ΔR = -105 ± 21 established for the Mesolithic in the region (Soares et al., 2016). [1]The $\delta^{13}C$ AMS value was provided by the Radiocarbon Lab.

Lab. number	Sample	SU	Radiocarbon age BP	$\delta^{13}C^{1}$	Calibration 2σ
OxA-28974	*Cerastoderma* sp.	Shell midden	1167 ± 25	−0.72	1161–1412

A total of 45,553 remains of marine molluscs were studied, for which an MNI of 1,558 has been estimated. They all belong to bivalves. Furthermore, nearly all of them correspond to cockles (*Cerastoderma* sp.), with an MNI of 1,547, or about 99.3 % of the total. This bivalve is gathered in sandy or muddy substrates in the *meso*-littoral zone of the Ría de Treto, in the middle section of the Asón Estuary, and at the mouth of the river. The complete or practically complete valves have been identified as the species *Cerastoderma edule* (Linnaeus, 1758). Hence, 140 right valves and 123 left valves definitely belong to that species (Table 2 and Fig. 3).

In addition to the cockles, a few other species have been recorded. They include some individuals of the grooved carpet shell *Ruditapes decussatus* (Linnaeus, 1758) and three of the Superfamily Solenoidea (razor shells) also gathered on sandy/muddy substrates in the *meso*-littoral zone, probably in the same zone as the cockles. In addition, a mussel (*Mytilus* sp.) and an oyster (Family Ostreidae) would have been obtained on hard substrates (walls, cliffs, rocky beds) in the mid- or low-shore zones, in the inner and outer areas of the Asón Estuary.

Nearly all the shells found in S.U. 6 are fragmented. They were probably broken by trampling after being consumed and abandoned. They all display traces of decalcification, which affects the most fragile parts of the valves, the teeth and the hinges. They do not preserve the periostracum. Fragmentation and decalcification hinder the identification of many of the shells to species level or to determine whether the fragments of complete cockle hinges, a total of 758, belong to right or left valves, which does not allow a more precise calculation of the MNI. Based on the complete hinges and the fragments of hinges broken into two or more fragments, it has been calculated that the number of individuals probably comes to over 2000. None of the quantified shells display traces of thermal alteration.

The biometric study of the cockles has taken into account the maximum height of all the complete right and left valves and the fragmented ones that preserve their full height. Most of the specimens are 27 or 28 mm high. However, the comparison between the archaeological specimens and modern populations shows a clear selection of the largest individuals, 23 to 27 mm in height (Table 3 and Fig. 4) Medieval shell-fishers selected the larger specimens, corresponding to the same cohort as modern catches.

The other evidence of marine fauna from S.U. 6 is a single echinoderm remain (Family Parechinidae). It is the mesial fragment of a sea urchin spine.

In total, 42 remains of terrestrial molluscs have been documented. They have been attributed to an MNI of 20 shells belonging to 8 different

Table 2
Marine and continental mollusc taxa identified, according to the number of remains (NR) and Minimum Number of Individuals (MNI) found in S.U. 6 at San Juan Bautista's Church in Colindres.

	NR	MNI
MARINE MOLLUSCS		
Cerastoderma edule (Linnaeus, 1758)	263	140
Cerastoderma sp.	45,164	1,407
Ruditapes decussatus (Linnaeus, 1758)	47	6
Solen sp.	40	3
Mytilus sp.	13	1
Ostreidae	6	1
Subtotal	45,533	1,558
CONTINENTAL MOLLUSCS		
Helicella itala (Linnaeus, 1758)	3	3
Pomatias elegans (O. F. Müller, 1774)	6	4
Cornu aspersum (O. F. Müller, 1774)	9	1
Cepaea nemoralis (Linnaeus, 1758)	4	1
Xerotricha conspurcata (Draparnaud, 1801)	1	1
Helicopsis striata (O. F. Müller, 1774)	3	3
Cochlicella acuta (O. F. Müller, 1774)	14	5
Zonites sp.	2	2
Subtotal	42	20
Total Molluscs	4,575	1,578

Fig. 3. Specimens and samples of *Cerastoderma* sp. from S.U. 6 at San Juan Bautista's Church in Colindres. Left: Fragment of shells; Middle: Fragments of shells with complete or broken hinges. Right: Complete valves.

Table 3
Comparison of the heights of *Cerastoderma edule* shells from S.U. 6 at San Juan Bautista's Church in Colindres and in modern populations of the same species. SD: Standard deviation; RV: Right valve; LV: left valve.

Type of shell	Height (mm)					Total N
	Mean	SD	Median	Maximum	Minimum	
Recent	16.43	9.54	16.15	40.07	2.50	150
Archaeological (RV)	27.22	2.01	27.68	32.03	21.69	81
Archaeological (LV)	27.02	2.04	27.25	30.72	21.31	69

taxa. Although many of the remains are decalcified, the colour and gloss on the surface of some individuals belonging to the species *Pomatias elegans* and *Cornu aspersum* shows that these are undoubtedly sub-modern specimens. The record is completed by *Cepaea nemoralis* and small snails corresponding to the species *Helicella itala*, *Xerotricha conspurcata*, *Helicopsis striata*, *Cochlicella acuta* and Family Zonitidae (Table 1). These are species that currently live on calcareous substrates in the proximity of the site.

Fish.

The number of fish remains documented is 126. Although identification to species level has not been possible for hardly any specimen owing to the general lack of diagnostic elements or their preservation state, 21 pharingeal teeth correspond to cyprinids and a molariform to a sparid, very probably a gilthead seabream (*Sparus aurata* L.). In the case of the cyprinids, it is likely that they were caught in the River Asón, where the South-west European nase (*Parachondrostoma toxostoma*) and the common minnow (*Phoxinus phoxinus*) currently live. In the case that sparids were caught for human consumption, they were probably fished in areas close to the coast or in brackish waters of a littoral lagoon or the Asón estuary. Sparids comprise several demersal species associated with both rocky beds and seagrass meadows. They would have been caught with hook and line in the river and on the shore. Both this sparid tooth and one of the cyprinid pharyngeals are thermally altered. The scarce evidence may be related to cleaning after fishing activity in the area (Fig. 5). The other ichthyologic elements are ten vertebrae, a fragmented pre-opercula, five branchiostegous radii and 93 indeterminate remains, mostly vertebra apophyses and both compete and broken radii.

Terrestrial vertebrates.

The terrestrial vertebrates documented at the church of SJBC consists of a few remains of large and small mammals.

The number of large mammal remains is 66, but they are so badly fragmented that only two of them are more than 1 cm in size but still without reaching 2 cm. For this reason, no osseous element has been identified anatomically, except for a tooth recognised by a fragment of enamel. In the same way, the taxonomical identification was not possible, even to approach the size of the species in the assemblage. However, it can be said that, owing to the density of the fragments, they do not belong to either small mammals or birds. Only one of them is altered thermally.

The micro-vertebrate remains are even scarcer. Three were documented: a fragmented molar and a whole molar of an Arvicolidae and a Rodentia incisor. These rodents would live in the immediate surroundings of the site.

Finally, a fragment of a possible iron object was documented in the shell midden. It was not studied further because of its insufficient state of conservation.

5.3. Archaeobotany: Anthracology

The remains found in S.U. 6 were relatively abundant and their conservation was satisfactory. The anthracological study of 100 remains has revealed considerable botanic diversity with species corresponding to diverse ecology (Table 4).

Among the arboreal species, the dominant taxa are beech and oak (*Fagus sylvatica, Quercus* t. *robur*). Chestnut (*Castanea sativa*), holm oak (*Quercus ilex*), willow and/or poplar (*Salix-Populus*) and pine appear in smaller quantities. The shrub layer is represented by Fabaceae and ivy (*Hedera helix*), and a monocotyledon. *Prunus*, with anatomical characteristics closely resembling almond (*Prunus* t. *amygdalus*), and grapevine (*Vitis)* suggest the presence of orchards near the site. The anthracological data suggest that Atlantic broad-leaf forest was exploited around

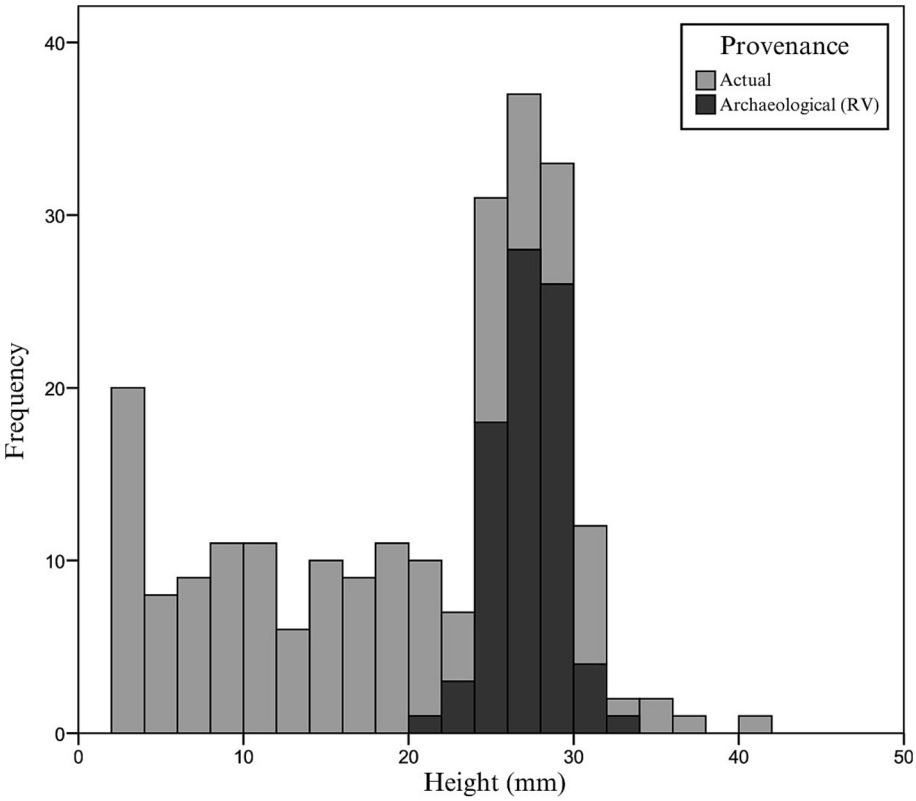

Fig. 4. Histogram comparing the heights (mm) of the right valves (n = 81) of *Cerastoderma* sp. shells in S.U. 6 with modern populations of the same species.

SJBC, to be precise, acidophilic oak woodland with *Quercus robur* and chestnut (*Castanea sativa*), typical of highly acidified coastal substrates, together with Fabaceae. The presence of *Quercus ilex* also could indicate the use of wood from limestone substrates, which also characterise this coastal area. The great abundance of *Fagus sylvatica* seems to suggest a systematic exploitation of that wood from somewhat more distant areas, although not necessarily at much altitude because beech is often found at medium and low heights in the Eurosiberian region, including this part of Cantabria, especially from the second half of the Holocene onwards. Beech might have occupied shady hillsides above the deciduous oak woodland during the period of study.

6. Discussion

The systematic archaeological excavation at the church of SJBC provided information about the economic activities of populations around the Asón Estuary (Cantabria, northern Spain) in the Middle Ages. In S.U. 6, dated between the second part of the 12th century and the beginning of the 15th century CE, a 'shell-midden' contained particularly abundant archaeozoological remains. The record is completed by a single abiotic object, a fragment of a very badly preserved iron tool. The context where the remains were found probably corresponds to an area of domestic waste, consisting of archaeozoological remains indicating animal consumption, where anthracological remains from the cleaning and emptying of domestic hearths were also dumped. These types of sites are interpreted as waste tips in prehistoric (e. g. Álvarez-Fernández, 2011; 2015; Fernández Rodríguez et al., 2008) and historic periods (e. g. Bolado del Castillo and Cueto, 2022).

Marine shells are abundant. They belong exclusively to bivalves and nearly all are cockles (>98 % in both NR and MNI), which were selected by size. The next more abundant taxa are razor shells and grooved carpet shells. These three taxa were probably gathered on sandy and slightly muddy substrates in the intertidal zone of the Ría de Treto (River Asón). Mussels and Oysters were gathered on rocky substrates in the mid- or low-shore zones of the Estuary. The virtual absence of alterations by fire on the outer surface of the valves, or fractures on their edges, probably suggests that they were boiled, so that they do not appear to be altered by heat to the naked eye.

Although the presence of marine mollusc species has been noted at several medieval sites in Cantabrian Spain, few details are given, and the assessment of the finds is limited. The exceptions would be Pontevedra City Walls (Galicia), Curiel Castle (Asturias) and Ereñozar Castle (Basque Country). At Pontevedra City Walls a total MNI of 810 molluscs gathered on rocky and sandy/muddy beds was estimated. Oysters (*Ostrea edulis*) made up a little under 50 % of the sample and cockles and carpet shells about 46 % (Álvarez-Fernández and Castro, 2010). In Phases II and III at Curiel Castle an MNI of about 400 was estimated, among which *O. edulis* and *R. decussatus* predominated. However, a difference is seen between Phase II in the 10^{th}-12^{th} centuries and Phase III in the 13^{th} century. In the former of these, oysters were more abundant than grooved carpet shells (64 % and 24 %), whereas the positions were reversed in the later phase (30 % compared with nearly 67 %) (Gutiérrez González, 2003b; 2008). In Ereñozar castle (11^{th}-13^{th} centuries), two hundred oyster shells (*O. edule*) were documented, probably collected in the nearby Guernika marshes (Castaños Ugarte and Castaños de la Fuente, 2018). In other medieval contexts in Cantabrian Spain the published information is reduced to the determination of the species (e g., in Oviedo city during the 12^{th}-13^{th} centuries: Adán, 1997; and in excavations in caves, fortifications and hermitages with medieval occupations in the Province of Cantabria: e. g. Ruíz and Muñoz, 2013; Sarabia, 2002; Bohigas, 2000).

On the European Atlantic coast, archaeomalacological studies enjoy a longer tradition, particularly in France. Thus, we know that oyster shellfishing was appreciated and, to a lesser extent, other species were collected from rocky substrates (mussels, limpets, periwinkles) (Le Goff, 2021), although there are certain places where specialization in bivalves from sandy and muddy substrates is noted. Thus, in Le Crotoy shell-midden (Somme), dated to the 10th century, and the rural coastal site

Fig. 5. Fish remains (teeth and vertebrae) from S.U. 6 at San Juan Bautista's Church in Colindres.

of Les Mathes (Charente-Maritime), dated to the 10th-11th centuries, specialization in the harvesting of cockles has been documented (Rougier, 2019; Le Goff, 2021), as occurs at SJBC.

No archaeological evidence has been found to support the consumption of terrestrial snails by the medieval populations around SJBC church, due to the small number of remains found and their conservation.

The scarcity of vertebrate remains (including bones and teeth of fish and macro- and microvertebrates) and their significant degree of fragmentation (sizes < 2 cm) may be a consequence of their processing. These bones may have been boiled, a common culinary practice, which would weaken the osseous structure and make them susceptible to their later fragmentation by trampling. However, this paucity of bones, in particular, may be due to other post-depositional processes. In addition to trampling and combustion (to a lesser degree as only few remains are burnt), the agent that very probably made them disappear was rainwater. Its low pH would have degraded the larger bones, so that the only ones that have survived (small whole bones and teeth of rodents and fish, and fragments of osseous remains of other animals) were protected by the bivalve shells. In this way, the cockle shells preserved these small bone remains inside them, enabling them to reach us. This explanation has also been proposed to explain the absence of vertebrate remains in

Table 4
Classification of anthracological remains from S.U. 6 at San Juan Bautista's Church in Colindres.

SU 6 TAXA	Number	%
Pinus sp.	1	1
Quercus t. *robur*	25	25
Castanea sativa	3	3
Fagus sylvatica	31	31
Quercus t. *ilex*	1	1
Salix-Populus	1	1
Prunus t. *amygdalus*	1	1
Vitis sp.	2	2
Hedera helix	2	2
Fabaceae	5	5
Monocotyledoneae	2	2
Indeterminable	26	26
TOTAL	100	100 %

the J3 shell-midden in the Basque Country, dated in the early Holocene (Álvarez-Fernández et al., 2014).

A few teeth and some bones are the fish remains documented at SJBC. They belong to cyprinids (e. g. common barbels, carps) and sparids (e.g. seabream) which were probably caught in the River Asón and at its mouth. Information on fish consumption in the Cantabrian region during the Middle Ages comes mostly from sites in Galicia and the Basque Country, from where 86 % of the ichthyological record derives (Roselló-Izquierdo et al., 2021). The tendency was towards the capture of resident littoral fish, including sparids, as well as species living in more open water, above all European hake (*Merluccius merluccius* L.), but also mackerel (*Scomber scombrus* L., spp.), sardine or pilchard (*Sardina pilchardus* L.), etc., particularly from the 13th century onwards, leading to the development of coastal fisheries (e.g. new types of boats and new preservation techniques). It is from that century that the development of fish preservation factories linked to local consumption and the export of marine fish has been documented. (e.g. Arizaga Bolumburu, 1989; Ferré and Rey, 1997; Ferré, 2003; Ferreira Priegue, 1998; 2009; Morales-Muñiz et al., 2009; González Gómez de Agüero, 2014; Roselló-Izquierdo et al., 2021).

The mammal bones at SJBC were so scarce and fragmented that the composition of the local livestock or the role they played in the economy cannot be determined. For information in this regard, it is necessary to resort to coetaneous sites in surrounding regions, in particular in Asturias and the Basque Country, since no archaeozoological studies have been undertaken for medieval Cantabria. In the early Middle Ages, the livestock was diversified, based on sheep, goats, cattle and swine. From the end of the Roman period to the Middle Ages, the number of sheep and goats increased relative to pigs, as documented at Curiel Castle (Phases II and III), in Asturias. This has also been documented at inland sites in the Basque Country between the 11th and 15th centuries (e.g., the urban settlement of the Old Jail at Balmaseda; the rural towns of Zornoztegi, Zaballa and Aistra, and on the other side of the Cantabrian Mountains (e.g., Santa María-Terradillos de los Templarios, in the Province of Palencia). The use of poultry increased in the late Middle Ages, as documented at Curiel Castle, Zornoztegi, and Zaballa sites (Grau-Sologestoa, 2015; Bravo et al., 2003; Fernández Carvajal et al., 2011). In these centuries, very little evidence of hunting wild animals is documented (e. g., red deer, roe deer and perhaps wild boar at Curiel Castle) (Bravo et al., 2003). Similarly, fowling has only been identified at the Zornoztegi and Zaballa sites, where galliforms predominate among the birds (Grau-Sologestoa, 2015). Terrestrial animals played a central role in the everyday life of humans at the economic (consumption of meat and secondary products, transport, ploughing, etc.) and social and symbolic levels (e.g., Salisbury, 1994).

The anthracological data suggest that Atlantic broad-leaf forest (oak, chestnut) was exploited around SJBC. The presence of European beech indicates a systematic exploitation of that wood from somewhat more distant areas. This type of forest management is usually associated with itinerant livestock activities, which in this case could not be documented given the poor state of preservation of the remains of terrestrial fauna. The presence of forest species alternating with the exploitation of open spaces related to crops and livestock activities would be characteristic of the exploitation of the plant environment in the centre of the Cantabrian region in the Middle Ages (e.g., La Tabacalera, in Asturias, 5th-7th centuries) (Carrión Marco et al., 2015), and later; e.g., Gauzón Castle, Asturias 6th-10th centuries (Uzquiano, unpublished) and Curiel Castle, Asturias, 10th-13th centuries (Allué, 2003). Finally, it should be noted that the species identified at SJBC include cultivated elements such as vines (*Vitis*), a possible almond tree (*Prunus t. amygdalus*) and chestnut (*Castanea*). The finding of charcoal belonging to these species could be the result of annual pruning. This has been recorded in certain contexts in the Iberian Peninsula, for example, in the complex of Santa María de Melque, in Toledo, dating from the 7th/8th and 12th centuries AD (Uzquiano, in Caballero Zoreda and Fernández Mier, 1999). The pruning of cultivated trees provides additional fuelwood for domestic households as is traditional in the Spanish rural economy.

The archaeological data obtained in SBJC complements the information known to date, particularly on the exploitation of aquaculture resources, from the few known documentary sources in the region. In the case of Colindres (a town which belonged to the Kingdom of Navarre until the end of the 11th century and later entered the Castilian orbit; González Echegaray, 1990; Sánchez Candeira, 1999) and the surrounding area, the documents of the cartulary of Santa María del Puerto, dated between 1082 and 1210, offer a picture of the 11th-13th centuries which does not differ from that of other inhabited towns in the early and middle Middle Ages. Thus, through these documents, we know of the existence of houses, farmland, granaries, and cider apple and cherry orchards, as well as the use of the surrounding mountains (Serrano y Sanz, 1919). However, in these documents there is no mention of the exploitation of river or maritime resources, apart from a reference in a document from the beginning of the 13th century, the famous Votos de San Millán, a period forgery purporting to be from the 10th century, which establishes the payment of two wineskins of whale oil by Laredo and Colindres to the Riojan monastery of San Millán de la Cogolla (Ortiz Real and Brígido Gabiola, 2000: 17). Another possible mention of the exploitation of river resources can be found, indirectly, in the nearby medieval place name Pelgolano, today Pieragullano village (Ampuero), which could indicate the existence of a 'piélago' or well where fishing was practised at that specific place in the course of the River Asón (Serrano y Sanz, 1919: 344).

The garbage dump studied in this article would be located about ten meters from the medieval church, on top of which the present church was built. It would be located behind the building, a space that was used from the Late Middle Ages onwards as a cemetery, according to the anthropological remains documented in the excavation process. To better determine the relationship between the midden and the stratigraphic units documented above it, it would be necessary to open a larger excavation area.

7. Conclusions

Bioarchaeological analyses combined with historical documentation studies allow us to reconstruct the ways of life during the Middle Ages. The research carried out at the church of SBJC has shed more light on dietary habits and forest management during the Late Middle Ages, particularly in the Central Cantabrian region, a region where this type of research is very scarce, as are documentary sources that inform us about the management of the animal and plant environment.

From the bioarchaeological data recovered at SBJC it has been determined that the remains formed part of a waste tip resulting from a specific preparation (wood charcoal remains from fires or hearths) and consumption of molluscs, fish and mammals. Perhaps it was the result of some type of feasting or communal celebrations.

The conservation of archaeobiological remains at SBJC is differential

so it would not be a reflection of what its inhabitants really ate. Their diets would be focused on plant resources (cereals, legumes, fruits) and on meat, fat and milk from domestic animals, either on farms belonging to religious communities or from livestock farmers at nearby sites who marketed their products, as noted in other medieval archaeological sites on the European Atlantic coast. Shell-fishing and hunting would provide them with supplementary food. In the case of SBJC, on the one hand, shellfish harvesting has been documented in sandy/muddy substrates owing to the almost exclusive presence of cockles; and on the other, river fishing (cyprinids); the first information known about this type of practice at medieval sites in the Cantabrian region.

In the future, in addition to studying in greater detail the bio-archaeological remains that appear in medieval archaeological excavations, comparisons should be made between the results of said studies with the documentary sources available for the region around the archaeological site.

CRediT authorship contribution statement

Esteban Álvarez-Fernández: Writing – review & editing, Writing – original draft, Formal analysis, Data curation. **Rafael Bolado Del Castillo:** Writing – review & editing, Formal analysis, Data curation. **Mª Teresa Aparicio:** Writing – review & editing, Formal analysis. **Ángel Borja:** Writing – review & editing, Data curation. **Marián Cueto:** Writing – review & editing, Formal analysis, Data curation. **Enrique Gutiérrez Cuenca:** Writing – review & editing, Data curation. **José Ángel Hierro Gárate:** Writing – review & editing, Data curation. **Jesús F. Jordá Pardo:** Writing – review & editing, Formal analysis. **Laura Llorente Rodríguez:** Writing – review & editing, Formal analysis. **Alberto Marchán-Fernández:** Writing – review & editing, Formal analysis. **Paloma Uzquiano:** Writing – review & editing, Formal analysis. **Miriam Cubas:** Writing – review & editing, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

Data will be made available on request.

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