



Fishing and the Church: Ichthyoarchaeological analyses of the visigothic settlement of Aiguafreda de Dalt site (Catalonia, Spain, 7th c.)[☆]

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ABSTRACT

During the post-Roman centuries, a new political, social and cultural order emerged in the Western Mediterranean. As part of this process, fisheries underwent significant changes, which laid the foundation for the subsequent development of medieval fisheries in the region. However, fishing activities during the Visigothic Kingdom (5th–8th centuries) in the Iberian Peninsula remain underexplored, especially in comparison to other areas such as Italy. This paper presents an analysis of the ichthyoarchaeological assemblage from the 7th-century site of Aiguafreda de Dalt (Catalonia, Spain), one of the first comprehensive studies of a fish assemblage from this period in the region. The results suggest that ecclesiastical elites played a key role in shaping fishing practices in the northeastern Iberian Peninsula and the existence of a small-scale system for transporting fresh fish inland. The study also reveals a continuity in fish consumption practices from the Roman period into the Visigothic era.

1. Introduction

During the European Middle Ages, fisheries underwent profound transformations, especially from the 10th century onwards (Barrett, 2016; Barrett et al., 2004; Hoffmann, 2002, 2005, 2023). To fully comprehend these changes, it is essential to consider how the new food system that emerged during the post-Roman period laid the foundations for later developments (Baldoni et al., 2021; Belcastro et al., 2007, p. 382; Montanari, 1988). Although the post-Roman fisheries are well documented on the NE Atlantic coast (see Barrett, 2016), they have been scarcely studied in the western Mediterranean, with notable knowledge gaps in some regions such as the NE of the Iberian peninsula (Morales Muñoz et al., 2009; Salvadori, 2015, p. 152). During the excavations at

Aiguafreda de Dalt (Aiguafreda, Montseny massif, Catalonia), the archaeologists collected an ichthyoarchaeological assemblage dating to the Visigothic kingdom, a previously undocumented period in Iberian ichthyoarchaeology. The recovered assemblage was analysed to characterise fishing practices during this period in the region, and to study whether or not elements of continuity with Roman period fisheries existed.

2. Background and historical context

During Late Antiquity, the migration and settlement of various Germanic peoples in the Western Mediterranean brought about a series of changes in the modes of production and cultural values linked to the

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diet, which fostered the importance of fish in the newly emerging food system (Baldoni et al., 2021; Belcastro et al., 2007, p. 382; Montanari, 1988, 1993, p. 18). Fish importance in the Early Middle Ages was shaped by environmental abundance and the cultural influence of Christianity (Donati, 1999, pp. 7–10; Lanconelli, 2001, pp. 7–8; Montanari, 1979, pp. 277–280, 1993, pp. 81–82; Salvadori, 2015, pp. 152–154; Zug Tucci, 1985, p. 207).

The periodization of Late Antiquity and Early Middle Ages is debated, but this paper adopts the periodization for the NE of the Iberian Peninsula, spanning from the 3rd–4th century CE to the beginning of the 8th century CE (Palol, 1999; Pazdernik, 2015; Santana Onrubia, 2018).

The reduction of Roman marine fisheries resulted in fishing practices reverting to subsistence levels during Late Antiquity and the Early Middle Ages (Bekker-Nielsen, 2010, p. 203; Hoffmann, 2002, pp. 4–5, 2023, p. 53). In the Western Mediterranean this shift focused on (1) the exploitation of freshwater and inshore species, (2) subsistence-level fishing, and (3) a decline in fish trade, emphasizing local consumption.

- (1) Large-scale fishing for pelagic species ended in the post-Roman period, as evidenced by the absence of pelagic fishing nets in mosaics after the 5th century (Bekker-Nielsen, 2010, p. 202–203). The archaeological record reinforces the idea that in Italy there was a decrease of marine fishing during Late Antiquity, particularly acute in the case of pelagic species (Salvadori, 2015, p. 170). For some time, it was suggested that this period witnessed a rise of continental fishing to the detriment of marine fishing (Baker, 2000, p. 427; Montanari, 1979, p. 292–293; Squatriti, 1998, p. 102). However, ichthyoarchaeological research has failed to confirm this shift, despite the documented decline in marine fishing (De Grossi Mazzorini, 2016, p. 57–58; Salvadori, 2012, p. 299, 2015, p. 171). On the Mediterranean French coast, fishing shifted back to lagoonal-riverine fishing during Late Antiquity (Buffat et al., 2009, p. 183–186; Forest, 2018; Landuré et al., 2019, p. 191–193; Sternberg, 1998, p. 96).
- (2) As pelagic fishing decreased, fishing became a subsistence activity (Hoffmann, 2023, p. 89), an indicator of which is the progressive disappearance of salting factories between the 5th and the mid-6th centuries CE (Bernal-Casasola, 2008, p. 51; Marzano, 2013, p. 104–105; Trakadas, 2005, p. 74). This shift meant that fish went from being a staple for a great part of the population to becoming a scarcer and restricted food item (Craig et al., 2009, p. 581; Marzano, 2018, p. 438). For example, in Italy, fish consumption became largely restricted to ecclesiastical settlements and a subsistence level activity (Baker, 2000, p. 427; Battafarano & De Grossi Mazzorini, 2010, p. 291–292; Salvadori, 2012, p. 304, 2015, p. 175–186).
- (3) Between the 4th and 6th centuries, trade in the western Mediterranean declined drastically (Horden & Purcell, 2000, p. 153). Long-distance preserved fish trade was no exception, and by the 7th century CE had significantly decreased in volume (Andrews et al., 2022, p. 252; Bernal-Casasola, 2001, p. 261–262, 2008, p. 44). However, this did not necessarily imply a lack of marine products trade at more restricted geographical levels, as has been observed in southern Italy or the Plan of Roussillon in France (Forest, 2018; Salvadori, 2015, p. 186).

In the northeastern Iberian Peninsula, following the Visigoth defeat by the Franks at the Battle of Vouillé (507 CE), the Visigoth kingdom was established, marking a shift in settlement and production systems. The new settlements also saw greater diversification of productive activities, particularly in husbandry (Folch et al., 2015; Folch Iglesias, 2012; Gallego Valle, 2022; Palol, 1999, pp. 38–39).

While information on agriculture and husbandry from this period is limited compared to others, knowledge of fishing practices is even scarcer. However, archaeological finds from sites in coastal areas such as Sant Martí d'Empúries or Puig Rom (6th–8th centuries CE, Fig. 1)

suggest a shift towards smaller-scale, subsistence fishing (Juan-Muns, 1999; Nolla et al., 2016, pp. 145–148; Subias et al., 2021, p. 63; Subias Pascual et al., 2016). At the Sotstinent Navarro¹ site in Barcelona (2nd century BCE – 14th century CE), the ichthyoarchaeological assemblage points to fishing in a nearby coastal lagoon or estuarine area, focusing on juvenile European pilchards (*Sardina pilchardus*) (Marlasca Martín, 2014). While this may hint at some specialization, it remains a tentative hypothesis.

Fishing along the northeastern Iberian coast during Late Antiquity appears to have been largely subsistence-based. However, compared to regions like Italy, where extensive research has been done, several questions remain. The role of freshwater fish in the new diet system, the influence of ecclesiastical centers on fish consumption, and the existence of local fish trade remain unclear. To address these issues, more ichthyoarchaeological analyses of inland and ecclesiastical settlements are needed. The findings from Aiguafreda de Dalt provide valuable insights to help bridge these gaps.

3. The assemblage of Aiguafreda de Dalt

The archaeological site of Aiguafreda de Dalt, located in the northern side of the Montseny Massif (Municipality of Aiguafreda, Catalonia), lies along a historic road (third century CE) connecting the towns of Barcelona and Vic, both former Roman settlements (*Barcino/ Ausa*) and episcopal sees in Late Antiquity (Mayer & Rodà, 1996; Padrós, 2010; Flórez & Rodà, 2014) (Fig. 1). The site is nowadays occupied by the church of Sant Martí d'Aiguafreda de Dalt, first documented in 898 next to a peasant settlement that receives its name (*“vilarizello Sancti Martini”*), the complexity of which (*“casas et curtes et ortos et terras cultas et incultas et silvis et garricis et molinis, aquis, aquarum viaductibus et reductibus”*), despite its small size indicated by the diminutive form of the Latin *villare*, suggests an even greater antiquity (Oliver & Jaime, 2013; Oliver & Onecha, 2012).

The excavations revealed phases predating the current 9th-century church, confirming the presence of a necropolis with carved tombs from the 7th–8th centuries, which continued throughout the Middle Ages. Beneath the necropolis, a domestic dump layer was dated to the 7th century by artifacts and two C14 dates (580–650 CE) (Fig. 2).

The deposit was rich in archaeological material. Kitchenware represent over 90 % of the recovered artefacts, but tableware (2 pieces of *Terra Sigillata Africana*) and transport containers (*one African Amphora –type Keay 61–*, and *one late oriental amphora*) are also represented. Fragments of glass and metal complemented a rich assemblage. A particular singular finding is an engraved bone, which contains a fragment of a Latin poem attributed to Eugenius, Bishop of Toledo around 654–657 CE (Gómez et al., 2017), which provides an unusually precise *terminus post quem* for the layer. Overall, the current interpretation points towards a dump formed in a relatively brief time and containing mostly domestic refuse from a close site not yet identified, but which seems connected to the elites of the period, with a most probable ecclesiastical character. Fish remains represent less than 3 % of the assemblage, which is dominated by birds (41 %) and mammals (14 %), mainly domestic. The percentages of fish and birds are noteworthy compared to other contemporary sites (Gallego Valle, 2022).

All the sediment from Aiguafreda de Dalt was sieved using meshes of 5 and 3 mm, and 4–8 L of sediment per stratigraphic unit were collected and floated. The sieved sediment produced an assemblage totaling 321 remains, referred here as the “sieved assemblage”. At the same time, flotation retrieved 46 additional fish remains which will be referred to as the “floated assemblage”. As both assemblages were recovered from different volumes of sediment, they were treated separately.

¹ The official name is Carrer del Sotstinent Navarro 12–16/ Baixada de caçador 8 (059/12).

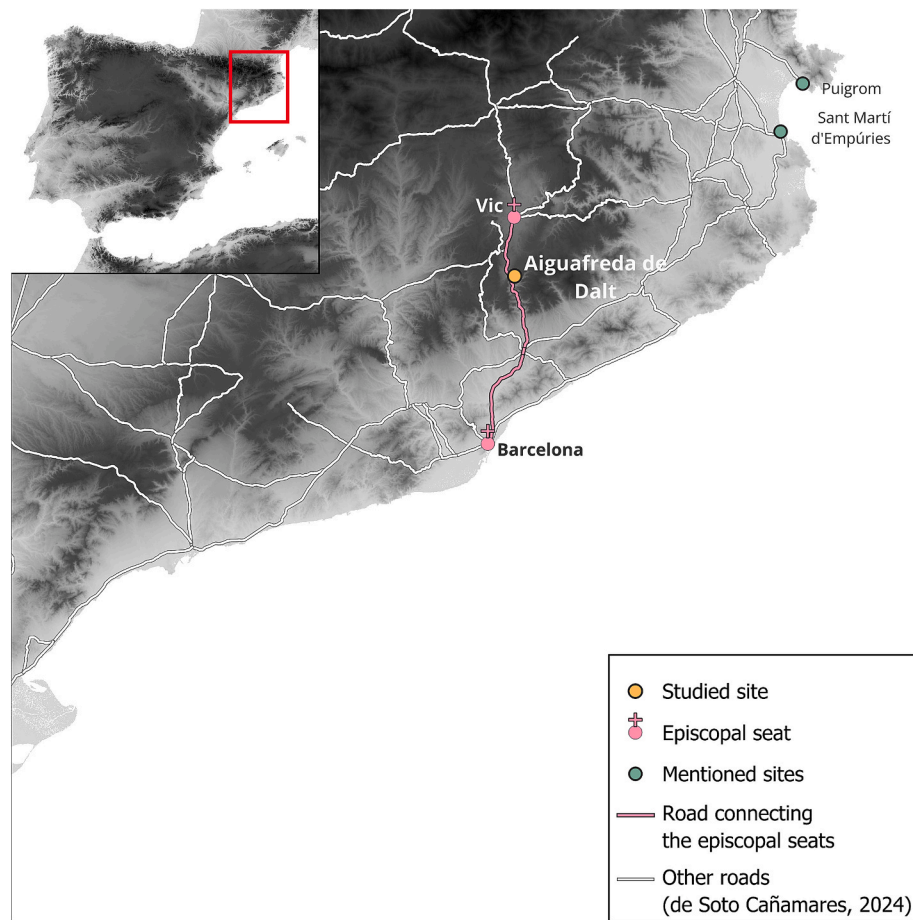


Fig. 1. Map showing the location of the studied site and its road connections to the episcopal seats of Barcelona and Vic. Also included are the locations of additional sites referenced in the text.

4. Methodology

Whenever possible, the taxonomic identification was carried out to the lowest hierarchical rank by comparing the archaeological material with specimens from a reference collection housed at the Laboratorio de Arqueozoología of the Universidad Autónoma de Madrid, and complemented with specialised literature (e.g. Lepiksaar, 1994; Roselló, 1988). Laterality (*right/left*) was documented whenever possible.

To quantify remains, number of identified specimens (NISP) and minimum number of individuals (MNI) were estimated (Lyman, 1994, p. 100; Reitz & Wing, 2008, pp. 202–210; Wheeler & Jones, 1989, p. 150).

Taphonomic analyses focused on recording surface modifications. These included: (a) modifications by loss of bone tissue or skeletal elements (i.e., “bone loss”), (b) physical alterations (i.e., “erosion and compression”), (c) surface marks, including gnaw-marks (rodents), bite-marks (carnivores), root-marks, cut-marks (humans) and colour changes caused by heat (i.e., thermoalterations), and (d) chemical modifications (i.e. “digestion marks”) (Fernández-Jalvo & Andrews, 2016; Frontini et al., 2021; Nicholson, 1991, pp. 31–33, 1993; Willis et al., 2008).

To estimate size for most of the identified individuals, a direct comparison using bones from modern specimens was carried out (Wheeler & Jones, 1989, p. 141). Only specimens from the reference collection that best matched the archaeological specimens’ size were selected to ensure accuracy. In the case of gilthead sea bream (*Sparus aurata*) published regression equations for the maxilla and the fourth caudal vertebra were used (Desse & Desse-Berset, 1996). For the red porgy (*Pagrus pagrus*) and the common pandora (*Pagellus erythrinus*) regression equations for the premaxilla and dentary were calculated (Appendix B). The z-score was calculated for the estimated size based on

the available data on the local common length of the species to assess whether the specimens were larger or smaller in relation to the common range for these species in the region today (Lloris & Meseguer, 2000). Since the reported common length is given as a range, for calculating the z-score the mean was considered as the midpoint and the standard deviation as one-fourth of the range.

5. Results

Of the 340 remains comprising the sieved assemblage, 167 (52.1 %) were identifiable below class level. These represented a MNI of 97. Concerning the non-identified remains, 28.3 % could only could not be identified below class level (i.e., Osteichthyes) due to the type of anatomical element and/or its state of preservation, and further 33 remains (19.6 %) could only be determined as fish (Table 1).

Sea breams (family Sparidae) dominated the assemblage (61 % of the NISP). Among them, red porgy (*Pagrus pagrus*) and common pandora (*Pagellus erythrinus*) combined amounted to 44.3 % of the total NISP, being by far the two most frequent taxa in the collection. Other relevant taxa included the scorpionfishes (Genus *Scorpaena*; several species), European seabass (*Dicentrarchus labrax*) and the conger eel (*Conger conger*). These taxa, along with less abundant species, including grouper (*Epinephelus marginatus*), brown meagre (*Sciaena umbra*), forkbeard (*Phycis phycis*), Mediterranean moray (*Muraena helena*), and cartilaginous fish and wrasses (Labridae), are frequent in rocky environments (Curcó et al., 2008; Lloris & Meseguer, 2000). We observe a similar pattern when considering MNI (Table 1).

In terms of anatomical representation, more than half of the assemblage represented cranial (57.1 %) and pectoral girdle elements (4.6 %),

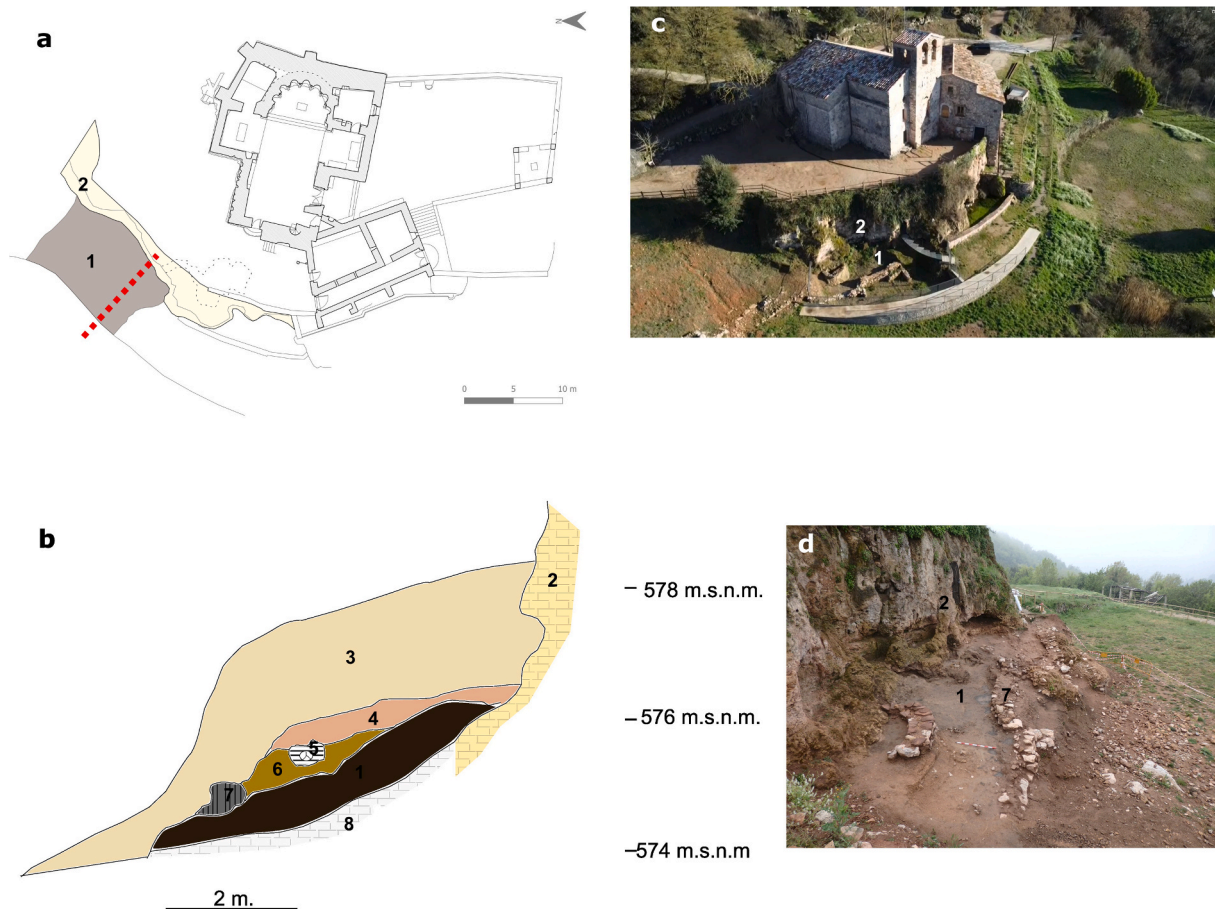


Fig. 2. General plan (a) and simplified cross-section (b) of the area excavated. Aerial view (c) of the site after the excavation and the arrangements for its musealization; and detail of the lower terrace (d) during the excavation of the dump layers where the faunal assemblages were recovered. In the images we have indicated (1) the area where the 7th century CE dump layer was excavated; (2) the travertine outcrop where the medieval church is built; the archaeological levels covering the dump layers, including the ruins resulted of the demolitions of part of the parish house in the 20th c. CE (3); levels associated to the agricultural use of the terrace between 14th and 19th c. CE (4); a tomb (5) and levels (6) associated to archaeological material of 11th – 12th c. CE; (7) small wall founded on the dump layer; and (7) deposits without archaeological material appearing under the 7th c. CE dump.

which when, combined, are quadruple the number of vertebrae (15.8 %). Ribs, fin rays (including spines) and pterygiophores together amount to ca. 21 % and could only be identified to the level of bony fish (Osteichthyes). As shown in Fig. 2, this skeletal spectrum is documented on almost all taxa, and explains why only cranial elements were recorded in some of the less frequent taxonomic groups. In the case of the ray remains, probably all representing *Raja clavata*, only dermal scutes were retrieved (Fig. 3, Appendix A-Table S1).

The analysis of the various surface modifications suggests good preservation of the assemblage. There was no evidence of alterations by rodents, carnivores, plant roots, digestion, burning or cut-marks. Only one fishbone exhibited possible traces of compression. In addition, 63 % of the remains exhibited a high percentage (i.e., over 60 %) of completeness. These taphonomic features match other data suggesting the deposits formed rapidly.

Considering the estimated size of the identified specimens, these can be considered large individuals, with some exceeding their present-day common size range. About 82 % of the estimated sizes had a positive z-score, indicating that most specimens fell within the upper half of the current common length range. In addition, 34 % had a z-score above 2, suggesting they proceed beyond the maximum commonly reported size today, notably in the case of the common pandora. The red porgy, gilthead sea bream, and conger eel were the only taxa with some specimens below the mean of their modern size ranges. However, except for one red porgy, their z-scores remained above -1. This suggests that, although not all specimens exceeded their current size ranges, they can

still be considered large individuals (Fig. 4, Appendix A-Tables 3–S4).

In the case of the floated assemblage, 32 remains were analysed from which an NISP of 8 (25 %), representing 4 individuals, could be identified (Table 2). Among the identified remains, one must remark on the presence of species not present in the sieved assemblage. Atlantic mackerel (*Scomber scombrus*), cyprinids (Cyprinidae) and the possible vertebra of a picarel (*Spicara* sp.) were identified in the flotation assemblage but absent in the sieved one. The only taxa also present in the sieved assemblage are sea breams (Sparidae indet.) and *Diplodus* sp.

In contrast to the anatomical representation of the sieved assemblage, no cranial elements appear in the floated samples. Instead, vertebrae (33 %) and postcranial elements, such as spines and pterygiophores (67 %), dominate the assemblage (Appendix A-Table S2).

The floated assemblage also exhibited a high percentage of completeness (i.e., over 60 % for 75 % of the studied remains). Among the remaining traits, only two vertebrae featured evidence of deformation due to compression.

6. Discussion

The sieved and floated assemblages present some differences. Notably, no cranial elements were recovered on the floated assemblage, and three taxa (i.e., the mackerel, picarel and cyprinids) were exclusively identified there. A key limitation we faced was the lack of precise data regarding the proportion of sediment subjected to flotation relative to the total volume retrieved. For each stratigraphic unit, between 4 and

Table 1

Taxonomic composition of the sieved assemblage and the quantification for each taxon based on Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI).

TAXA	FAMILY	NISP	MNI
Rajidae indet.	Rajidae	2	2
Squatina sp.	Squatinae	2	1
Lamnidae indet.	Lamnidae	1	1
Muraena helena	Muraenidae	4	4
Conger conger	Congridae	11	7
cf. Conger conger	Congridae	1	0
Phycis phycis	Phycidae	3	2
Scorpaena cf. scrofa/elongata	Scorpaenidae	12	8
Scorpaena cf. porcus	Scorpaenidae	1	1
Scorpaena sp.	Scorpaenidae	3	2
Dicentrarchus labrax	Moronidae	16	9
Epinephelus cf. marginatus/caninus	Serranidae	15	2
cf. Epinephelus sp.	Serranidae	2	1
Dentex dentex	Sparidae	7	5
Dentex sp.	Sparidae	1	1
Diplodus sargus	Sparidae	2	2
Diplodus sp.	Sparidae	3	2
Lithognathus mormyrus	Sparidae	1	1
Pagellus erythrinus	Sparidae	28	10
Pagrus pagrus	Sparidae	18	7
Pagrus sp.	Sparidae	3	2
Pagrus/Pagellus	Sparidae	25	13
Sparus aurata	Sparidae	3	3
Sparidae indet.	Sparidae	12	6
Sciaena umbra	Sciaenidae	3	3
Labrus cf. merula	Labridae	1	1
Labrus sp.	Labridae	1	1
TOTAL (NISP/MNI)	—	167	97
Osteichthyes indet.	—	91	—
Not determined remains	—	63	—
TOTAL REMAINS	—	321	—

8 L of sediment were floated. Based on the size of the deposits, we estimated that the floated fraction represented anywhere from 15–20 % of the total sediment per unit.

From the floated assemblage, eight remains were identified to at least family level. Extrapolating these numbers, we estimated that flotation of the entire sample would have yielded approximately an additional 40 identifiable remains. These would account for roughly 20 % of the total assemblage when both sieved and floated materials are considered. Consequently, although flotation contributed to enrich and complement the data provided by sieved samples, its quantitative impact on the overall assemblage would have been relatively limited.

However, from a qualitative perspective, flotation proved valuable, as three additional taxa were identified exclusively in the floated assemblage. The presence of these taxa, therefore, must be acknowledged in the interpretation of the assemblage.

The ratio of cranial vs. vertebral elements suggests that the studied assemblage would not necessarily reflect consumption refuse, but rather by-products of a specific type of fish processing. A different anatomical spectrum would be expected if the fish had been processed elsewhere (e.g. Barrett, 1997, p. 622; Orton et al., 2014, p. 518; Perdikaris, 1996, p. 25, 1999, p. 396). Although no cut-marks were identified, it is important to note that cut-marks on fish bones can be difficult to detect after burial (Willis et al., 2008; Willis & Boehm, 2014). Another noteworthy aspect, if the deposit was indeed a processing site, is the absence of scales. This may be due to taphonomic loss, as scales generally do not preserve as well as bones, or else that fish could have been scaled in an other area (Ball, 2021, p. 49; Wheeler & Jones, 1989, p. 65).

The evidence of fish processing suggests that the fish arrived fresh, with little or no prior processing, likely caught along the rocky shores of the nearby coast as the identified taxa are frequent in those rocky environments (Curcó et al., 2008; Lloris & Meseguer, 2000). Determining the exact fishing area is challenging, for it could be either south of Barcelona (i.e., Costa Garraf) or further north (i.e., Costa Brava). Undoubtedly, the transport of fresh fish would have relied on of the connections provided by the Roman road network (Fig. 5). The consumption of preserved fish products cannot be ruled out, as Atlantic mackerel has been widely used as salted fish since Roman times and amphorae fragments were present in the assemblage. However, the low frequency of this species, compared to the number of taxa likely to have arrived fresh at the site, makes it difficult to confirm this hypothesis (Carannante et al., 2022, p. 653; García Vargas et al., 2018).

Other assemblage characteristics offer valuable insights on who the fish consumers might have been. The results indicate that we are dealing with a large-sized fish consumed fresh assemblage of mostly marine taxa. These features best fit fish consumed by the wealthier strata of society of Roman societies (Marzano, 2013, 2018, p. 439; Mylona, 2003, p. 108). Equally relevant, we find a notable absence of common but less valued species such as anchovies and sardines, reinforcing the idea of putative high social strata consumers for the Aiguafreda de Dalt fishes. This, in turn, aligns with the small apocryphal Latin inscription on a bone shaft linked to Toledo's Bishop Eugenio de Toledo recovered at the site which suggests a connection of this site with the ecclesiastic aristocracy. However, we cannot verify with the data at hand whether part of the fish assemblage was redistributed and consumed—either entirely

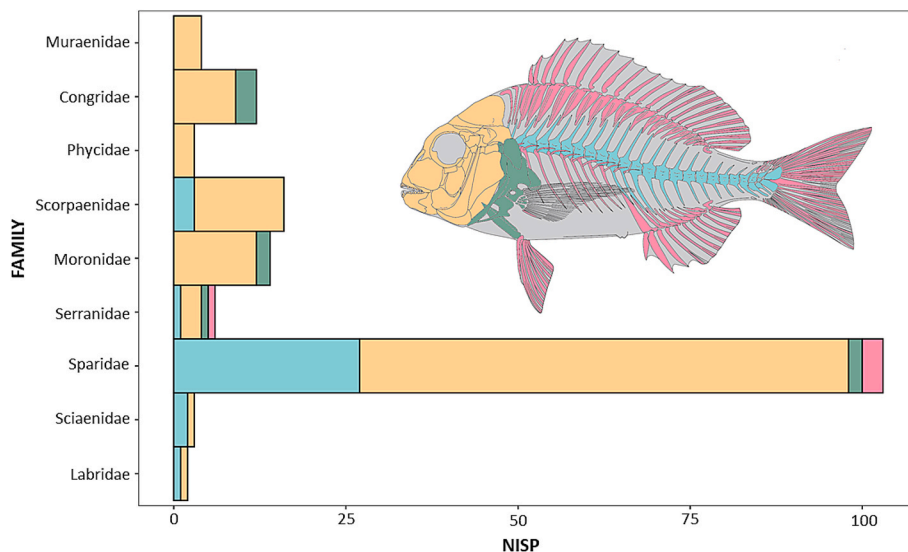


Fig. 3. Skeletal spectra of the Aiguafreda de Dalt fish taxa based on NISP.

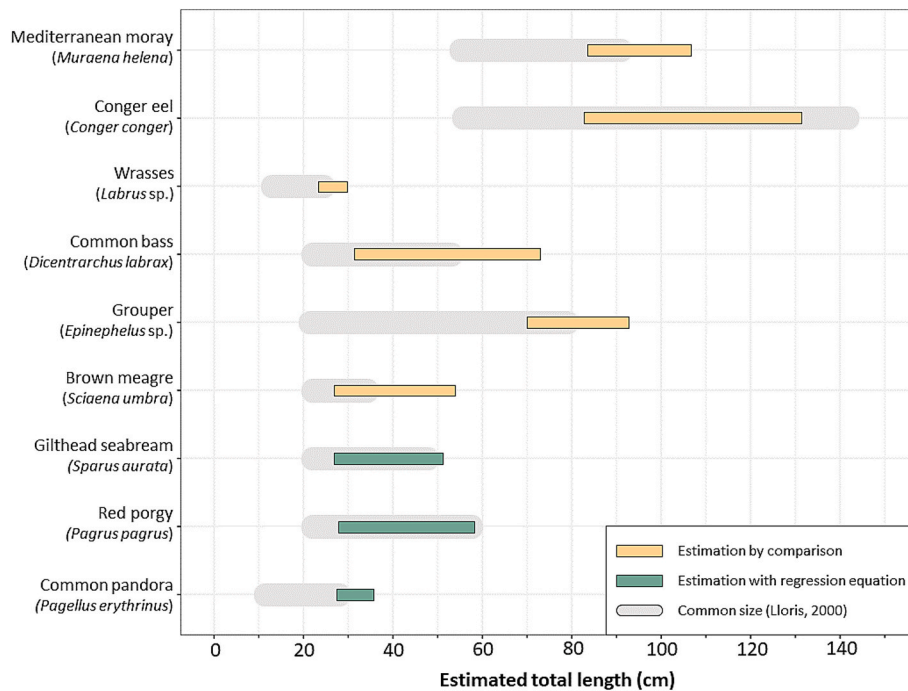


Fig. 4. Estimated size range of selected taxa, determined through comparison with reference specimens and regression equations, along with the common size observed for these taxa in the region (Lloris, 2000).

Table 2

Taxonomic composition of the floated samples and the quantification for each taxon based on the Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI).

TAXA	FAMILY	NISP	MNI
Cyprinidae indet.	Cyprinidae	2	1
cf. <i>Spicara smaris</i>	Centracanthidae	1	1
<i>Diplodus</i> sp.	Sparidae	1	1
Sparidae indet.	Sparidae	1	0
cf. <i>Scomber scombrus</i>	Scombridae	3	1
TOTAL (NISP/MNI)	—	8	4
Osteichthyes indet.	—	25	—
Not determined remains	—	13	—
TOTAL REMAINS	—	46	—

or partially— at other nearby ecclesiastic or aristocratic centers (i.e. Vic or l'Esquerda). It is also possible that it was exclusively consumed at a yet unexcavated sector at Aiguafreda de Dalt. This uncertainty arises because the ichthyological evidence from this site derives exclusively from a single dumpyard, and no ichthyoarchaeological or zooarchaeological studies from the Plana de Vic region during the Visigoth period have been published yet.

If we contrast our results with the documented characteristics of fishing during Late Antiquity and the Early Middle Ages in the western Mediterranean, the assemblage from Aiguafreda de Dalt indicates an essentially inshore fishery with a minimal presence of pelagic species. This fact is further supported by the available ichthyoarchaeological data from Sant Martí d'Empúries or Sotstinent Navarro, the only contemporary sites in the region with this data on record (Juan-Muns, 1999; Marlasca Martín, 2014). The small size (Total length: 6–10 cm), thus young age, of the European pilchard from the latter site, appears to indicate fishing focusing on nursery grounds which, in the case of this species, includes estuarine and/or lagoonal areas (Sinovčić et al., 2008).

The presence of freshwater fish (Cyprinidae) is also worth commenting. Documentary sources from the Early Middle Ages indicate that in inland areas of the NE of the Iberian Peninsula, freshwater fish were important dietary items (Terol Amigó, 2016, pp. 169–170). At

Aiguafreda de Dalt, the Congost river, which lies close to the site but is not too productive in terms of fishing, or the larger Ter, where freshwater fish would have been readily available, would have turned carp-fishes into an accessible resource. Medieval and modern documents also refer to pools and ponds in the neighboring plains as additional fishing grounds (García Molsosa, 2013, pp. 40–41). The low quantitative representation of freshwater fish at Aiguafreda de Dalt, one may attribute to the lower social value of such fish during Antiquity (Marzano, 2018, p. 439; Squatriti, 1998, p. 100). Nevertheless, their presence in this assemblage could be taken to evidence an intensification of the exploitation of freshwater zones during Late Antiquity. Further ichthyoarchaeological research in the area will prove crucial to confirm such hypothesis.

The second noteworthy feature of Late Antiquity fishing is its subsistence nature. Despite the studied assemblage being the result of some kind of productive activity, this does not seem to conform with that of a large production center. Indeed, even though the assemblage is dominated by red porgy and pandora, a high diversity of “secondary” species is also documented, suggesting that there was not a focus on one or two species. It thus seems more plausible that the assemblage would have been the result of productive activities set around fish in a small ecclesiastic community.

Another aspect related to the subsistence nature of Late Antiquity fishing is the disappearance of fish as a staple food and the connection of fish consumption with the ecclesiastic stratum as evidenced by different studies in the Western Mediterranean (Baker, 2000, p. 427; Battafarano & De Grossi Mazzorini, 2010, pp. 291–292; Bekker-Nielsen, 2010, p. 203; Salvadori, 2012, p. 304, 2015, pp. 175–186). In the NE Iberian peninsula, the power of the Church was well consolidated by the 6th century CE (Godoy Fernández, 1999, p. 57; Nolla et al., 2016, p. 116). Aiguafreda de Dalt is the only Late Antiquity inland site in NE Iberia where fish remains have been found, and all the evidence thus far collected point to its close association with the ecclesiastical aristocracy. Other contemporaneous sites in the region are coastal settlements which primarily exploited nearby marine resources, combining these with husbandry and other activities (Juan-Muns, 1999; Nolla et al., 2016, p. 148; Subías Pascual et al., 2016). Such “patterns” suggest that the

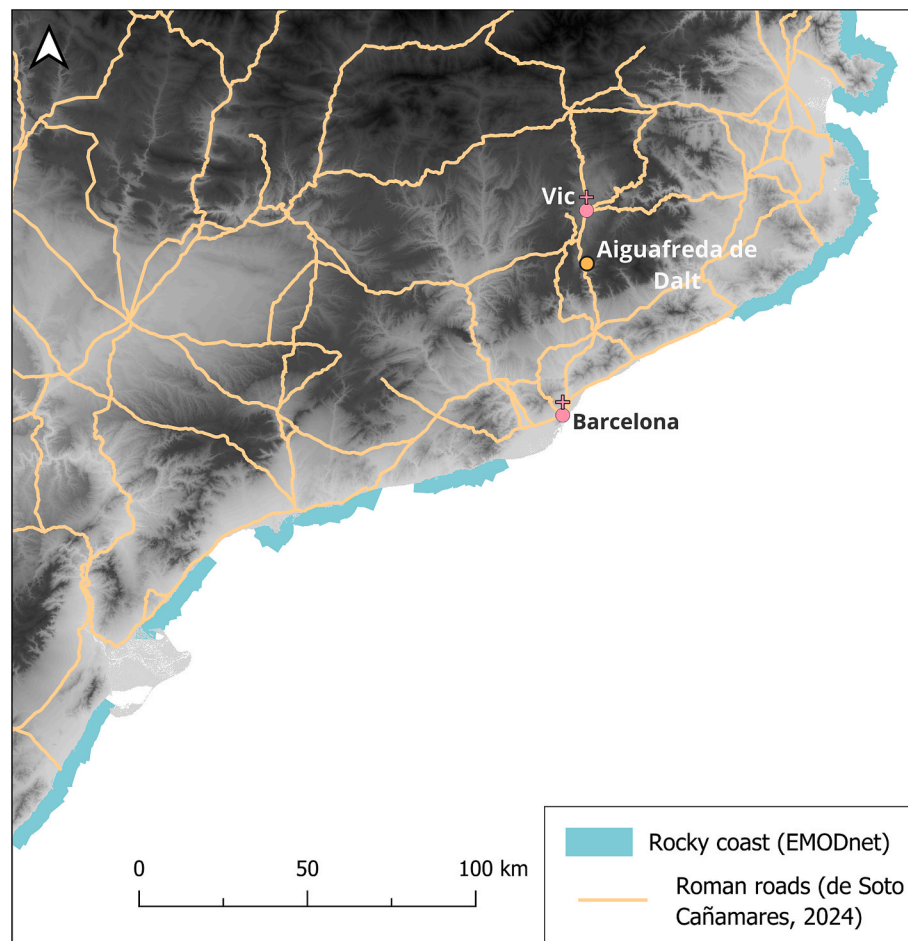


Fig. 5. Map illustrating the rocky coastal areas (data set from EMODnet: <https://emodnet.ec.europa.eu/geonetwork/srv/eng/catalog.search#/metadata/862b7c229778c441a7c02bb31e50522c8f8eff3b>) and their connection to the site of Aiguafreda de Dalt via Roman roads (De Soto, 2024).

ecclesiastical elite may have played a significant role in modulating fishing practices while local coastal communities continued to exploit marine resources on a subsistence, low-intensity, basis. This influence or control by the ecclesiastical sector highlights the role of ecclesiastical institutions in the privatisation of fishing rights, as documented in Italy (Salvadori, 2012; Squatriti, 1998, pp. 109–113). While there is no direct documentary evidence of the privatization process in the NE Iberian Peninsula, the early medieval documents from the 10th century onwards evidence that fishing rights had come under the control of local lords, in particular ecclesiastical ones (Ginot i Julià, 2024, pp. 90–91).

The Aiguafreda de Dalt assemblage further reveals that marine, freshwater, and large-sized fish continued to hold high social value during Late Antiquity, shaping the fish consumption patterns of the wealthier social groups as had been the case since Roman times. This continuity challenges the notion that the barbarian conquest of the Roman Empire led to a significant dietary shift (Baldoni et al., 2021; Belcastro et al., 2007, p. 382; Montanari, 1988, 1993, p. 18). The strong connections between the ecclesiastical hierarchy and the former Roman urban and social elites may explain that continuity (Godoy Fernández, 1999, p. 57; Nolla et al., 2016, p. 110).

The third diagnostic element of fishing during Late Antiquity was the reduction of fish trade. Our assemblage is not the result of long distance commerce of salted fish since fishes presumably arrived fresh, and no solid evidence as of this writing supports the arrival of salted fish products from more distant regions. Aiguafreda de Dalt was located at some distance from the coast (i.e., 30–33 km in a straight line which represents a longer distance on the road given the rough orography of the landscape). This alone suggests the existence of small-scale trade and

of a local transportation system of fresh coastal goods inland similar to those proposed for the Plain of Roussillon and for southern Italy (Baker, 2000, p. 427; Forest, 2018; Salvadori, 2015, p. 186). At the abbey of San Vincenzo al Volturno (Isernia, Molise, Italy), the available evidence indicates that marine fish, both fresh and dried, arrived from lagoons located + 100 km away from the abbey (Carannante et al., 2022, pp. 652–653).

7. Conclusions

The ichthyological analyses from Aiguafreda de Dalt provide crucial insights into fish consumption and exploitation practices in the NE Iberian Peninsula during Late Antiquity. This is a particularly relevant issue given the scarcity of archaeozoological data from this period (Nolla et al., 2016, pp. 145–148).

Overall, the evidence indicates a shift from large-scale fish processing and trade during the Roman period to smaller-scale, coastal, and subsistence-level exploitation during Late Antiquity. Our results highlight the influence of cultural and economic factors on fishing practices, suggesting that the early medieval ecclesiastical hierarchy may have played a significant role in shaping these practices along with trade at the local scale, as has also been demonstrated in the case of husbandry (Gallego Valle, 2022, pp. 240–241). Similar dynamics of fishing practices have been now reported in other Western Mediterranean regions, particularly Italy (Salvadori, 2012, 2015). Nonetheless, elements of continuity from the Roman period, such as the social value of certain fish taxa and large sizes, most likely reflect the connection of the ecclesiastical aristocracy with the former Roman elites.

One may conclude by stressing that the ichthyoarchaeological assemblage from Aiguafreda de Dalt contributes to a partial filling of the multiple gaps that remain on the fishing dynamics and fish consumption practices on the NE of the Iberian Peninsula during Visigothic times. As expected, several crucial questions, such as the significance of continental fishing and the extent to which various cultural factors influenced fish consumption and exploitation during this period in the region, remain unresolved. But these questions cannot detract us from the goal of achieving a more balanced view of the subject in the future, by requesting not only ichthyoarchaeological analyses that would cover the whole of NE Iberian territory but also a truly interdisciplinary approach to fill in gaps that no isolated discipline could possibly manage to achieve on its own.

CRediT authorship contribution statement

Arnau Brosa-Planella: Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Arnau Garcia-Molsosa:** Writing – review & editing, Funding acquisition, Data curation. **Abel Gallego-Valle:** Writing – review & editing, Funding acquisition, Data curation. **Judit Ciurana Prast:** Writing – review & editing, Funding acquisition, Data curation. **Jaume Oliver-Bruy:** Writing – review & editing, Funding acquisition, Data curation. **Santiago Riera Mora:** Writing – review & editing, Funding acquisition. **Maria Saña Seguí:** Writing – review & editing. **Arturo Morales Muñoz:** Writing – review & editing, Funding acquisition, Conceptualization.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jasrep.2025.105215>.

Data availability

Data will be made available on request.

References

- Andrews, A.J., Di Natale, A., Bernal-Casasola, D., Aniceti, V., Onar, V., Oueslati, T., Theodopoulou, T., Morales-Muñoz, A., Cilli, E., Tinti, F., 2022. Exploitation history of Atlantic bluefin tuna in the eastern Atlantic and Mediterranean—Insights from ancient bones. *ICES Journal of Marine Science* 79 (2), 247–262. <https://doi.org/10.1093/icesjms/fsab261>.
- Baker, P., 2000. Society and economy in northern Italy in the Early Medieval Period (c.6th-11th centuries AD): A zooarchaeological study. University College London.
- Baldoni, M., Nardi, A., De Angelis, F., Rickards, O., Martínez-Labarga, C., 2021. How does diet influence our lives? Evaluating the relationship between isotopic signatures and mortality patterns in Italian roman imperial and medieval periods. *Molecules* 26 (13), 3895. <https://doi.org/10.3390/molecules26133895>.
- Ball, A.M., 2021. Fisheries at a new scale: The contributions of archaeological fish scales in understanding Indigenous fisheries in Wuikinuxv First Nation territory and beyond [MA Thesis]. University of Victoria.
- Barrett, J.H., 1997. Fish trade in Norse Orkney and Caithness: A zooarchaeological approach. *Antiquity* 71 (273), 616–638. <https://doi.org/10.1017/S0003598X00085367>.
- Barrett, J.H., 2016. Medieval sea fishing AD 500–1550: Chronology, causes and consequences. In: Orton, D.C., Barrett, J.H. (Eds.), *Cod and Herring: the Archaeology and History of Medieval Sea Fishing*. Oxbow Books, pp. 250–271.
- Barrett, J.H., Locker, A.M., Roberts, C.M., 2004. The origins of intensive marine fishing in medieval Europe: The English evidence. *Proc. R. Soc. Lond. B* 271 (1556), 2417–2421. <https://doi.org/10.1098/rspb.2004.2885>.
- Battafarano, M., De Grossi Mazzorini, J., 2010. Analisi dei resti itici da alcuni contesti archeologici della Puglia di età tardoantica e medievale. In: Tagliacozzo, A., Fiore, I., Marconi, S., Tecchiati, U. (Eds.), *Atti Del 5° Convegno Nazionale Di Archeozoologia* (rovereto, 10-12 Novembre 2006). Museo civico di Rovereto, pp. 289–292.
- Bekker-Nielsen, T., 2010. Fishing in the Roman World. In D. Bernal-Casasola & T. Bekker-Nielsen (Eds.), *Ancient nets and fishing gear: Proceedings of the international workshop on 'Nets and fishing gear in classical antiquity: A first approach'*, Cádiz, November 15-17, 2007 (pp. 187–203). Servicio de Publicaciones de la Universidad de Cádiz & Aarhus University Press.
- Belcastro, G., Rastelli, E., Mariotti, V., Consiglio, C., Facchini, F., Bonfiglioli, B., 2007. Continuity or discontinuity of the life-style in central Italy during the Roman Imperial Age-Early Middle Ages transition: Diet, health, and behavior. *Am. J. Phys. Anthropol.* 132 (2), 381–394. <https://doi.org/10.1002/ajpa.20530>.
- Bernal-Casasola, D., 2001. Las ánforas béticas en el s. III d.C. y en el Bajo Imperio. In: *Congreso Internacional Ex Baetica Amphorae (vol. I): Conservas, aceite y vino de la Bética en el Imperio Romano* (Sevilla-Ecija, 17 al 20 de diciembre de 1998). Editorial graficas sol, pp. 329–372.
- Bernal-Casasola, D., 2008. In: Napoli, J. (Ed.), *Ressources et activités maritimes des peuples de l'Antiquité*, (Vol. 6., Centre de Recherche en Histoire Atlantique et Littorales Université du Littoral Côte d'Opale, pp. 31–57.
- Buffat, L., Guerre, J., Masbernati-Buffat, A., Renaud, A., Rovira, N., Piquès, G., Gardeisen, A., Cantuel, J., Garcia, L., Longepierre, S., Porcier, S., Payan, G., 2009. La villa de La Gramière (Castillon-du-Gard). Premier bilan de la recherche. *Revue Archéologique de Narbonnaise* 42, 115–216.
- Carannante, A., Chilaridi, S., & Solinas, F., 2022. Last Meal for the Monks. Human Ecology, Food Prescriptions and Manipulation from a Sealed Archaeological Context. Case Study of San Vincenzo al Volturno Abbey, Molise, Southern Italy, Late Ninth Century. *Cambridge Archaeological Journal*, 32(4), 643–659. doi: 10.1017/S0959774322000075.
- Craig, O.E., Biazzo, M., O'Connell, T.C., Garnsey, P., Martínez-Labarga, C., Lelli, R., Salvadei, L., Tartaglia, G., Nava, A., Renò, L., Fiammenghi, A., Rickards, O., Bondioli, L., 2009. Stable Isotopic Evidence for Diet at the Imperial Roman Coastal Site of Velia (1st and 2nd Centuries AD) in Southern Italy. *American Journal of Physical Anthropology* 139, 572–583. <https://doi.org/10.1002/ajpa.21021>.
- Curcò, A., Ferré, A., Font, J., Gestí, J., Vilar, L., & Ballesteros, E., 2008. 1. Ambients litorals i salins: Vol. II (J. Vigo, J. Carreras, & A. Ferré, Eds.). Departament de Medi Ambient i Habitatge Generalitat de Catalunya.
- De Grossi Mazzorini, J., 2016. I resti archeozoologici come strumento di conoscenza dell'economia alimentare nell'Alto Medioevo. In: *L'alimentazione nell'Alto Medioevo: Pratiche, simboli, ideologie*. Fondazione Centro Italiano di studi sull'Alto Medioevo, pp. 21–82.
- de Soto Cañameres, P., 2024. Roman roads from Hispania [Dataset]. Zenodo.
- Desse, J., Desse-Berset, N., 1996. Ostéométrie et archéologie de la daurade royale (Sparus aurata, Linné 1758). Centre de Recherches Archéologiques du CNRS.
- Donati, A., 1999. Dal mare al fiume: La pesca sul finire dell'antichità. In A. Donati & P. Pasini (Eds.), *La pesca. Realtà e simbolo. Fra tardo antico e Medioevo* (pp. 7–29). Leonardo Arte.
- Fernández-Jalvo, Y., Andrews, P., 2016. *Atlas of Taphonomic Identifications*. Springer.
- Flórez, M., Rodà, I., 2014. Las vías romanas en Cataluña: El caso del Vallès Oriental (Barcelona). *Hommages à Robert Sablayrolles, Revue Aquitania, Supplément*, pp. 247–262.
- Folch, C., Gibert, J., Martí, R., 2015. Les explotacions rurals tardoantigues i altmedievales a la Catalunya Vella: Una síntesi arqueològica. *Estudis d'història Agrària* 27, 91–113.
- Folch Iglesias, C., 2012. Els territoris del nord-est de Catalunya durant l'alta edat mitjana (segles VI-XI d.C.): Organització territorial i arqueologia del poblament [Tesi doctoral]. Universitat Autònoma de Barcelona.
- Forest, V., 2018. Synthèse archéozoologique (ostéologie, ichtyologie, conchyliologie) des sites ruraux des régions de l'Agly et de la plaine roussillonnaise entre le Néolithique et le XVIIIe siècle [Unpublished manuscript].
- Frontini, R., Roselló-Izquierdo, E., Morales-Muñoz, A., Denys, C., Guillaud, É., Fernández-Jalvo, Y., Pesquero-Fernández, M.D., 2021. Compression and digestion as agents of vertebral deformation in Sciaenidae, Merluccidae and Gadidae remains: An experimental study to interpret archaeological assemblages. *J. Archaeol. Method Theory* 1–28. <https://doi.org/10.1007/s10816-021-09527-5>.
- Gallego Valle, A., 2022. Pràctiques ramaderes al nord-est de la Tarraconense durant la Tardoantiguitat (segles IV-VIII): Aproximació arqueozoològica a l'explotació i l'alimentació del bestiar [Tesi doctoral]. Institut Català D'arqueologia Clàssica.
- García Molsosa, A., 2013. Arqueologia dels paisatges culturals del massís del Montseny: Dinàmiques històriques de la prehistòria a l'edat mitjana [Doctoral theses]. Universitat Rovira i Virgili.
- García Vargas, E., Roselló Izquierdo, E., Bernal Casasola, D., Morales Muñoz, A., 2018. Salazones y salsas de pescado en la Antigüedad. Un primer acercamiento a las evidencias de paleoalimentos y depósitos primarios en el ámbito euro-

- mediterráneo. In D. Bernal Casasola & R. Jiménez-Camino Álvarez (Eds.), *Las cetariae de Iulia Traducta* Resultados de las excavaciones arqueológicas en la calle San Nicolás de Algeciras 2001-2006 (pp. 287-). UCA.
- Ginot i Julià, A., 2024. Arts i barques: L'activitat pesquera i els seus actors a la selva dels segles XV i XVI. Universitat de Girona [Doctoral thesis].
- Godoy Fernández, C., 1999. L'organització eclesiàstica i cultural sota els visigots. In: de Palol, P., Pladevall, A. (Eds.), *Del Romà Al Romànic: Història, Art i Cultura De La Tarraconense Mediterrània Entre Els Segles IV i X*. Enciclopèdia Catalana, pp. 44–59.
- Gómez, J., García, A., Colominas, L., Gallego, A., Roig, J., Oliver, J., 2017. La Tradición Apócrifa De Eugenio De Toledo a La Luz De Un Nuevo Hallazgo Epigráfico. *Aevum* 91, 295–310.
- Hoffmann, R.C., 2002. Carp, cods, connections: New fisheries in the European medieval economy and environment. In: Henninger-Voss, M.J. (Ed.), *Animals in Human Histories: the Mirror of Nature and Culture*. University of Rochester Press, pp. 3–55.
- Hoffmann, R.C., 2005. A brief history of aquatic resource use in medieval Europe. *Helgol. Mar. Res.* 59 (1), 22–30. <https://doi.org/10.1007/s10152-004-0203-5>.
- Hoffmann, R.C., 2023. *The catch: An environmental history of Medieval European fisheries*. Cambridge University Press.
- Horden, P., Purcell, N., 2000. *The corrupting sea: A study of Mediterranean history*. Blackwell Publishers.
- Juan-Muns, N., 1999. Les restes de peixos. In X. Aquilué (Ed.), *Intervencions arqueològiques a Sant Martí d'Empúries (1994-1996)*. De l'assentament precolonial a l'Empúries actual (Vol. 9, pp. 618–620). Museu Arqueologia de Catalunya Empúries.
- Lanconelli, A., 2001. La pesca nelle acque interne: Fiumi e laghi. In: Balestracci, D., Pasini, P. (Eds.), *Pesca e Pescatori. Dal Tardo Medioevo Alla Prima Età Moderna*. Leonardo Arte, pp. 7–21.
- Landuré, C., Arcelin, P., Arnaud-Fassetta, G., Buxó Capdevila, R., Chabal, L., D'Ovidio, A.-M., Duperron, G., Forest, V., Gentric, G., Girard, B., Lemoine, Y., Sternberg, M., 2019. *Les atouts économiques du delta du Rhône dans l'Antiquité. L'exemple de l'habitat fluvio-lagunaire de la Capelière (Camargue, Arles, Bouches-du-Rhône)* 16, 179–193.
- Lepiksaar, J., 1994. Introduction to osteology of fishes for paleozoologists. Göteborg University Press.
- Lloris, D., Meseguer, S., 2000. Recursos marins del Mediterrani: Fauna i flora del Mar Català. Departament d'Agricultura, Ramaderia i Pesca.
- Lyman, R.L., 1994. *Vertebrate Taphonomy*. Cambridge University Press.
- Marlasca Martín, R., 2014. Estudi de les restes d'ictiofaunes arqueològiques recuperades a les excavacions del Fossat de Sostinent Navarro. (Informe ictiofauna).
- Marzano, A., 2013. Harvesting the sea: The exploitation of marine resources in the Roman Mediterranean. Oxford University Press. <https://0-doi-org.pugwash.lib.warwick.ac.uk/10.1093/acprof:oso/978019675623.001.0001>.
- Marzano, A., 2018. Fish and Fishing in the Roman World. *J. Marit. Archaeol.* 13, 437–447.
- Mayer, M., Rodà, I., 1996. La via romana del Congost. *Monografies Del Montseny* 11, 93–103.
- Montanari, M., 1979. L'Alimentazione contadina nell'alto medioevo. Liguori.
- Montanari, M., 1988. Barbari e Romani. In *Alimentazione e cultura nel Medioevo*. Editoria Laterza, pp. 13–22.
- Montanari, M., 1993. El hambre y la abundancia: Historia y cultura de la alimentación en Europa. Crítica.
- Morales Muñoz, D.C., Roselló Izquierdo, E., Morales Muñoz, A., 2009. Pesquerías medievales hispanas: Las evidencias arqueofaunísticas. In *La pesca en la Edad Media* (pp. 145–159). Sociedad Española de Estudios Medievales.
- Mylona, D., 2003. Fishing in late antiquity: The case of Itanos, Crete. *British School at Athens Studies* 9, 103–110.
- Nicholson, R.A., 1991. An investigation into variability within archaeologically recovered assemblages of faunal remains: The influence of pre-depositional taphonomic processes. University of York.
- Nicholson, R.A., 1993. A morphological investigation of burnt animal bone and an evaluation of its utility in archaeology. *J. Archaeol. Sci.* 20, 411–428. <https://doi.org/10.1006/jasc.1993.1025>.
- Nolla, J.M., Burch, J., Palahí, L., Amich, N.M., Canal, E., Casas, J., Castanyer, P., Sagrera, J., Sureda, M., Tremoleda, J., Vivó, D., Vivo, J., Costa, A., Prat, M., Simon, J., Varenna, A., 2016. Baix imperi i antiguitat tardana al sector nord-oriental de la província Tarraconensis. De L'adveniment De Diocleciana a La Mort De Carlemany (284-814). *Documenta Universitaria*.
- Oliver, J., Jaime, M., 2013. La cova cripta d'Aiguafreda i l'església de Sant Martí en els inicis del procés de feudalització. VIII Monografies Del Montseny.
- Oliver, J., Onecha, B., 2012. La recuperació del conjunt monumental d'Aiguafreda de Dalt: Un projecte transversal de posada en valor del patrimoni religiós. In *Episcopus. El bisbat de Vic i l'Església a Catalunya en el context europeu* (pp. 225–235).
- Orton, D.C., Morris, J., Locker, A., Barrett, J.H., 2014. Fish for the city: Meta-analysis of archaeological cod remains and the growth of London's northern trade. *Antiquity* 88 (340), 516–530. <https://doi.org/10.1017/S0003598X00101152>.
- Padrós, C., 2010. Els camins antics i les vies romanes a la comarca d'Osona (Barcelona): Estat de la qüestió. *Quaderns De Prehistòria i Arqueologia De Castelló* 28, 233–245.
- Palol, P., 1999. El final del domini romà a la Tarraconense i la seva incorporació al regne visigòtic. In: de Palol, P., Pladevall, A. (Eds.), *Del Romà Al Romànic: Història, Art i Cultura De La Tarraconense Mediterrània Entre Els Segles IV i X*. Enciclopèdia Catalana, pp. 36–44.
- Pazdernik, C.F., 2015. Late antiquity in Europe c. 300–900 CE. In: Benjamin, C. (Ed.), *The Cambridge World History*. Cambridge University Press, pp. 375–406.
- Perdikaris, S., 1996. Scaly Heads and tales: Detecting commercialization in early fisheries. *Archaeofauna* 5, 21–33.
- Perdikaris, S., 1999. From chiefly provisioning to commercial fishery: Long-term economic change in Arctic Norway. *World Archaeol.* 30 (3), 388–402. <https://doi.org/10.1080/00438243.1999.9980419>.
- Reitz, E.J., Wing, E.S., 2008. *Zooarchaeology*. Cambridge University Press.
- Roselló, E., 1988. Contribución al atlas osteológico de los Teleosteos ibéricos I: Dentario y articular. Universidad Autónoma de Madrid.
- Salvadori, F., 2012. La pesca nel Medioevo: Le evidenze della cultura materiale. In J. De Grossi Mazzorini, D. Saccà, & C. Tozzi (Eds.), *Atti del 6° Convegno Nazionale di Archeozoologia. Centro visitatori del (Parco dell'Orecchiella San Romano in Garfagnana - Luca, 21-24 maggio 2009)* (pp. 297–305). Associazione Italiana di Archeozoologia.
- Salvadori, F., 2015. Uomini e animali nel Medioevo: Ricerche archeozoologiche in Italia, tra analisi di laboratorio e censimento dell'edito. Edizioni Accademiche Italiane.
- Santana Onrubia, R., 2018. El concepto de tardoantigüedad. Revisión historiográfica y problemas metodológicos. In: Cutillas Orgilés, E. (Ed.), *Convergencia y Transversalidad En Humanidades: Actas De Las VII Jornadas De Investigación De La Facultad De Filosofía y Letras De La Universidad De Alicante (alicante. Facultad de Filosofía y Letras. Universidad de Alicante, pp. 197–202, 6 y 7 de abril de 2017*.
- Sinović, G., Keč, V.C., Zorica, B., 2008. Population structure, size at maturity and condition of sardine, *Sardina pilchardus* (Walb., 1792), in the nursery ground of the eastern Adriatic Sea (Krka River Estuary, Croatia). *Estuarine, Coastal and Shelf Science*, 76(4), 739–744. doi: 10.1016/j.jecss.2007.07.037.
- Squattri, P., 1998. *Water and Society in Early Medieval Italy, AD 400–1000*. Cambridge University Press.
- Sternberg, M. (1998). Les produits de la pêche et la modification des structures halieutiques en Gaule Narbonnaise du IIe siècle av. J.-C. au Ier siècle ap. J.-C. Les données de Lattes (Hérault), Marseille (Bouches-du-Rhône) et Olbia-de-Provence (Var). *Mélanges de l'École Française de Rome, 110(1)*, 81–109.
- Subías, E., Puig, A.M., Codina, D., Fiz, J.I., 2021. El jaciment fortificat del Puig Rom a Roses: Cronologia i identificació. *FAT. Publicació Digital De Divulgació Científica* 1, 58–72.
- Subías Pascual, E., Puig Griessenberger, A.M., Codina Reina, D., Fiz Fernández, J.I., 2016. El castrum visigòtic de Puig Rom revisitat. *Annals De L'institut D'estudis Empordanesos* 47, 75–96.
- Terol Amigó, A., 2016. El lèxic de l'alimentació en la documentació de la Catalunya altmedieval. Universitat de Barcelona.
- Trakadas, A., 2005. The Archaeological Evidence for Fish Processing in the Western Mediterranean. In: Bekker-Nielsen, T. (Ed.), *Ancient Fishing and Fish Processing in the Black Sea Region*. Aarhus University Press, pp. 47–82.
- Wheeler, A., Jones, A.K.G., 1989. *Fishes*. Cambridge University Press.
- Willis, L.M., Boehm, A.R., 2014. Fish bones, cut marks, and burial: Implications for taphonomy and faunal analysis. *J. Archaeol. Sci.* 45, 20–25. <https://doi.org/10.1016/j.jas.2014.01.026>.
- Willis, L.M., Eren, M.I., Rick, T.C., 2008. Does butchering fish leave cut marks? *J. Archaeol. Sci.* 35, 1438–1444. <https://doi.org/10.1016/j.jas.2007.10.010>.
- Zug Tucci, H., 1985. Il mondo medievale dei pesci tra realtà e immaginazione. In *L'Uomo di fronte al mondo animale nell'alto medioevo* (pp. 291–360). Centro Italiano di Studi sull'alto Medioevo.