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Albane Mazet

albane.mazet@gmail.com

CEPAM (UMR 7264), CNRS, Université Côte d'Azur

José Manuel Vargas Girón

Universidad de Cádiz

Pauline Garberi

CEPAM (UMR 7264), CNRS, Université Côte d'Azur

Gabriele Carenti

CEPAM (UMR 7264), CNRS, Université Côte d'Azur

Tatiana Theodoropoulou

CEPAM (UMR 7264), CNRS, Université Côte d'Azur

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The Evolution of Fishing Gear in the Western Mediterranean from Prehistory to Antiquity: Preliminary Investigations, Limitations and Biases

Albane Mazet*,[1,2] , José Manuel Vargas Girón[3], Pauline Garberi[1], Gabriele Carenti[1,4], Tatiana Theodoropoulou[1]

1. CEPAM (UMR 7264), CNRS, Université Côte d'Azur, Nice, France
2. ArScAn, équipe AnTet (UMR 7041), Université Paris Nanterre, Nanterre, France
3. Departamento de Historia, Geografía y Filosofía, Universidad de Cádiz, Cádiz, Spain
4. Service d'Archéologie, Métropole Nice Côte d'Azur, France
   * corresponding author: albane.mazet@gmail.com

ORCID:
- Albane Mazet: 0000-0002-4811-9188
- José Manuel Vargas Giron: 0000-0003-2882-8902
- Pauline Garberi: 0009-0000-8991-5351
- Gabriele Carenti: 0000-0002-2419-4597
- Tatiana Theodoropoulou: 0000-0002-1135-1119

Preliminary abstract (150 to 250 words): This study presents a large-scale survey of fishing gear in the Western Mediterranean, covering the Spanish, French, and Italian coasts, from Prehistory to Antiquity. Based on the meta-analysis of more than 1,500 artifacts from nearly 100 archaeological sites, processed within the ERC MERMAID program, this work aims to establish a comparative overview of fishing gear and its evolution through time. The corpus includes a variety of contexts: open-air sites, rock-shelters, ancient towns, as well as specialized sites such as fish salting or processing facilities.

The analysis focuses primarily on hooks and sinkers, which account for the bulk of fishing tool remains, while also incorporating a secondary inventory of complementary equipment (needles, shuttles, harpoons, tridents, traps, gaffs, gorges). With respect to fishhooks, the study examines the diversity of materials (bone, bronze, iron and copper) and changes in size, while sinkers are studied according to their shapes and materials in order to infer the associated fishing practices (coastal vs. offshore fishing; line fishing, longline fishing, net fishing, etc.).

Beyond a typological description, this research examines the representativeness of the corpus based on the nature of the sites, coastal environments, and time periods under consideration. It highlights how the type of site (industrial, urban, residential, funeral or ritual context) and the nature of the environment (rocky coasts, lagoons, estuaries) influence both the fishing practices observed and the conditions under which artifacts have been preserved. Furthermore, the study highlights the impact of potential biases in identifying the fishing functions of certain types of equipment, particularly for the earliest periods. By comparing these data, the article questions the relevance of existing typologies in light of regional diversity and proposes a chronological and functional synthesis to better understand fishing strategies in the western Mediterranean basin.

Keywords: fishing; fishing tools; mediterranean sea; prehistory; antiquity; western europe

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Introduction

The Mediterranean Sea has long shaped the landscapes and economies of its coastal regions, with marine resources playing a pivotal role in the development of circum-Mediterranean civilisations. The role of marine resources and fishing activities has often been addressed, when examining the history of various civilisations that have developed in the circum-Mediterranean coasts, densely inhabited since prehistoric times (Cleyet-Merle, 1990). Studies of fishing activities in the ancient Mediterranean rely on three primary categories of evidence: (a) zooarchaeological data (bones of fish and marine mammals, shells of invertebrates), (b) material culture (fishing gear), and (c) pictorial evidence. Although these records are rarely combined in a single analytical framework, their study may offer a more complete image of human-sea interactions. The study of the identified species, their habitats and ethology, as well as reconstructed size classes, combined with the remains of fishing gear, enables assessment of (a) the adaptation of exploitation strategies as well as relevant social organization of Mediterranean communities at different chronological and geographical scales, and (b) the impact of different fishing methods on fish yields.

The Mediterranean provides an ideal context for applying this integrated approach, which is central to the ERC-funded MERMAID program (https://www.cepam.cnrs.fr/sites/mermaid/). The program aims to offer a concrete reconstruction of marine resources available in the Mediterranean past, covering a long time span from the Palaeolithic to the Roman period, and provide an understanding of (a) how these resources may have varied through time, (b) the environmental and anthropogenic factors behind such fluctuations, and (c) the ways human activities depended on natural resources and adapted to changing marine ecosystems. Within the latter, the reconstruction of fishing methods through their material remains is the first step towards interpreting human adaptations to coastal/marine environments. Their study addresses the technological possibilities and advances linked to fishing/collecting activities and highlights the ways and degree of social organization. The second part of the analysis integrates faunal and ecological data collected and processed during the program (species ID, ethology, size distribution of catches, etc.). The comparative study of biological and cultural archives ultimately provides a more concrete understanding of fishing traditions in the Mediterranean past.

This study presents the first regional synthesis of fishing gear recovered from the Mediterranean coast, processed within MERMAID. For the aims of this paper we focus on the western Mediterranean. This maritime region has a long-standing tradition of archaeological research, with first regional inventories dating back several decades. Early comprehensive works include those by Feugère (1994) for Antiquity and the Iron Age in France, Vigié-Chevalier (1994) for the Iron Age, Neolithic, and Mesolithic periods in France, Cleyet-Merle (1990) for a broader synthesis, and Parker (1992) for ancient shipwrecks. More recent contributions have expanded this corpus, notably Trakadas in Mauretania Tingitana (2009), Bernal (2010),Vargas (ed., 2020) and Casal Fernandez (2022) for Spain; Giardino and Zappatore (2022) for the Salento region in Italy, or the ongoing project on Altino within the research initiative *The Coastal Lagoons and Their Hidden Cultural Heritage* (https://site.unibo.it/coastal-lagoons-and-their-cultural-heritage/). On the contrary, no recent systematic synthesis has been undertaken specifically for France, leaving a critical gap in our understanding of western Mediterranean fishing practices.

To address gaps for the area of study, our study adopted a comprehensive bibliographic survey of published studies and excavation reports, aiming to compile the most exhaustive dataset possible to this day (September 2026). The distinctive feature of this study lies in its exclusive focus on the Mediterranean shoreline. While most previous regional syntheses incorporate both coastal and inland assemblages, this work is confined to strictly coastal or near-to-coast sites, defined as those located within 25 km from the current coastline. While absolute exhaustiveness is unattainable given the chronological and spatial scale of the study, the integration of the systematic review into the MERMAID database, a dynamic resource, allows future updates and expansions.

The study focuses on the following major categories of fishing techniques, as outlined by Botte (2009): line fishing (using hooks), net fishing, harpoon fishing, and trap fishing (with baskets or weirs). These techniques are

represented archaeologically by a range of artifacts, including primarily hooks and sinkers, but also net needles, harpoons, gaffs, basketry remains, gorge tools (for earlier periods), and other associated implements. It is important to note that this meta-analysis considers only those tools explicitly associated with fishing practices by the original authors. Since this is a bibliographic compilation rather than a direct analysis of the material itself, the identification of artifacts as fishing gear is contingent upon the interpretations provided in the cited publications. Bernal (2010) conducted a significant typological study that serves as the foundational framework for the classification and inventory of all recorded fishing equipment. This framework was designed to maintain continuity with prior research while enhancing comparability between assemblages. The original typology was itself based on the work of Galili et al. (2002), expanding upon it by incorporating ceramic sinkers—previously overlooked—and introducing additional shapes for lead and stone sinkers. The present study offers minor refinements to this typology, while maintaining its essential structure to avoid confusion and ensure continuity. This approach aims to facilitate communication and comparability between research groups.

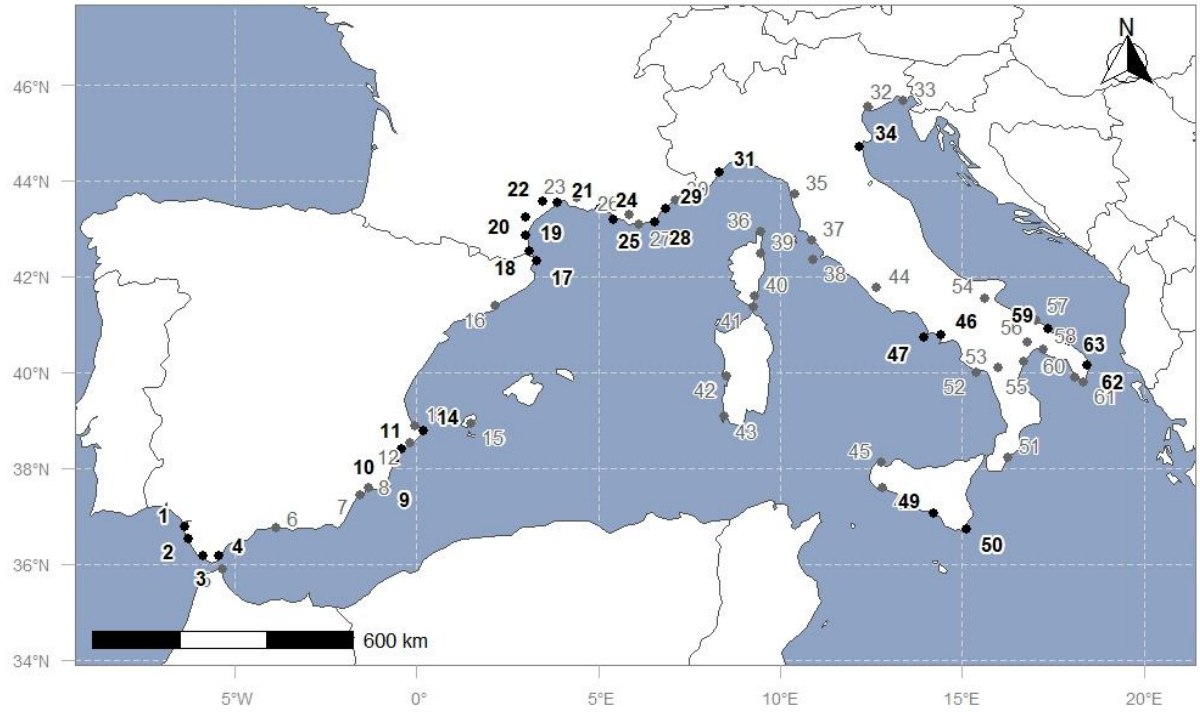


Fig. 1: Spatial distribution of the archaeological sites and/or site clusters considered in the study. A total of 143 sites, including 36 isolated sites (grey) and 27 areas grouping several sites (black) in a radius less than 20 km (total of 107 sites). See Annex 1 for the complete list of sites and remains.

***1**. La Algaida; Necrópolis de Chipiona; **2**. Cadiz (c/ Acacias 21; 23; 25; c/Ancha; Avda. Andalucía 21-27; Avda. Andalucía – c/ Ciudad de Santander; Plaza Asdrúbal; Avda. Amílcar Barca; c/ Brunete–c/ Granja San Ildefonso; c/ Botica 31-33 – c/ Concepción Arenal 5; c/ Santa Cruz de Tenerife n° 1 – c/ Santa María del Mar; c/ Dr. Gregorio Marañón; c/ Mirador 25; Club Náutico Caleta; Palacio de la Justicia; Avda. Portugal – Avda. Andalucía; c/ Juan Ramón Jiménez; c/ Santa Cruz de Tenerife 1 – c/ Santa María del Mar; Plaza San Antonio; c/ Solano 3; Teatro Andalucía; c/ Tolosa Latour; Cuarteles de Varela; Puerta de Tierra); Baños del Blanco; Camposoto; Castillo de Doña Blanca; Puerto-19; Las Redes; Torre Alta; **3.** Baelo Claudia; Barbate (c/ Brunete - c/ Colón; c/ Padre Castrillón); **4.** Algeciras; Cerro del Prado; **5**. Ceuta; **6**. Cueva de Nerja; **7.** Costa de Águilas; **8.** Mazarrón; **9.** Las Amoladeras; El Capitán; Teatro romano de Cartagena; Escombreras; Escolletes - Pudrimel; **10.** La Fonteta; Santa Pola; **11**. La Albufereta; Foia de Santa María; Illeta dels Banyets; Tossal de Manises; **12.** Tossal de la Cala; **13.** El Pla; **14.** Banys de la Reina; Cueva del Montgó; **15.** Cala Olivera; 16. Barcino; **17.** Cala Culip IV; VIII; **18.** Port Vendres I; II; **19.** Ilôt Corrège; Grotte des Fées; Salses; **20**. Grotte de la Hache; Station des Valentines; **21.** Lattara; Station de la Madeleine; **22**. La Ramasse; Sept-Fonts; **23**. Espeyran; **24**. Station Collet-Redon; Grand Abri de Châteauneuf-Les-Martigues; Salins de Ferrières; **25**. Le Grand Congloué; Grotte du Puits Segond; **26**. Les Ferrages; **27**. Olbia; **28**. Cap Camarat B; Cavalière, Heraclea Caccabaria; Cap Lardier*

4; Le Titan; ***29****. Chrétienne C; M; Dramont G;* ***30****. Port d'Antipolis;* ***31****. San Antonino di Perti; Grotta della Arene Candide;* ***32****. Altinum;* ***33****. Iulia Felix;* ***34****. Fortuna Maris; Valle Ponti;* ***35****. San Rossore;* ***36****. Marine de Meria;* ***37****. Castiglione;* ***38****. Giglio;* ***39****. Palazzi;* ***40****. Porto-Vecchio;* ***41****. Cavallo;* ***42****. Sa Osa;* ***43****. Cronicario;* ***44****. Villagio delle Macine;* ***45****. Grotta dell'Uzzo;* ***46****. Herculaneum; Pompeii (Asciutta; Insula Occidentalis; Maison du Grand Hôtel);* ***47****. Punta Chiarito; Punta D'Alaca;* ***48****. Malophoros di Selinunte;* ***49****. Gela I; II;* ***50****. Portopalo; Vendicari;* ***51****. Locri Epizephyrii;* ***52****. Grotta della Cala;* ***53****. Grotta di Latronico;* ***54****. Passo di Corvo;* ***55****. Eraclea;* ***56****. Laterza;* ***57****. Scamuso;* ***58****. Scoglio del Tonno;* ***59****. Egnazia; Piazza Palmieri;* ***60****. Le Pazze di Ugento;* ***61****. Grotta Porcinara;* ***62****. Castro; Grotta dei Cervi; Carpignano Salentino; Rocca Vecchia; San Foca; Grotta Zinzulusa;* ***63****. Punta Patedda; Punta le Terrare.*

Presentation and Description of the Corpus

1. Chronological and geographical distribution

This study analyses a corpus of fishing implements recovered from archaeological contexts at a range of c. 25 km from the current coastline (Fig. 1) and dated from around 10 000 BCE to 600 CE across the western Mediterranean coast. We also took into consideration sites that would have been coastal during the time of their occupation, before major geomorphological events occurred (e.g., alluvial/colluvial). Inversely, it was not possible to have access to prehistoric sites, especially from the Palaeolithic period, that might have lied on currently submerged coasts. 1,825 remains over 110 sites (see Annex 1) were quantified, complemented by an additional 50 sites that yielded fishing-related artefacts but were not subjected to systematic quantification. Although these undocumented assemblages cannot be included in quantitative analyses due to the lack of precise counts, their presence is essential for a comprehensive understanding of fishing practices in the region (Fig. 2). These sites are known to have produced at least a few artefacts—sometimes several dozen per site—but the absence of detailed records prevents their integration into statistical datasets. Additionally, in Annex 1, we included the information of the presence/absence of fish remains in the sites that yielded fishing tools, as recorded in full detail in the M-ARCHIVES database (https://www.cepam.cnrs.fr/datas/Mermaid.php).

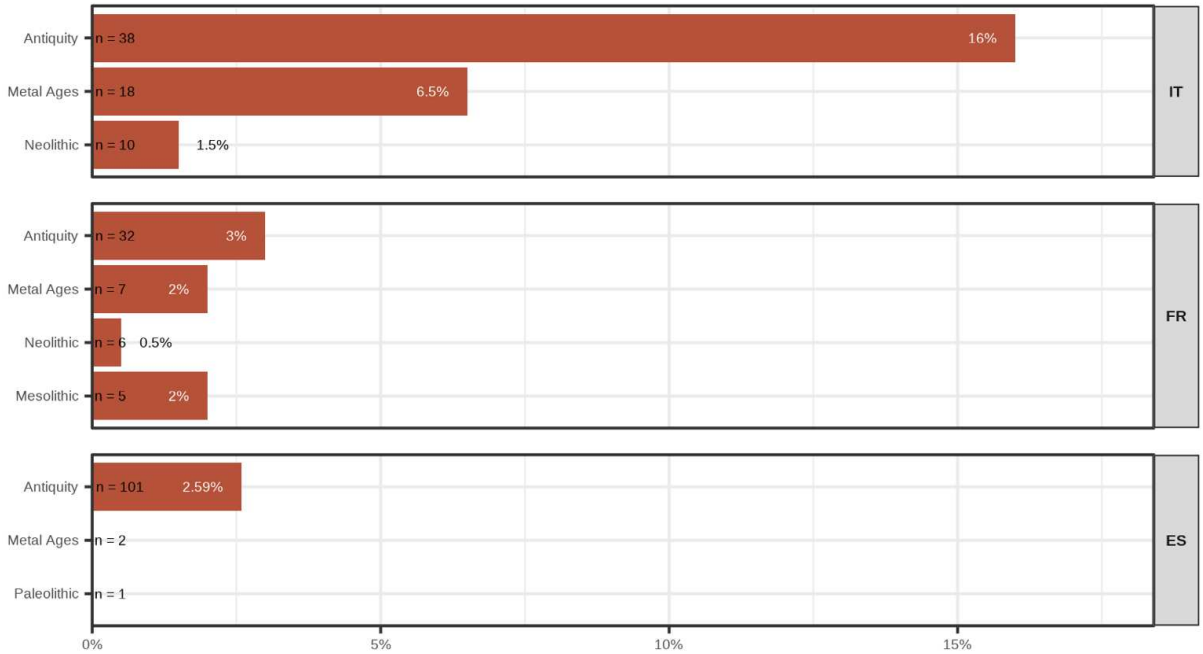


Fig. 2: Proportion of sites (in red) mentioning fishing equipment without enumerating them among surveyed sites (n=) that provided fishing equipment.

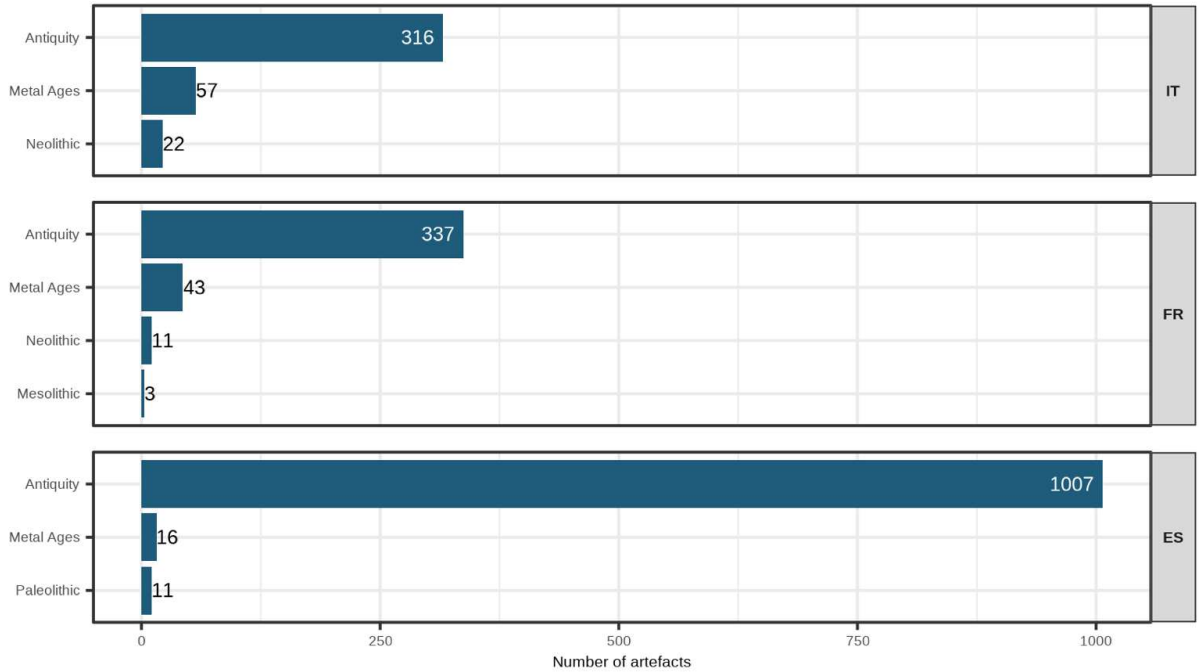


Fig. 3: Distribution of fishing tools per country and period.

The corpus is geographically distributed across 60 sites in Spain, 36 in France, and 48 in Italy, providing a broad regional overview of fishing equipment from prehistoric to late antique periods. The chronological distribution of the corpus (Fig. 3) is overwhelmingly dominated by Antiquity (c. 600 BCE–500 CE), which accounts for 1,657 of 1,825 artefacts (90.8%). This period is particularly well represented in Spain, which alone contributed 1,033 artefacts (56.6% of the total corpus), reflecting both historical fishing intensification and potential research biases. A striking feature of the assemblage from Antiquity is the concentration of artefacts in a small number of key sites, with Baelo Claudia yielding 156 artefacts, Plaza Asdrubal in Cádiz 103, Tossal de la Cala 84, Algeciras 72, La Fonteta 60 (Vargas, ed., 2020) and Castillo de Doña Blanca 60 (Ruiz Mata et al., 2006). Together, these six sites account for 535 artefacts (52% of the Spanish assemblage in Antiquity), demonstrating the disproportionate influence of a handful of major locations on the overall dataset.

In France, 337 artefacts from Antiquity were recorded from 36 sites, with two locations contributing disproportionately to the assemblage. Lattara yielded a substantial collection of hooks and weights, while the Porto Vecchio shipwreck produced over 100 hooks alone (Feugères, 1994). In Italy, 314 artefacts from Antiquity were identified from 48 sites, with Pompeii yielding particularly large assemblages (Surintendance Pompeii, 2015). However, a significant limitation of the Italian dataset is the lack of quantified data, especially for hooks and weights, as 24 sites provided only qualitative mentions of fishing equipment (Fig. 2). If these were quantified, the Italian corpus could significantly increase. Undocumented sites also include three in France and five in Spain, further highlighting the challenges of reconstructing a complete picture of fishing practices in these regions.

For earlier periods, the dataset is far more limited, leading to their grouping under the broad category of "Metal Ages" for the Bronze Age and the Iron Age. This grouping is adopted solely because of the limited number of documented artefacts and sites available for each period, and should not be understood as evidence of cultural, technological or functional continuity between the two periods. In Spain, this period is represented by just 16 artefacts from a single site, El Pla (Aparicio and Climente, 1985), with a near absence of fishing equipment from this period across the country. In France, only seven artefacts (5 hooks, 2 weights) were counted from three sites, Espeyran, La Ramasse (Feugères, 1994) and Salins de Ferrières (Vigié-Chevalier, 1992), even if two other sites delivered uncounted Iron Age fishing tools (Salses, Feugères, 1992; Ile, Vigié-Chevalier, 1992). Italy yielded around sixty artefacts distributed across ten sites–Sa Osa single-handedly delivered 30 weights, a harpoon and a fishhook (Depalmas and Di Gennaro, 2016). Notably, six undocumented sites in Italy and two in France further complicate efforts to assess the true scale of littoral fishing activities during the Metal Ages.

The Neolithic period presents a contrasting pattern, with a remarkable absence of fishing-related artefacts in Spain, whereas France yielded over fifty implements, including twenty Chalcolithic remains from the Collet Redon site alone (mainly stone weights and one bone gorge, Vigié-Chevalier, 1992). In Italy, 24 Neolithic artefacts were recorded over 9 sites: Carpignano Salentino; Grotta della Cala (De Grossi Mazzorin and Rugge, 2009); Grotta delle Arene Candide (Tiné, 1999); Grotta dell'Uzzo (Tagliacozzo, 1993); Grotta di Latronico (Cremonesi, 1978); Grotta Zinzulusa (Giardino and Zappatore, 2022); Laterza (Biancofiore, 2009); Passo di Corvo (Isetti, 1983); Scamuso (Biancofiore and Coppola, 1997). Most of them are bone hooks or gorges. The Mesolithic period is represented exclusively in France, with stone weights documented in the Grotte de Hache and Puits Segond and microliths from Abri Cornille-Sulauze and La Baume Longue (Vigié-Chevalier, 1992).

For the Palaeolithic, the dataset is exceptionally sparse, consisting of eleven gorge tools from Cueva de Nerja in Spain, whose fishing function remains hypothesised but unproven. While fishing equipment is documented or even supposed for inland late Palaeolithic contexts (Cleyet-Merle, 1990), no fishing gear has been recorded in coastal contexts for this period. The Cueva de Nerja remains the sole exception, underscoring both the rarity of such finds and the challenges of interpreting their function.

This corpus thus provides a foundational dataset for studying fishing practices in the western Mediterranean, though its limitations—particularly the undocumented sites and regional biases—must be acknowledged. The overwhelming dominance of the Antique period, the scarcity of earlier material, and the disparities between regions highlight both historical trends and research gaps, which are addressed in the results.

2. Tool type distribution

A marked disparity can be observed between the quantities of tools recorded for the different periods, from Antiquity back to the Palaeolithic. This disparity concerns not only the number of artefacts, but also the diversity of tool types (Fig. 4). During Antiquity, the most widely documented tools are metal hooks, weights—made of metal, generally lead, but also of ceramic or stone—as well as a number of uncategorised objects, which appear in smaller quantities (Tab.1). In decreasing order of frequency, these include: needles, counting more than one hundred items, although their exclusive association with fishing activities cannot be established (Tab.2); netting shuttles, of which nearly fifty have been recorded, including 24 in Spain, 11 in France and at least 13 in Italy; nets, attested at La Albufereta in Spain (Alfaro Giner, 2010) and Herculaneum in Italy (Stefani, 1990; Deiss, 1995); metal harpoons, bone or metal spear heads, and metal tridents; fish traps; and gaffs. Each of these latter categories is represented by only one to three examples.

Tool diversity is more limited during the Metal Ages, when hooks and weights are the main types recorded (Fig. 4). The large quantity of archaeological material recovered from coastal sites during this period contrasts sharply with the inventory of nearly 150 hooks compiled by J-J Cleyet-Merle (1990) for the entire France (with a predominance in the eastern region). While hook-based exploitation of aquatic resources is therefore well attested, it could have been concentrated primarily in rivers and streams, suggesting that coastal zones may have been largely overlooked. For the Metal Ages, the presence of a harpoon at Sa Osa (Depalmas and Di Gennaro, 2015) and of microliths at the site of Villaggio delle Macine (Angle and Guidi, 2007) should nevertheless be noted. During the Neolithic, a broader range of equipment made from hard animal materials is documented, including hooks, gorges, harpoons, netting shuttles and microliths. For the Mesolithic and Palaeolithic, the identification of fishing equipment becomes considerably more difficult, and coastal assemblages are even less diverse. Although occurrences of fishing equipment, or of tools whose fishing function has been hypothesised, are known, such objects are only very rarely found in coastal contexts. The only occurrences consist of bipointed pieces that may have served as gorges at the Grotta de Nerja in Spain (Aura et al., 2001), microliths from the Abri Cornille-Sulauze and the Baume Longue, and stone weights from the Grotte de la Hache and the Puits Segond mentioned earlier (Vigié-Chevalier, 1992). The identification of the two latter is, however, hypothetical.

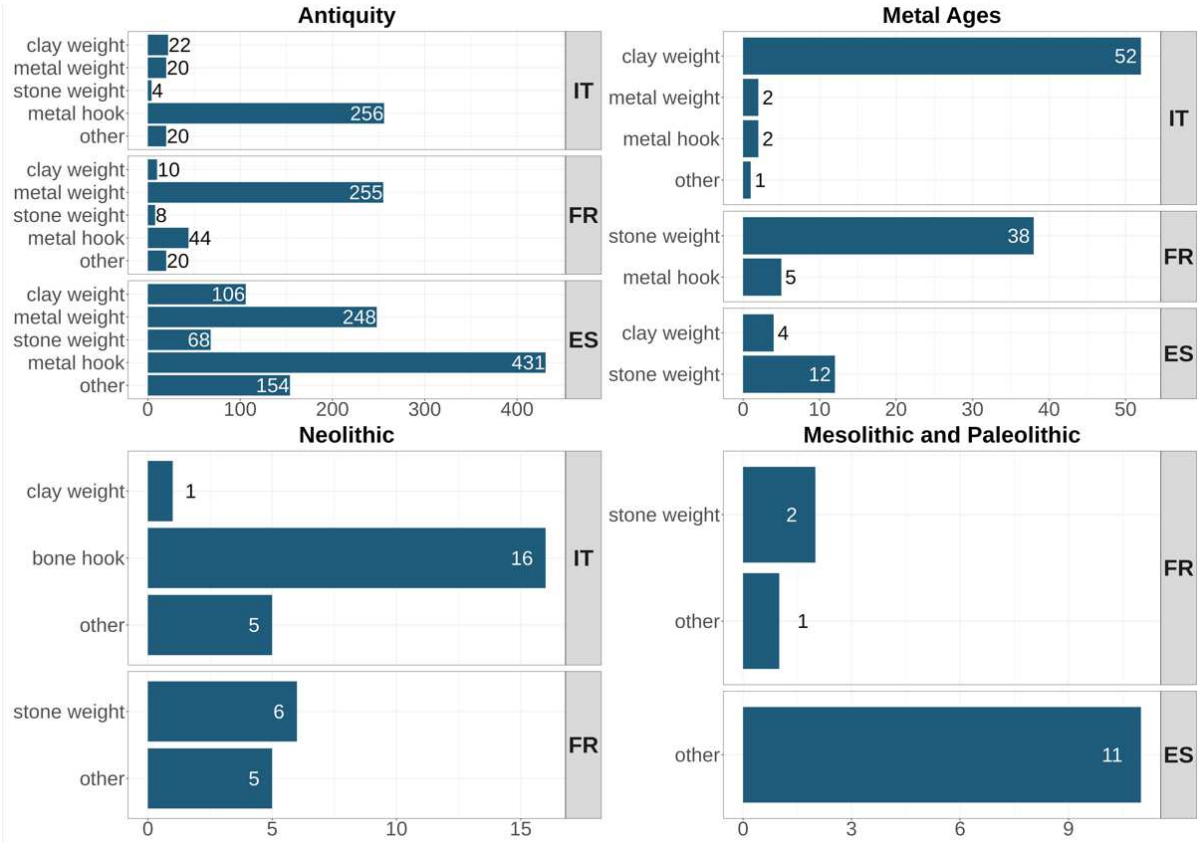


Fig. 4: Distribution of fishing tools per type, country and period.

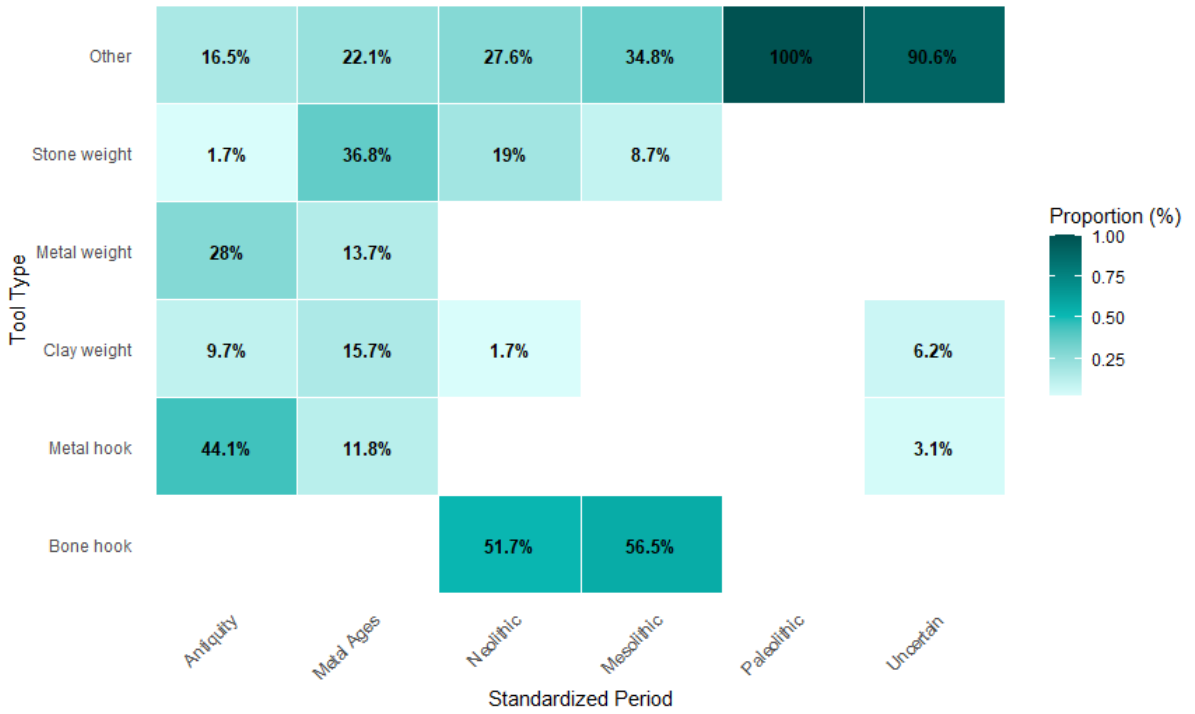


Fig. 5: Relative distribution of tool types by period.

Antiquity	Metal Ages	Neolithic	Mesolithic and Paleolithic
Projectile gear Harpoon (metal) / Spear head (bone / metal) / Trident (metal) ***Nets and netting tools*** Needle Netting shuttle Net	***Projectile gear*** Harpoon (bone) Microlith	***Hooks*** Gorge (bone) ***Projectile gear*** Microlith Harpoon (bone) ***Nets and netting tools*** Bone netting shuttle	***Hooks*** Gorge (bone) ***Projectile gear*** Microlith

Tabl. 1: Other tool types considered in this study.

Methodological challenges and limitations

1. Identification of the fishery function

To account for potential recording biases, all artefacts were classified as *undoubted*, *highly probable* or *possible fishing gear*. This classification reflects the interpretative position adopted in the relevant publications and highlights the extent to which the apparent distribution of fishing equipment is shaped not only by past practices, but also by the criteria used to identify and report them. Artefacts with a more secure fishing attribution are more likely to be systematically included in studies of fishing practices, whereas objects with only a possible fishing function may be omitted depending on the aims of the research. The recorded distribution should therefore be understood as partly reflecting publication and identification practices.

Hooks

Relatively few artefact types can be assigned an unequivocal fishing function. These consist predominantly of metal hooks, most of which date from Antiquity. Their relatively recent date, morphology and close similarity to hooks still used today allow them to be associated with both a specific function and a clearly identifiable operating principle. Their attribution to fishing is therefore more secure than that of most other categories.

Bone hooks are more problematic. Although their morphology may suggest a fishing function, they are not always diagnostic, particularly when fragmentary. In the absence of detailed techno-functional (Mazet et al., 2024) or traceological (Lozovskaya et al., 2014) studies, it is not always possible to distinguish fishing hooks from implements used for other purposes. This uncertainty is even greater for gorges, whose use in fishing has not yet been demonstrated. Their pointed form alone is insufficient to establish such a function and would require a specific diagnostic approach.

Weights

Most metal and ceramic weights are generally regarded by authors as highly probable fishing gear, on the basis of their morphology, archaeological context, or both. Some forms are more diagnostic than others. Hammered metal net weights, apparently formed directly around cords and frequently found in groups, provide relatively strong evidence for the use of nets; comparable examples are documented throughout the Mediterranean basin. Other forms are less distinctive, while stone weights present the greatest uncertainty. Although they may plausibly be related to fishing, they are rarely considered unequivocal evidence of this activity.

Nets and netting tools

Netting needles occupy an intermediate position. Ethnographic studies, including those conducted in Italy, have identified parallels between these artefacts and tools used for making or repairing nets. Their morphology, archaeological contexts and wide distribution in the Mediterranean during Antiquity therefore support a probable association with fishing. Nevertheless, this attribution is not always considered certain in individual publications.

Other needles were classified as possible fishing gear. These include, most commonly, examples with a double circular eye and, more occasionally, a single narrow and elongated eye. Although such tools could have been used to manufacture or repair fishing nets, they were easily transportable and suitable for numerous other activities. Their fishing function is therefore not exclusive. Detailed studies of their typology, use-wear and techno-functional characteristics would be necessary to determine whether particular forms were specifically associated with fishing. Their representation in the present dataset is also likely incomplete, since only needles mentioned in publications concerned with fishing were recorded.

Nets themselves can sometimes be more securely associated with fishing, particularly when their mesh size is compatible with known fishing techniques. Their highly fragmented condition, however, often limits their analysis. Moreover, at La Albufereta, nets associated with fishing were found alongside other nets related to funerary clothing. Nets should therefore not be treated as exclusive indicators of fishing, but interpreted in relation to their archaeological context, mesh size, manufacturing characteristics and associated artefacts.

Projectile equipment

A similar degree of uncertainty applies to harpoons, tridents, spears, spear heads and microliths that may have formed part of composite spearheads. Fishing is a plausible, but not exclusive, function for these artefacts, and cannot generally be demonstrated on morphological grounds alone. Their interpretation consequently depends on the combination of typological, contextual and, where available, functional evidence.

Overall, the certainty of fishing attribution varies substantially between artefact categories. This variability is essential to consider when interpreting the distribution of fishing equipment, since the dataset reflects both the archaeological record and the interpretative choices through which artefacts were identified and published.

Fishing practice	Tool	Undoubted	Highly probable	Possible
Line fishing	**Metal hook**	**790+**	50+	7+
	Bone hook	6	3+	9
	Gorge			**20**
Line or net fishing	**Metal weight**	23+	**354+**	36
	Clay weight	47+	**126+**	22
	Stone weight		**121+**	16
Net fishing	**Net**		3+	1
	Netting shuttle	11+	**34**	5

	Needle			**126+**
Projectile fishing	**Harpoon**	1	2	**2**
	Trident		1	**1**
	Spearhead			**2**
	Microlith			+

Tabl. 2: Degree of certainty in identifying the fishing function (bold indicates the main "degree of certaincy" for each tool type.

2. Representativeness of artifact quantities relative to fishing gear type

The quantification of fishing equipment in archaeological contexts presents significant challenges, arising from both the nature of the artefacts themselves and preservation biases. Net weights—particularly those made of metal, which are often associated with nets—exhibit a peculiar characteristic: when counted, they can reach substantial quantities, sometimes several dozen examples, despite representing only a single net. This abundance partly explains why such artefacts are sometimes not recorded during excavations, as their sheer numbers make recording tedious and potentially irrelevant to excavation objectives.

Hooks, for their part, present a similar issue. Their use could be individual (simple line fishing) or collective (assembled into longlines or trolling lines), complicating any quantitative assessment. For instance, a longline may comprise several dozen hooks. Thus, artifact counts do not necessarily reflect the number of functional tools: a single hook does not constitute a line, just as a single net weight does not represent an entire net.

This variability in the interpretation of assemblages necessitates a case-by-case approach, where each artefact must be evaluated based on:

- the archaeological context (dating, stratigraphy, association with other remains);
- the possibility of establishing contemporaneity between pieces;
- the type of tool: some, such as simple hooks—particularly large ones—were almost certainly used individually, whereas others, due to their small size and frequency, appear to have been combined with other elements (nets, lines) to form functional equipment. In the latter case, their exact number depends directly on the size and structure of the fishing gear, making generalization hazardous.

Material evidence for longline fishing remains rare, though two exceptional examples illustrate its existence in antiquity: Herculaneum yielded a complete longline preserved inside a basket. The bronze hooks and folded lines are still visible (Bernal et alii, 2009c, figure 9); The Comacchio wreck also revealed hooks encrusted together (Rossi, 1990; Gianfrotta, 1999, 27, figure 17), which might suggest multiple uses of the hooks. Other assemblages of hooks found on shipwrecks in wooden chests exist—Port Vendres B (Parker, 1992: 330–331) and Le Titan (ibid.: 424–425)—without implying their use in multiple-line fishing, but rather their storage.

Regarding net weights, Bernal (2010) proposes distinguishing between types of weights that may have belonged to nets and those associated with line fishing (individual or otherwise). This classification is based on three key observations:

1. Typological diversity (Fig. 6): Weights associated with line fishing—whether with or without a rod—exhibit a wide variety of forms, often more atypical (PLIII: cone/truncated cone; PLIV: cubical; PLV: clamps-rods; PLVI: off-centre/crescent-shaped; PLVII: spherical; PLVIII: sphenoid; PLX: pyramidal/truncated pyramid; PLXI: pear-shaped; PLXII: triangular perforated; PLXIII: tubular). The often asymmetric location of the binding system, or even morphological irregularities, can be considered as an argument toward line fishing. Indeed, their individual use would explain this diversity, as fishermen adapted weights and shapes to their specific needs and available resources at a given time. The same observation can be made with ceramic weights, since it is the trimmed weights (CV)—likely resulting from the recycling of clay objects—or the truncated pyramids (CVI), which are asymmetric in their attachment system, that Bernal (2010) identifies as possible line weights.
2. Standardization of net weights: Conversely, four categories of clay net weights and three major categories of metal net weights (notably lead) emerge for net fishing. For both raw materials, their morphological similarity and abundance when present in assemblages suggest standardized production and use. This concerns cylindrical (CI), disc-shaped (CII), spherical (CIII), and spindle-shaped (CIV) clay weights, and for lead weights, they can be ring-shaped (PLI); cylindrical (PLII), whose dimensions vary widely; and rolled plates (PLIX), typically hammered directly onto the net. Harder to determine their use (whether for line or net fishing), stone weights are, however, the oldest weight type identified (and likely underrepresented in the record due to the scarcity of manufacturing traces).
3. Archaeological context and quantities: Net weights are often found in groups (REF), with multiple examples almost systematically associated within the same context. This characteristic contrasts with the rarity of isolated weights, which are more likely to belong to individual lines. We will test this hypothesis in light of this survey across the Spanish, French, and Italian coastlines to determine whether these typological/functional hypotheses are confirmed based on the proportion of types represented by site.

This approach highlights a documentary bias: atypical weights, potentially linked to individual fishing, risk being underrepresented in assemblages because they are less systematically associated with a clear fishing function.

These observations underscore that raw artefact quantification is insufficient to accurately reflect ancient fishing practices. Each piece must be contextualized within its functional role, taking into account:

- the variability of uses (individual vs. collective fishing);
- preservation biases (disappearance of organic elements);
- counting biases, directly linked to functional identification biases.

Therefore, a fine-grained analysis of assemblages is essential to overcome the limitations imposed by the eclectic nature of these remains.

3. Typological considerations

Moreover, several adjustments have been made to Bernal's proposed typology to extend its applicability across all periods with regard to fishhooks. It is readily apparent that the typological framework for fishing equipment originates in Antiquity, with most forms known from this period pre-dating subsequent eras; the converse, however, is not true. Nevertheless, bone gorges employed during the earliest periods may be incorporated into the revised classification (AIV).

Regarding sinkers, the typology has been further expanded. A subcategory for clay sinkers (CV) has been introduced, with a third subdivision (CV3) characterized by a trimmed, off-center perforation (Vargas, ed., 2020, Lam. 84.511, p. 331). Another type, hitherto unconsidered in the typology and designated CVII, comprises "perforated puck". A single-perforation variant (CVII1) has been documented by Bound (1991: 27),

whereas multiple-perforation examples (CVII2) are attested at several sites (Daveau et al., 2007: 17, fig. 14; Bates et al., 2001: 13, fig. 3; Vargas, ed., 2020, figs. 81.501–503, p. 328; figs. 82.504–508, p. 329).

New forms of lead sinkers have also been designated: a truncated cone variant (PLIII) featuring a longitudinal perforation (PLIII4) (Charlin et al., 1998:52, fig. 25.9; Bernal et al., 2018: 13, fig. 4). Another morphology, resembling an ingot, is designated PLXIV (Joncheray, 2002: 93, figs. 2 and 4; Bernal et al., 2018: 479, fig. 1.6; Vargas, ed., 2020: 344–345; 350, figs. 97.664, 98.666, and 103.719). A final form, consisting of a simple perforated lead plate, is designated PLXV, with PLXV1 for rectangular plates (Vargas, ed., 2020: 345, figs. 98.667–668) and PLXV2 for circular plates (Bats, 2001: 13, fig. 4).

The value of this typology, as originally defined by Bernal (2010), lies in its capacity for ongoing refinement through new discoveries and subsequent research. It should be noted that, at present, this typology remains primarily focused on sinkers; however, future refinements concerning fishhooks may incorporate more precise functional considerations (including barb morphology, material composition, shank aperture, terminal tackle attachment systems, among other attributes). For the purposes of this study, only raw material and the presence or absence of barbs have been incorporated.

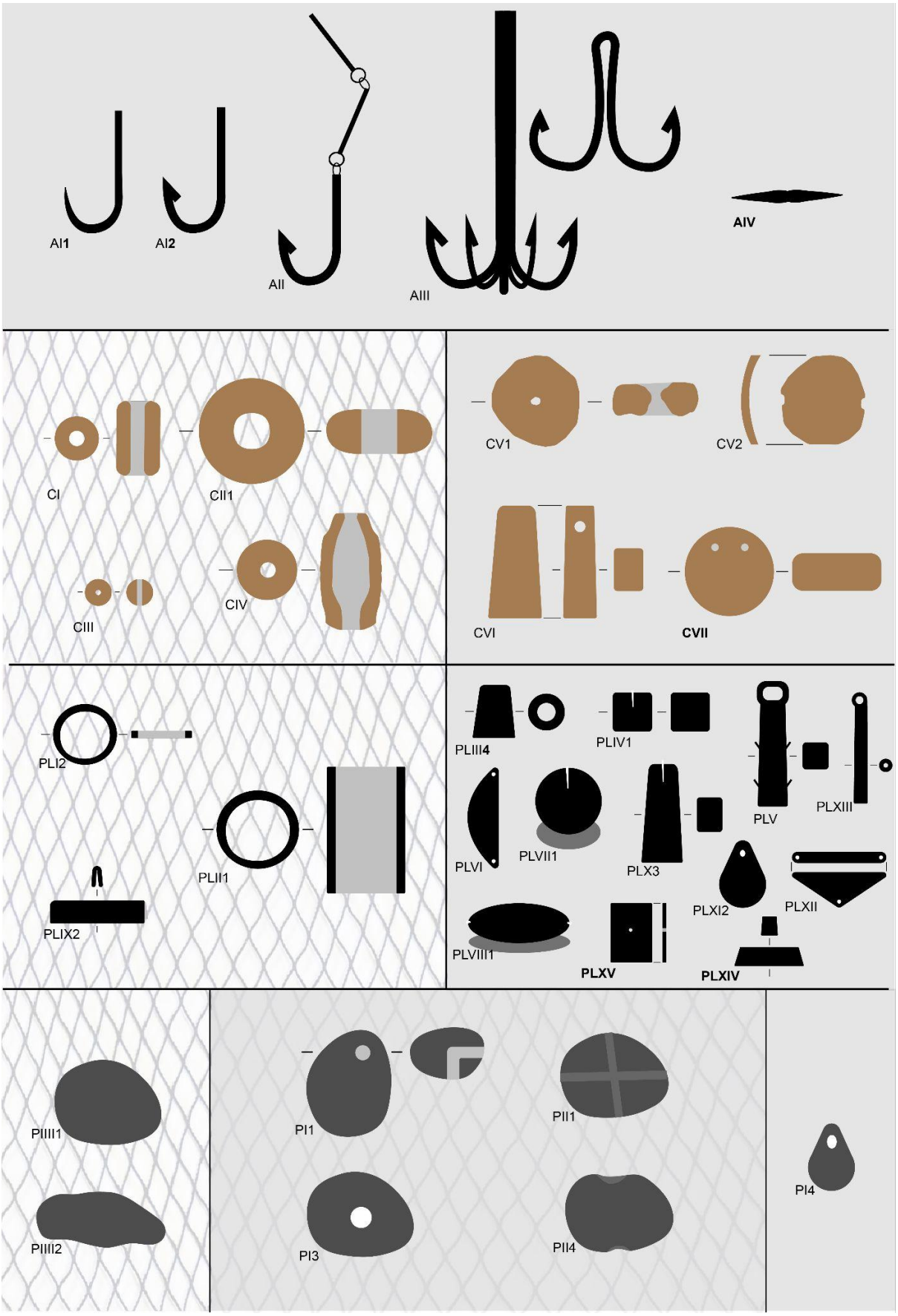


Fig. 6: The typology of fishing gear following Bernal's (2010) classification.

A = hooks; C = clay weights (brown); PL = lead weights (black); P = stone weights (grey).
Roman and Arabic numerals indicate, respectively, the type and subtype, the latter referring to the binding system. Each type is represented here with one binding system, although several sub-shapes may occur within a given type.
Grey background hypothetically associated with line fishing, net background with net fishing.
Bold indicates added type or subtype to the previous classification.

Results

1. Simple fish hooks

The classification of fishing hooks into three functional categories—Small, Medium, and Large—was established through a statistical analysis of their width. The choice of width as the primary classification parameter, rather than length—a more conventional metric in typological studies—stems from its direct functional relevance to prey capture as it can be correlated to the size of prey captured. Hooks of identical length can exhibit substantial width variations, which critically influence their functioning, making width a more reliable indicator of morphological variability tied to tool use.

However, methodological constraints must be acknowledged. The width data were derived from direct measurements when published but also estimations based on illustrations and photographs (where scales were available), introducing inherent imprecision for certain artifacts. This limitation justified the subsequent analysis of data in categorical form (Small/Medium/Large) rather than as continuous values, ensuring robustness in the classification system.

A Shapiro-Wilk normality test ($W = 0.8977$; $p < 0.001$) was conducted on hook width measurements, revealing a significant deviation from normality. The distribution showed substantial asymmetry and multimodality making summary statistics based on the hypothesis of normality, such as the mean and standard deviation less appropriate for characterizing our data. Consequently, two robust classification methods—Jenks (natural breaks) and K-means (iterative clustering)—were compared, yielding identical results and confirming their suitability for this dataset. The resulting objective thresholds define Small hooks as those with a width of less than 1.8 cm, Medium hooks as those between 1.8 cm and 3 cm, and Large hooks as those 3 cm or wider.

The size distribution of hooks shown in Fig. 7 supports the hypothesis that large hooks were preferentially used individually, whereas smaller and medium-sized hooks were also employed in longlines. This interpretation is consistent with the significantly lower number of large hooks compared to small and medium hooks. Such a pattern aligns with the constraints of big-game fishing, where single hooks are typically used to facilitate the landing of large fish. However, further archaeological or contextual evidence would be needed to confirm the specific functional use of each hook size category.

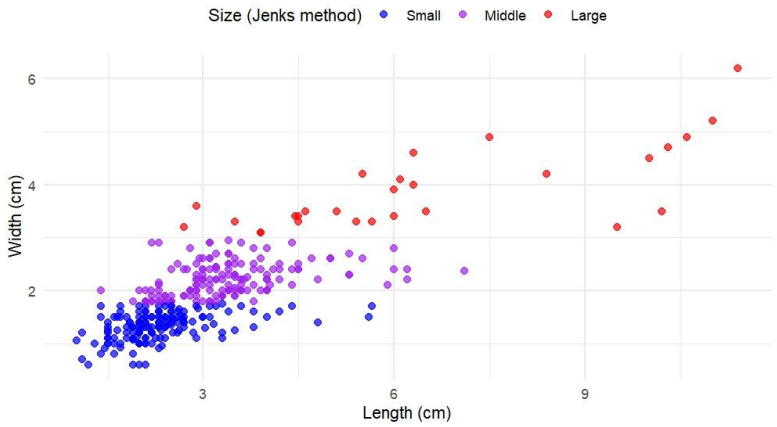


Fig. 7: Size (length and width) distribution according to the Jenks classification.

The size distribution of hooks by country (Fig. 7) reveals a consistent skewed pattern across all datasets, characterized by a predominance of small hooks and a markedly lower quantity of large hooks. This distribution pattern is similar between countries, though the proportion of medium-sized hooks varies significantly. For instance, France exhibits a relatively balanced ratio of small to medium hooks, whereas Spain and Italy display a much larger discrepancy between these two size categories.

However, the number of hooks with documented dimensions differs substantially between countries: Spain's dataset includes nearly ten times more hooks than those of France and Italy combined. Given the observed trend across these three countries, it is plausible that larger datasets would yield more comparable distributions. Nevertheless, this hypothesis remains speculative without additional data.

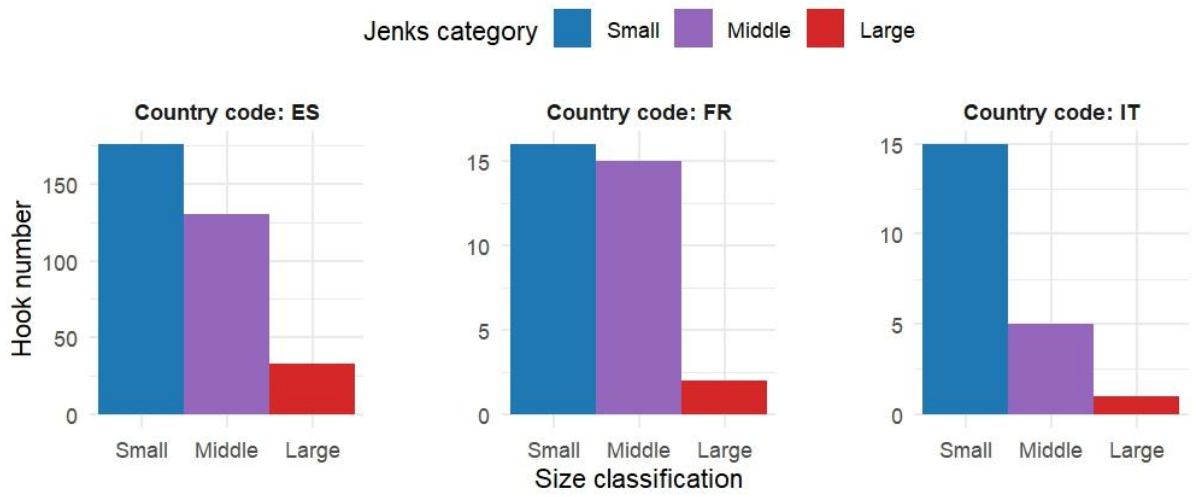


Fig. 8: Distribution of fishhooks by size and by country.

The temporal distribution of hook sizes (Fig. 9) is constrained by significant gaps in the dataset, particularly the absence of Neolithic and Metal Age specimens for Spain, as well as Neolithic material for France. Additionally, Italy's dataset suffers from a substantial proportion of missing morphometric data. Despite these limitations, a clear trend emerges for the Antiquity period: small hooks dominate the assemblage, followed closely by medium-sized hooks. This distribution—observed in both France and Italy—largely shapes the overall histogram presented in Fig. 8.

Large hooks are also documented in France and Italy during the Metal Ages, though their representation remains limited. While this suggests the practice of big-game fishing, we must consider a critical sampling bias: large

hooks may have been preferentially recorded due to their exceptionalism, whereas smaller hooks might have been overlooked in documentation. Such a bias could skew our understanding of past fishing practices.

The Neolithic period is exclusively represented in Italy, where no large hooks have been documented to date. Furthermore, only bone hooks are known from this period, and their dimensions remain undocumented for a significant portion of the assemblage. This raises a key question: Could the apparent size limitations of Neolithic hooks be influenced by raw material constraints? Most specimens derive from long bones, antler, or boar tusks—materials that inherently impose structural constraints on hook width and curvature. Future research should prioritize the systematic recording of undocumented specimens to assess whether these patterns reflect genuine technological or ecological constraints or merely sampling biases.

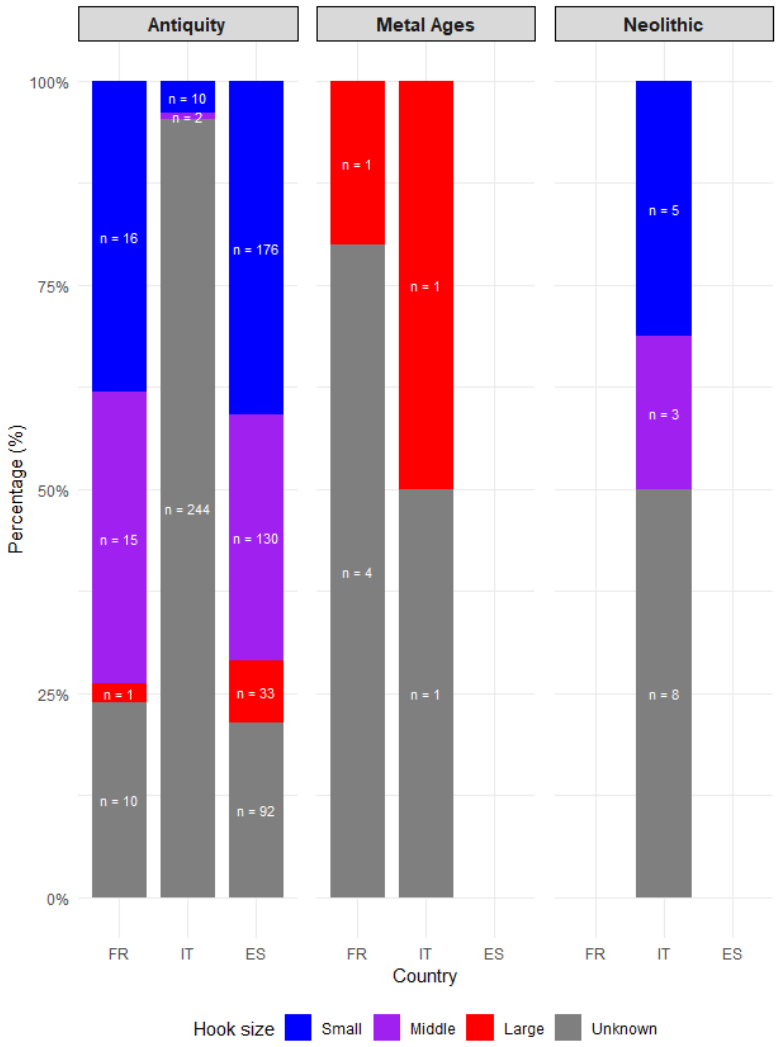


Fig. 9: Relative frequencies of fishhooks by size, period and country

The presence or absence of a barb on hooks (Fig. 9) represents a critical parameter for reconstructing fishing practices, particularly in determining whether hooks were used individually or in multi-hook systems (e.g., longlines or set lines). The barb functions as an additional retention mechanism beyond the hook's natural curvature, enabling passive fishing and reducing the need for active hook-setting. Consequently, barbed hooks facilitate the use of multi-hook configurations, whereas unbarbed hooks require constant vigilance and manual intervention to secure the catch. Thus, the proportion of barbed versus unbarbed hooks may serve as an indirect indicator of fishing techniques across different periods.

Analysis of the dataset reveals distinct temporal trends in barb presence:

- Antiquity: Barbed hooks dominate the assemblage, accounting for the vast majority of documented specimens. This predominance of small- to medium-sized barbed hooks suggests frequent use of passive fishing techniques, potentially involving multi-hook systems. However, the prevalence of such techniques cannot be ascertained, as barbed hooks were not necessarily employed exclusively in these contexts. Conversely, while the use of multi-hook equipment is highly plausible, individual fishing—albeit on a smaller scale and associated with unbarbed hooks—was also undoubtedly practiced.
- Metal Ages: Represented exclusively in France by a small sample size, unbarbed hooks appear slightly more common. While this could indicate a shift in fishing practices, the very limited dataset (n =5) precludes definitive conclusions.
- Neolithic: Barbless hooks are systematically documented for bone specimens in Italy. This observation aligns with the hypothesis that unbarbed hooks were more prevalent in earlier periods, though the sample remains insufficient to confirm a definitive chronological trend.

Current limitations prevent us from asserting that barbed hooks became increasingly systematic over time. However, the observed pattern raises an intriguing hypothesis: multi-hook systems (e.g., longlines) may have been preferentially adopted in later periods, coinciding with the increased use of barbed hooks. This interpretation warrants further investigation, as it implies technological and cultural adaptations in fishing strategies.

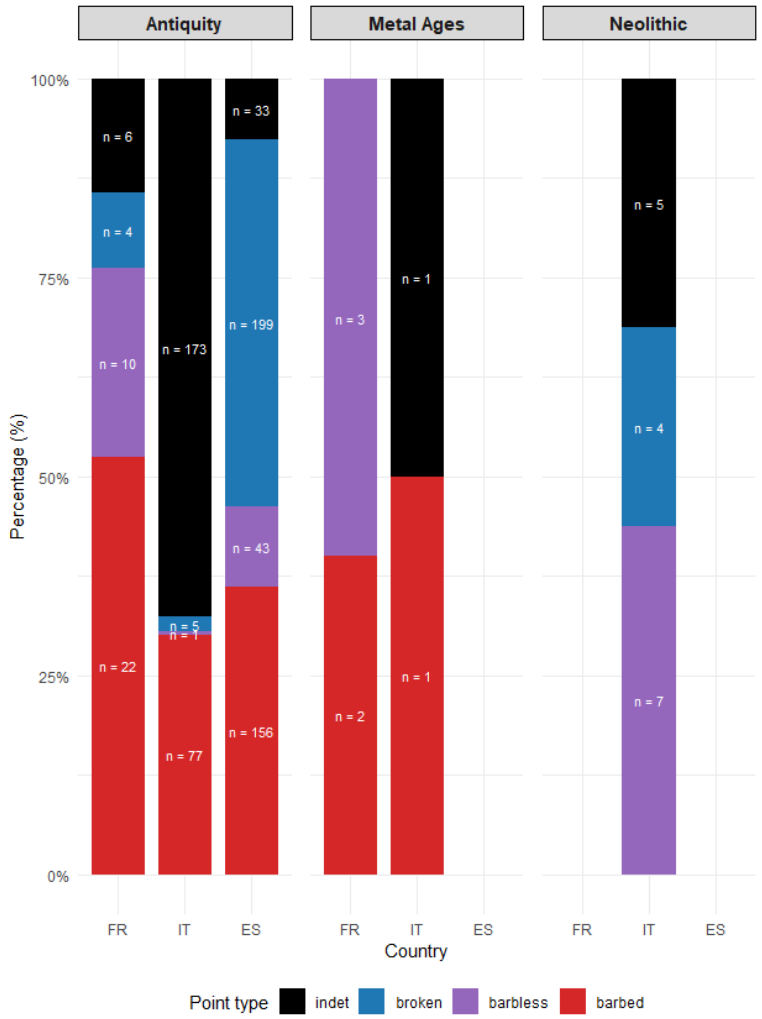


Fig. 10: Relative frequencies of hook point types by period and country.

2. Double, multiple, and chained hooks

Double, multiple (Fig. 6.AIII), and chained hooks (Fig. 6. AII) remain exceptionally rare in the western Mediterranean archaeological record, with only a handful of documented specimens despite their functional and chronological significance. A comprehensive survey by Bernal (2010) has catalogued these artefacts, yet their archaeological contexts often lack the precision required for robust chronological analysis. Among double hooks, only two specimens have been recorded: one from Pompeii (Stefani, 1990:14), and a second from a Pisa shipwreck, though its stratigraphic uncertainty precludes secure chronological attribution (Camilli, De Lorenzi, & Setari, 2006). While the latter's exceptional preservation aligns with an antiquity date, its comparability to the Pompeii specimen notwithstanding, the lack of contextual reliability renders it unusable for chronological inferences.

For multiple hooks—a category frequently, though not exclusively, associated with octopus fishing—the artefacts exhibit diverse fabrication techniques. Some appear to have been constructed by binding individual single hooks to a shared shank using organic fibres, while others may have involved metallurgical joining methods such as soldering or brazing. Several cases are documented: one from the Comacchio shipwreck in Italy (Berti, 1990), two from Albuferreta (Bernal, 2010), and two from Baelo Claudia (Vargas, 2020:60, fig. 1.2) in Spain. A last multiple hook was recovered in Antibes (Bernal, 2010). However, its provenance is deemed unreliable due to a lack of primary documentation, thus excluding it from chronological considerations.

Chained hooks, by contrast, are even rarer in this region, with only two examples recovered at Asciutta near Pompeii (Stefani, 1990) and Baelo Claudia (Vargas, 2020:60, fig.1.1). These artefacts feature an extended shank designed to protect the terminal line from damage by carnivorous fish, whose teeth could otherwise sever it. This innovation preserves a short hook-to-point ratio while mitigating the leverage effect that longer shanks would exert, enabling captured fish to escape. While similar chain hooks are known from the eastern Mediterranean (e.g., []), their rarity in the western basin underscores both technological specialization and the challenges posed by incomplete archaeological records.

3. Weights

The typological study of the fishing weights was based on the work of Bernal (2010), as discussed above. Typological identification was carried out systematically during the inventory, using as a starting point the hypotheses proposed by Bernal regarding the function of these weights, inferred from their morphology, raw material, quantity, and archaeological context. This approach made it possible to distinguish between weights potentially associated with line fishing and those possibly used in net fishing.

Bernal further proposed that specific types of nets could be associated with particular categories of weights. Cylindrical lead weights (PLII), for example, were linked to almadrabas, large-scale and fixed fishing nets used primarily to capture large fish such as tuna (Garcia and Florido del Corral, 2010). Their considerable size and operational requirements imply that they were handled collectively by several fishers. By contrast, the weights associated with cast nets correspond to rolled lead sheets that could be hammered directly onto the netting (PLIX). These nets were used for individual fishing activities and are discovered all around the ancient Mediterranean, with 23 recorded sites, both from inland and coastal sites (Vargas et al., 2021:421, fig.12).

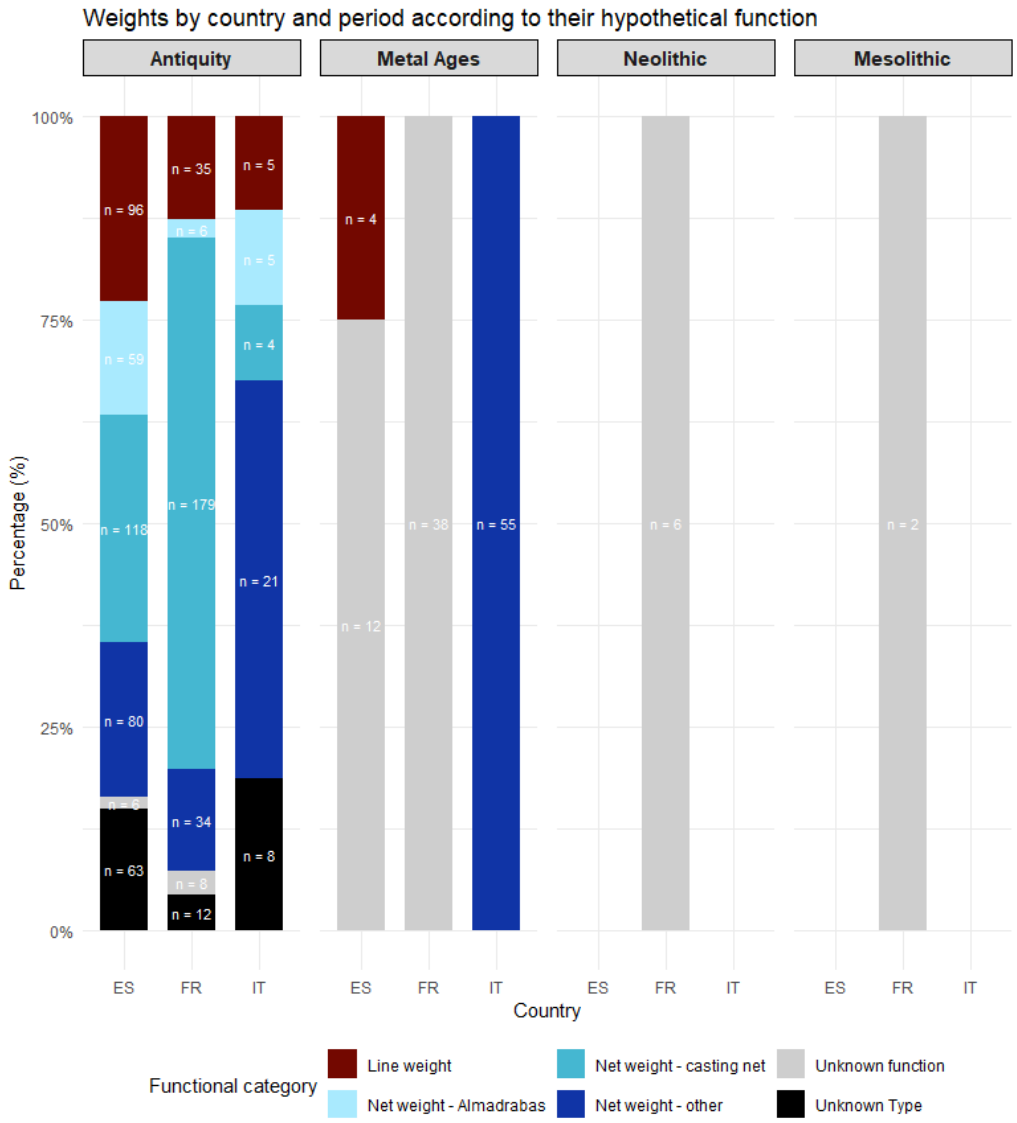


Fig. 11: Relative frequencies of weights by country and period according to their hypothetical function.

Functional Distribution of Fishing Weights Through Time and Across Regions

The distribution of fishing weights by functional category reveals significant dynamics both through time and across regions (Fig. 10). During Antiquity, the three study areas display broadly comparable patterns, with a clear predominance of weights associated with net fishing, followed by a smaller proportion attributed to line fishing. In Spain, 61% of the recorded remains are associated with net fishing, compared with 23% attributed to line fishing and 16% whose function remains indeterminate. In France, the proportion of weights associated with net fishing reaches 80%, while line-fishing weights account for 13% and indeterminate objects for 7%. Italy presents an intermediate pattern, with 70% of the remains attributed to net fishing, 12% to line fishing, and 18% remaining unidentified.

These figures should not, however, be interpreted as indicating that line fishing was practised less frequently than net fishing in terms of the number of individuals involved in each activity. Net fishing generally requires a considerably larger number of weights than line fishing. Consequently, the quantitative predominance of net-fishing weights may reflect the technical requirements of the equipment rather than the relative importance of the two practices.

This observation provides a degree of support for the functional hypotheses proposed by Bernal (2010). If each type is assigned to the function suggested by its morphology, the resulting quantitative distribution is broadly consistent with the technical characteristics of the practices concerned: net fishing would be expected to involve a larger number of individual weights than line fishing. This correspondence does not constitute definitive proof of the proposed functional attributions, but it strengthens their plausibility and demonstrates that the interpretation is not merely circular. Rather, the morphological classification produces distributions that are coherent with the anticipated requirements of the fishing techniques.

The internal composition of the net-fishing category also reveals important regional differences. In Spain and Italy, large nets of the *almadraba* type represent a significant proportion of the remains associated with net fishing, whereas they are only marginally represented in France. Conversely, casting nets account for a particularly substantial proportion of the net-fishing weights recorded in France and appear to be much less prominent in the Italian assemblage during Antiquity. Italy is also characterised by a relatively high proportion of weights associated with nets other than *almadrabas* and casting nets. This distribution may indicate the importance of other fishing systems or types of equipment, which may have played a more significant role in Italy than in France or Spain.

The situation is markedly different for the earlier periods. Indeed, most of the objects included in the unknown function category are stone weights, whose precise use as net or line-fishing equipment is difficult to establish. More generally, the proportion of such indeterminate stone objects appears to increase further back in time. As a result, the distinction between net fishing and line fishing in the earliest periods must rely on additional evidence, such as the presence of hooks attesting to line fishing or the identification of fish species that could have been captured exclusively, or preferentially, using one of these techniques.

During the Metal Ages, only four artefacts are recorded in Spain, representing 25% of the remains, and these are associated with line fishing. The remaining 75% cannot be assigned with confidence to a specific function. In France, the recorded weights consist exclusively of stone objects, as is also the case for the Neolithic and Mesolithic periods. Their identification as fishing equipment is therefore uncertain, particularly when based solely on morphology. The comparatively larger number of such objects in France may partly result from the work of Vigié-Chevalier (1994), who paid particular attention to equipment potentially related to fishing on the basis of its archaeological context. Although a fishing function cannot be established with certainty in every case, this research has contributed to the identification and inclusion of a larger number of possible fishing weights in the French corpus. It is therefore reasonable to assume that a comparable focus on this type of material in Spain and Italy might also result in the recognition of additional objects.

The evidence for line fishing during the Metal Ages is equally problematic. Although line-fishing weights are identified only in Spain, hooks are documented for the Metal Ages in all three regions. It is therefore plausible that weights were used in association with hooks as components of fishing lines. Two possibilities must consequently be considered. First, the proposed functional classification may not be fully applicable to the Metal Ages (as it was developed for Antiquity) and may fail to identify weights associated with hooks. Second, some of the relevant objects may correspond to morphological forms that have not yet been recognised as fishing weights.

Italy offers yet another contrasting pattern. During the Metal Ages, all of the recorded fishing weights are associated with net fishing according to Bernal's classification. Most of these objects are ceramic weights, including symmetric and perforated forms classified as cylindrical weights (CI), disc-shaped weights (CII), or spindle-shaped weights (CIV). The exclusive attribution of these objects to net fishing raises the same question as in Spain: can the distinction between line- and net-fishing equipment proposed for Antiquity be applied reliably to the Metal Ages, given that hooks are also documented for this period in Italy?

This issue is particularly relevant because only two hooks are currently recorded for the Metal Ages in Italy, and only one of them has a known size; this specimen is relatively large. In this context, it cannot be excluded that some of the weights currently associated with net fishing on the basis of their large number, symmetrical

morphology, and relatively substantial internal diameter may have been used in connection with big-game fishing. Such fishing would have required thicker and more resistant cordage, potentially involving weighting elements comparable to those used in certain net-fishing systems. Some of these objects may therefore have been used in both line fishing and net fishing targeting large fish.

This remains a hypothesis, however, and the available evidence is currently insufficient to confirm it. It should nevertheless be considered when the archaeological corpora is expanded and when the relationships between fishing weights, hooks, cordage, and captured species can be examined in greater detail.

Distribution of Net-Fishing Weights during Antiquity

The proportions of the different types of net-fishing weights provide further insight into regional practices during Antiquity. In Spain, casting nets account for 46% of the weights associated with net fishing, while *almadrabas* represent 23% and other types of net-fishing weights account for the remaining 31%. France displays an even stronger predominance of casting nets, which represent 81.73%—approximately 82%—of the assemblage. By contrast, *almadrabas* account for less than 3% of the remains considered.

Italy presents a markedly different distribution. Casting nets represent only 13.3% of the net-fishing assemblage, while *almadrabas* account for slightly less than 17%. Nearly 70% of the remains associated with net fishing correspond to other types of weights, consisting primarily of ceramic objects. This Italian profile therefore differs substantially from those observed in France and Spain, where one specific type of net-fishing equipment—particularly the casting net in France—clearly predominates.

The Italian evidence also makes it possible to consider potential continuity between the Metal Ages and Antiquity in the use of particular types of ceramic weights. The ceramic weights documented during the Metal Ages, including cylindrical (CI), disc-shaped (CII), spindle-shaped (CIV), and trimmed forms (CV), appear to find parallels in the substantial proportion of ceramic net-fishing weights recorded during Antiquity. Although this continuity cannot yet be demonstrated in every individual case, the persistence of comparable categories of equipment suggests that some technical traditions may have been maintained or adapted over time.

More broadly, these distributions may reflect a cultural and technological distinction between Italy on the one hand and France and Spain on the other. In France and Spain, the assemblages are more strongly dominated by casting nets and, in Spain, by *almadrabas*, whereas Italy is characterised by a much greater diversity of other net-fishing weights, especially ceramic forms. This difference may indicate the use of distinct fishing technologies and manufacturing traditions, with Italian practices anchored in Metal Ages. It should nevertheless be interpreted cautiously considering the quantity of remains and this hypothesis has to be challenged with additional data.

Netting shuttle, needles, nets

Although the quantities of other types of equipment are lower, or although these artefacts are not directly related to fishing activities, it nevertheless seems important to provide a brief quantitative overview of the equipment represented, beginning with artefacts associated with net fishing. In addition to net weights, a small fragment of net has been documented in Spain, at the La Albuferreta site (Alfaro Giner, 2010).

Netting shuttles have also been identified. Several terms are used in the literature to describe these artefacts, including *navette* in French, *lanzadera* in Spanish, and *mòdani* in Italian. They are documented exclusively in Antiquity and occur in varying proportions across the three countries: 24 specimens were recorded in Spain, 11 in France, and 13 in Italy. However, not all of these artefacts were preserved sufficiently well to be measured or were suitable for measurement (Fig. 12).

The statistical tests applied to the lengths of the netting shuttles (n=27) revealed no significant differences among the three Mediterranean countries considered —Spain, France, and Italy. An analysis of variance (ANOVA) confirmed the apparent homogeneity of the samples, with F=0.208 and p=0.814. Preliminary tests supported both the normality of the distributions, based on Shapiro–Wilk tests, and the homogeneity of variances, based on Levene's test. Descriptive statistics also showed comparable mean lengths, ranging from 12.3 to 13.2 cm, and similar standard deviations, ranging from 1.7 to 2.1 cm.

From a functional perspective, the limited differences observed between the three countries are noteworthy. If the dimensions of complete netting shuttles are related to the size of the meshes they were used to produce, the comparable dimensions observed here may suggest that nets with broadly similar mesh sizes were manufactured during Antiquity across the western Mediterranean, irrespective of whether they were used in France, Spain, or Italy. This result could indicate that comparable fishing practices — and, more particularly, comparable target species — were present along the western Mediterranean coastline.

This interpretation must nevertheless remain tentative. The number of specimens included in the analysis is limited, and the samples are strongly unbalanced, with 18 observations from Spain, compared with only 6 from France and 3 from Italy. The current statistical power, estimated at approximately 45%, is insufficient to detect moderate differences, and local variations may therefore remain undetected. Additional data, particularly from France and Italy, are required to confirm or reject the hypothesis of dimensional homogeneity with adequate statistical power (≥80%).

The potential significance of this result lies in the functional importance of mesh size. In fishing nets, mesh dimensions determine not only the size of the fish that can be retained, but also the size of individuals that are able to pass through the net. Mesh size therefore involves two distinct but complementary selection thresholds: a minimum size below which fish can escape and a maximum size that determines the upper range of fish that can be effectively retained. The dimensions of the netting shuttle may consequently provide indirect information about the functional parameters of the nets with which they were associated. If the dimensions of the shuttles were indeed comparable, this could suggest that the corresponding nets operated within broadly similar dimensional constraints and were intended to target fish of comparable size across the western Mediterranean.

However, the relationship between shuttle size and mesh size should not be treated as strictly deterministic. It may also have depended on the technique used to construct the net, the thickness and flexibility of the cordage, the way in which the shuttle was handled, and the specific type of net being produced. Further analysis of complete specimens, combined with experimental and traceological studies, will therefore be necessary to evaluate more precisely the relationship between netting-shuttle dimensions, mesh size, and fishing practices. Two bone netting shuttles were also identified by Vigié-Chevalier (1992): one at the Station des Valentines site in Ouveillan, dating to the Late Neolithic (Vérazien), and the other at the Station de la Madeleine site in Villeneuve-lès-Maguelone, dating to the Middle Neolithic (Chasséen). Traceological analyses could help strengthen this hypothesis, while greater attention should be paid to identifying additional equipment of this type throughout the study area. At present, therefore, fishing with nets cannot be ruled out for this period.

The presence of needles should also be noted. These have sometimes been interpreted as evidence of net fishing in published studies, since net weights were often found at the same sites. However, their precise function cannot always be determined. The quantities recorded here should therefore be considered primarily as indicative of the degree of scholarly attention devoted to this type of equipment, rather than as representative of the actual number of needles recovered. This study focused on publications dealing with fishing practices and did not systematically consider all needles documented in coastal assemblages.

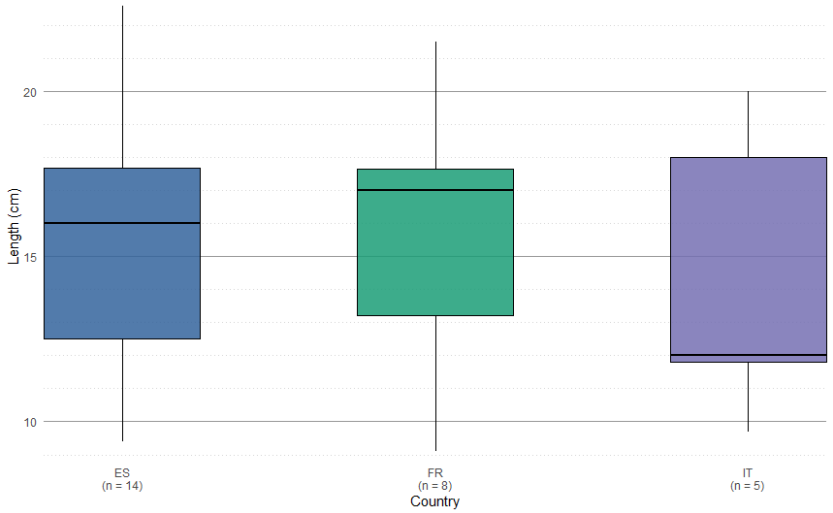


Fig. 12: Netting shuttle length per country.

Projectile equipment

This category includes harpoons, tridents, spearheads, points, and microliths. Although all these artefacts can confidently be identified as projectile points, their association with fishing activities varies considerably depending on the specific type of equipment, the archaeological context, and the chronological period.

As is the case for most of the fishing equipment considered here, the largest number of specimens dates to Antiquity. Examples are attested in all three regions under consideration—France, Spain, and Italy. In Italy, the assemblage from Sant'Antonino di Perti includes a bronze harpoon (De Vingo and Fossati 2001). Several examples are also known from Spain, including a bronze harpoon recovered from a tomb at Plaza Asdrubal (Vargas, ed., 2020). The Plaza Asdrubal site also yielded an iron trident from a fish-salting establishment. Finally, in an industrial context, a bone spearhead was discovered at Algeciras (Bernal and al., 2018).

Ancient shipwreck contexts have likewise produced projectile-fishing equipment. These include a bronze harpoon from the Dramont G shipwreck in France (Joncheray 1987), as well as a metal trident from the Cavallo shipwreck, although the raw material is not specified by Beltrame (2002). A lead gear was also recorded at the Lattara site by Feugère (1994:155, fig. 17.9) but it is unlikely to be a spearhead.

Even within Antiquity, therefore, the evidence reveals a wide range of forms—including harpoons, tridents, spearheads, and points—and several different materials, such as bronze, iron and bone. Given the current state of the evidence, it is not possible to establish a coherent typology based on these artefacts. However, the lack of regularity in both form and raw material may indicate that projectile fishing was primarily an individual practice. It may have been undertaken occasionally within the household and as a complementary component of subsistence activities, rather than as a major economic strategy.

This interpretation is consistent with the technical requirements of projectile fishing. Such practices require specific environmental conditions, particularly calm and shallow waters in which larger fish approach the shore or become accessible during specific seasonal periods. These conditions differ from those associated with the use of longlines or nets, which allow the capture of substantially larger quantities of fish. Projectile fishing was therefore probably not sufficiently productive to constitute a major source of food on a daily basis.

For the Bronze Age, two specimens are currently recorded in Italy. The first is a bone harpoon from the Sa Osa site (Depalmas and Di Gennaro, 2015). The second consists of microliths from the Villaggio del Machine site (Angle and Guidi, 2007). It is noteworthy that, although metal objects were already used both as fishing weights

and as fishhooks, projectile-fishing equipment is not currently documented in metallic materials for this period, despite the limited number of known specimens.

For the Neolithic, bone equipment is documented at the Grand Abri at Châteauneuf-les-Martigues, where a harpoon was recovered, and at the Îlot Corrèges site in Leucate, where a bone point was found. Both are cited by Vigié-Chevalier (1992). The same author also mentions several microliths from the Grand Abri at Châteauneuf-les-Martigues that may have been mounted on a composite projectile.

Finally, for the Mesolithic, also in France, Vigié-Chevalier's inventory includes microliths from the Abri Cornille-Sulauze rock shelter and from La Baume-Longue at Martigues.

For the earlier periods considered, the evidence therefore points to the recurrent presence of microliths that could have been associated with fishing activities on the basis of their archaeological contexts. If all microliths recovered from sites around the Mediterranean were reassessed from the perspective of their potential use as fishing equipment, the resulting inventory would probably be considerably different.

Nevertheless, securely identifying these artefacts as fishing equipment requires further use-wear and technico-functional studies, and particularly detailed traceological analyses (Orłowska and al., 2026), to test and substantiate these hypotheses. Bone equipment also deserves further attention. Although it is currently represented in relatively small numbers around the Mediterranean, comparable artefacts are well documented in inland contexts, where their association with fishing activities has already been considered (Julien, 1982; Pétillon, 2009; Christensen and al., 2016). Considerable work therefore remains to be undertaken in order to strengthen these identifications and expand the available corpus.

	Antiquity	**Metal Ages**	**Neolithic**	**Meso/Paleolithic**

Hooks	Mainly bronze hooks, with a few iron ones. In France and Spain, fewer than 10% of the hooks are large (more than 3 cm wide), with considerable variation in length (between 3 and 11 cm). More than 30% are medium-sized hooks (between 1.8 and 3 cm wide), and approximately 40% are small hooks (less than 1.8 cm wide). Around 20% have an indeterminate width. Too little data are available for Italy. More than 70% are barbed hooks, compared with barbless ones (Spain: 78%; France: 69%; Italy: 98.7%). *Biases*: Italian remains are underrepresented in the morphometric dataset.	Metal (mainly bronze) hooks are found only in France and Italy. Only large hooks were measured. The distribution of barbless and barbed hooks appears balanced. *Biases*: very few hooks are known (n=7), and even fewer have been documented morphometrically.	Bone gorges are known from France and Italy. Only bone hooks are documented in Italy (n = 16). All measured specimens are less than 3 cm wide. Only barbless hooks. *Biases*: very few hooks are known, and even fewer have been documented morphometrically; difficulties in identifying the fishing function; issues related to bone preservation.	Only possible bone gorges during the Magdalenian period in Spain, from a single site: Cueva de Nerja. *Biaises:* difficulties in identifying the fishing function; issues related to bone preservation; and the disappearance of older sites due to sea-level changes.
Weights	Represented by 25 types and 54 subtypes, made of clay, stone, and lead. Considering the number of artefacts associated with a specific type of fishing gear, 73% belong to nets. In France and Italy, 86% are related to nets. In detail, casting nets represent 46% of net weights in Spain, 82% in France, and 13.3% in Italy. Almadrabas represent 23% of net weights in Spain, 3% in France, and 17% in Italy. *Biases*: no comparison can be done between net and line weights to estimate the proportion of each activity.	Represented by 8 types and 8 subtypes. Mainly stone weights, with a few lead weights, in Spain; only stone weights in France; and almost exclusively clay weights in Italy. *Biases:* very few weights are known; difficulties in identifying the fishing function of stone weights	Only stone weights are recorded in France. *Biases*: very few weights are known; difficulties in identifying the fishing function of stone weights.	No records.
Nets and netting tools	Metal netting shuttles are known only for this period with one to two dozen of remains found in each country. *Biases:* too few gears are measured in France and Italy.		Two supposed bone shuttles were recorded in France. *Biases*: very few records	
Projectile fishing tools	Wide range of forms (harpoons, tridents, spearheads, and points), types, and raw materials (bronze, iron and bone)	Bone harpoon and microliths are recorded in Italy. *Biases*: too few gears and	Bone points and microliths are recorded in France. *Biases*: too few gears and	Microliths *Biases*: difficulties in identifying the microliths fishing function

		difficulties in identifying the microliths fishing function	difficulties in identifying the microliths fishing function	

Tabl. 3: Synthesis of fishing gear evolution.

Discussion

The results presented here highlight the considerable variability in the identification of fishing equipment and in the attribution of its specific function. This variability operates at several levels, depending on the geographical region, the chronological period, the category of equipment considered, and the degree of preservation and documentation available. Consequently, the apparent distribution of fishing practices across the western Mediterranean should not be interpreted solely as a reflection of past behaviour. It also reflects differences in archaeological research, publication practices, material preservation, site formation processes, and the criteria used to identify fishing-related artefacts.

Regional disparities in the archaeological record from Antiquity

Antiquity is particularly well represented in the Spanish corpus. Fishing equipment is documented in relatively large numbers and across a broad range of categories, including hooks, weights, netting equipment, and projectile-fishing tools. The Spanish dataset is also comparatively well documented from both a typological and contextual perspective. It may therefore provide a relatively reliable overview of ancient fishing practices, although the effects of preservation and publication bias cannot be entirely excluded.

The situation is different in France and Italy. In France, the number of documented fishing remains is relatively limited, with strong concentrations at a small number of sites, such as Lattara. This pattern may partly result from the limited number of coastal sites currently represented in the corpus. However, the scarcity of remains cannot be explained solely by a lack of archaeological research. Numerous preventive excavations have been conducted in France, and these operations might be expected to have produced a larger number of fishing-related artefacts, particularly where such objects were specifically sought during excavation and post-excavation studies.

This raises the question of the actual importance and visibility of fishing activities along the French Mediterranean coast. Fishing was certainly practised, as demonstrated by the presence of fishing equipment, including remains from shipwreck contexts. Nevertheless, it appears under-represented in comparison with Spain and Italy. This observation must be qualified by the shorter length of the French Mediterranean coastline, which limits the area available for comparison. Other factors may also have contributed to the apparent scarcity of evidence, including differential preservation, the nature and intensity of coastal occupation, and possible differences in fishing practices during Antiquity. Further research should therefore distinguish between a genuine difference in the intensity or organisation of fishing and a discrepancy produced by the archaeological record.

In Italy, the main problem is not necessarily the absolute number of artefacts, although the corpus appears relatively small given the large number of known antic coastal sites. Rather, the principal limitation concerns the qualitative and morphometric documentation of the artefacts. Many objects are insufficiently described, incompletely measured, or difficult to compare with material from France and Spain. This limits the possibility of reconstructing fishing practices in detail, particularly when distinctions depend on dimensions, morphology, or manufacturing techniques.

Fishing practices during Antiquity

Despite these regional disparities, the comparison of the available evidence suggests a certain degree of similarity in hook fishing during Antiquity. Small and medium-sized hooks dominate the corpus, while large hooks are less common. Barbed hooks are also more frequent than barbless specimens. Although these patterns may partly reflect differences in recording and preservation, they could indicate that comparable line-fishing practices were employed across the western Mediterranean.

The evidence for net-fishing suggests a more complex situation. During Antiquity, a wide range of net weights was used, manufactured from clay, stone, and lead. The proportions and morphological diversity of these weights differ between countries. Casting-net weights are particularly prominent in France and Spain, whereas Italy is characterised by a much greater diversity of ceramic forms. This contrast may reflect differences in fishing techniques, manufacturing traditions, or the types of environments and target species exploited in each region.

However, these differences should not be interpreted too rapidly as evidence for fundamentally distinct fishing traditions. The unequal size and quality of the national corpora may have substantially influenced the observed distributions. The current typological differences should therefore be regarded as working hypotheses requiring confirmation through the study of larger and more systematically documented assemblages.

The dimensions of the netting shuttles provide an interesting counterpoint to the variability observed among net weights. Although the sample remains limited, the comparable dimensions recorded in France, Spain, and Italy may indicate that nets with broadly similar mesh sizes were manufactured across the western Mediterranean during Antiquity. Since mesh size determines both the minimum size of fish able to escape and the maximum size of fish that can be effectively retained, it constitutes a major functional parameter of fishing nets. Comparable shuttle dimensions could therefore suggest that similar types or size ranges of fish were targeted in the three regions.

This hypothesis must nevertheless remain tentative. The relationship between shuttle size and mesh size is indirect and may have depended on the type of net, the diameter and flexibility of the cordage, and the technique used to manufacture the net. Moreover, the statistical analysis is based on a small and unbalanced sample. The systematic measurement of additional specimens will be necessary to determine whether the apparent dimensional homogeneity reflects a genuine technological pattern or merely insufficient statistical resolution.

Projectile-fishing equipment presents a different pattern. Harpoons, tridents, spearheads, points, and microliths display considerable variability in morphology and raw material. Their low frequency and heterogeneous character suggest that projectile fishing may have constituted a relatively specialised or individual practice, rather than a standardised large-scale fishing technique.

Major chronological gaps

The most significant chronological bias concerns the periods preceding Antiquity. In Spain, fishing equipment is almost entirely absent from the Neolithic and Metal Ages. This absence may reflect a genuine difference in the archaeological record, but it could also result from research priorities, unequal site distribution, differential preservation, or changes in coastal occupation. The current evidence is therefore insufficient to determine whether fishing was less important during these periods or whether its material expression has simply not yet been recognised.

The Metal Ages are poorly represented in all three regions. The number of documented artefacts is small, and the typological and morphometric diversity is consequently limited. This prevents the formulation of robust hypotheses concerning the organisation and technical variability of fishing during this period. The contrast with Eastern Europe, where Metal Age fishing equipment is much more extensively documented (Powell, 1996), suggests that the scarcity observed in the western Mediterranean may not be explained by chronological factors alone. It should encourage renewed research into Metal Age coastal sites and a critical reassessment of objects currently assigned to unknown or non-fishing functions.

The Neolithic record is also highly uneven. Bone hooks are documented in Italy, but not in comparable numbers elsewhere. Their preservation is generally good, yet many specimens remain insufficiently described or measured. Detailed technological and morphometric studies of these artefacts would be particularly valuable, as they could clarify manufacturing procedures and functional variability and possible regional differences in fishing practices.

For the earliest periods, the main difficulty concerns the identification of fishing equipment itself. Microliths and bone points may have been used in fishing contexts, but their association with fishing cannot generally be established on typological grounds alone. Use-wear analysis, technological study, and technico-functional approaches should therefore be prioritised. These methods could help distinguish fishing equipment from hunting weapons or other projectile systems.

Integrating artefacts and fish remains

Future research should also systematically combine fishing equipment with ichthyological evidence. Some fish species can only be captured, or are preferentially captured, using particular techniques. Conversely, certain fishing implements are more compatible with specific prey sizes, habitats, or behaviours. The comparison of artefact assemblages with fish remains could therefore provide an independent basis for assessing the proposed functions of ambiguous objects. Within the MERMAID program, the combination of remains of fishing tools and fish remains will allow for a more comprehensive synthesis of fishing activities in the Mediterranean past.

The limited number of sites yielding both fishing equipment and fish remains in all periods studied within the program nevertheless requires explanation. In later periods, this separation may reflect the spatial organisation of activities. Fish processing, consumption, net manufacture, equipment repair, and storage may have taken place in different locations.

For earlier periods, the discrepancy may also result from excavation methods. Fish remains are generally recovered through fine sediment sampling and sieving, often from relatively restricted volumes. The probability of recovering accidentally discarded or lost fishing equipment within these samples is therefore limited. Conversely, fishing equipment is more likely to be identified during larger excavation when it corresponds to visually distinctive objects, such as hooks, harpoons, or characteristic weights. This difference in archaeological visibility may explain why some categories of equipment are over-represented relative to less recognisable objects.

Overall, the present corpus should be regarded as an initial framework rather than a definitive reconstruction of Mediterranean fishing practices. The evidence suggests both shared technical traditions and regional variability, but the relative importance of these two dimensions remains difficult to evaluate because the archaeological record is uneven. Expanding the corpus, improving the documentation of existing material, and integrating artefactual, technological, traceological, and ichthyological evidence will be essential for developing a more reliable understanding of the evolution of fishing practices in the western Mediterranean.

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Annexe 1 : List of sites that yielded fishing tool remains (quantified or mentionned without quantification), and presence/absence of fish remains according to the MERMAID database (NA = Non available)

ID on the map	Country	Site	Number of quantified fishing tool remains	Mentioned fishing tools (without quantification)	Fish remains recorded in the MERMAID database	Reference
1	ES	La Algaida	41		NA	Bernal Casasola (Ed.), 2011 ; Vargas Girón (Ed.), 2020
1	ES	Necrópolis de Chipiona	1		NA	Vargas Girón (Ed.), 2020
2	ES	Avda. Amílcar Barca	1		NA	Vargas Girón (Ed.), 2020
2	ES	Avda. Andalucía – c/ Ciudad de Santander	3		NA	Vargas Girón (Ed.), 2020
2	ES	Avda. Andalucía 21-27	1		NA	Vargas Girón (Ed.), 2020
2	ES	Avda. Portugal – Avda. Andalucía	1		NA	Vargas Girón (Ed.), 2020
2	ES	Baños del Blanco	1		NA	Vargas Girón (Ed.), 2020
2	ES	c/ Acacias 21	14		NA	Vargas Girón (Ed.), 2020
2	ES	c/ Acacias 23	1		NA	Vargas Girón (Ed.), 2020
2	ES	c/ Acacias 25	1		NA	Vargas Girón (Ed.), 2020
2	ES	c/ Botica 31-33 – c/ Concepción Arenal 5	1		NA	Vargas Girón (Ed.), 2020
2	ES	c/ Brunete – c/ Granja San Ildefonso	2		NA	Vargas Girón (Ed.), 2020
2	ES	c/ Ciudad de Santander – Avda. Andalucía	1		NA	Vargas Girón (Ed.), 2020
2	ES	c/ Dr. Gregorio Marañón	2		NA	Bernal Casasola (Ed.), 2011
2	ES	c/ Juan Ramón Jiménez	5		NA	Vargas Girón (Ed.), 2020
2	ES	c/ Mirador 25	1		NA	Vargas Girón (Ed.), 2020
2	ES	c/ Santa Cruz de Tenerife 1 – c/ Santa María del Mar	2		NA	Vargas Girón (Ed.), 2020
2	ES	c/ Santa Cruz de Tenerife nº 1 – c/ Santa María del Mar	1		NA	Vargas Girón (Ed.), 2020
2	ES	c/ Solano 3	1		NA	Vargas Girón (Ed.), 2020
2	ES	c/ Tolosa Latour	1		NA	Vargas Girón (Ed.), 2020
2	ES	Calle Ancha		+	NA	Bernal Casasola, 2010
2	ES	Camposoto	16		NA	Ramón et al., 2007
2	ES	Castillo de Doña Blanca	60	+	NA	Ruiz Mata et al., 2006
2	ES	Club Náutico Caleta	9		NA	Vargas Girón (Ed.), 2020

2	ES	Cuarteles de Varela	16		NA	Vargas Girón, 2020
2	ES	Las Redes	38		NA	Bernal Casasola (Ed.) 2011 ; Vargas Girón (Ed.), 2020
2	ES	Palacio de la Justicia	5		NA	Bernal Casasola (Ed.), 2011
2	ES	Plaza Asdrúbal	103		NA	Bernal Casasola (Ed.) 2011 ; Vargas Girón (Ed.), 2020
2	ES	Plaza San Antonio	38		NA	Bernal Casasola (Ed.) 2011 ; Vargas Girón (Ed.), 2020
2	ES	Puerta de Tierra	6		NA	Vargas Girón (Ed.), 2020
2	ES	Puerto-19	5		NA	Arévalo et al. (2004) ; Bernal Casasola et al. (2008)
2	ES	Teatro Andalucía	6		NA	Bernal Casasola (Ed.) 2011 ; Vargas Girón (Ed.), 2020
2	ES	Torre Alta	6		NA	Arévalo et al., 2004 ; Bernal Casasola, 2009
3	ES	Baelo Claudia	156		NA	Bernal Casasola, 2009 ; Bernal Casasola, (Ed.) 2011 ; Vargas Girón (Ed.), 2020
3	ES	c/ Brunete – c/ Colón	2		NA	Vargas Girón (Ed.), 2020
3	ES	c/ Brunete - c/ Colón, Barbate	2		NA	Vargas Girón (Ed.), 2020
3	ES	c/ Padre Castrillón	7		NA	Vargas Girón (Ed.), 2020
4	ES	Algeciras	72		YES	Bernal Casasola, Aguilera Rodríguez et Jiménez Pérez, 2018
4	ES	Cerro del Prado	10		NA	Arévalo et al., 2004
5	ES	Ceuta	10	+	YES	Bernal Casasola, 2009 ; 2010 ; Bernal Casasola et Pérez Rivero, 1999 ; Bernal Casasola et al. 2012 ; Villada et al., 2011
6	ES	Cueva de Nerja	11		YES	Aura et al., 2001 ; Aura et Pérez, 1998
7	ES	Costa de Águilas	1		NA	Vargas Girón, 2013
8	ES	Mazarrón	11		NA	Vargas Girón, 2013 ; Vargas Girón, J. M., 2020
9	ES	El Capitán	5		NA	Vargas Girón, 2013
9	ES	Escolletes, Pudrimel	1		NA	Vargas Girón, 2013
9	ES	Escombreras	52		NA	Pinedo, 2004 ; Vargas Girón, 2013 ; Vargas Girón, J. M., 2020
9	ES	Las Amoladeras	6		NA	Miñano, 2006 ; Vargas Girón, 2013
9	ES	Teatro romano de Cartagena	6		NA	Vizcaino, 2005
10	ES	La Fonteta	60		YES	Prats, 2010

10	ES	Santa Pola	1		NA	Vargas Girón (Ed.), 2020
11	ES	Foia de Santa María	1		NA	Vargas Girón (Ed.), 2020
11	ES	Illeta dels Banyets	16		NA	Vargas Girón (Ed.), 2020
11	ES	La Albufereta	54	+	NA	Alfaro Giner, 2010 ; 2007 ; Bernal Casasola, 2007 ; Bernal Casasola, 2010 ; Rubio Gomis, 1986 ; Vargas Girón (Ed.), 2020
11	ES	Tossal de Manises	24		NA	Figueras Pacheco, 1971 ; Vargas Girón (Ed.), 2020
12	ES	Tossal de la Cala	84		NA	Bayo, 2010 ; García Hernández, 1986 ; Vargas Girón (Ed.) 2020
13	ES	El Pla	16		NA	Aparicio Pérez et Climente Mano, 1985
14	ES	Banys de la Reina	1		NA	González, Ronda et Menéndez, 2009
14	ES	Cueva del Montgó	1		NA	Vargas Girón (Ed.), 2020
15	ES	Cala Olivera	7		NA	Alfaro Giner, 2010
16	ES	Barcino	21		NA	Beltrán de Heredia Bercero, 2007
17	ES	Cala Culip IV	5		NA	Arévalo et al., 2004 ; Nieto Prieto et al., 1989
17	ES	Cala Culip VIII	1		NA	Carreras et al., 2004
18	FR	Port Vendres I	2		NA	Parker, 1992
18	FR	Port Vendres II	5		NA	Parker, 1992
19	FR	Grotte des Fées, Leucate	17		NA	Vigié-Chevalier, 1992
19	FR	Ilôt Corrège, Leucate	7		YES	Vigié-Chevalier, 1992
19	FR	Salses		+	NA	Feugère, 1994
20	FR	Grotte de la Hache, Narbonne	1		NA	Vigié-Chevalier, 1992
20	FR	Station des Valentines, Ouveillan	1		NA	Vigié-Chevalier, 1992
21	FR	Lattara	76		YES	Feugère, 1994 ; Py, 1990
21	FR	Station de la Madeleine, Villeneuve-lès-Maguelone	1		NA	Vigié-Chevalier, 1992
22	FR	La Ramasse - Clermont l'Hérault	4		NA	Feugère, 1994
22	FR	Sept-Fonts, Saint-Pons-de-Mauchiens	1		NA	Feugère, 1994
23	FR	Espeyran, Saint-Gilles-du-Gard	1		NA	Feugère, 1994
24	FR	Abri Cornille-Sulauze		+	NA	Vigié-Chevalier, 1992
24	FR	Grand Abri de Chateauneuf-les-Martigues	2	+	YES	Vigié-Chevalier, 1992
24	FR	Ile, Martigues		+	YES	Vigié-Chevalier, 1992
24	FR	La Baume Longue, Ponteau, Martigues		+	NA	Vigié-Chevalier, 1992

24	FR	Salins de Ferrières, Martigues	2		NA	Vigié-Chevalier, 1992
24	FR	Station Collet-Redon	20		YES	Vigié-Chevalier, 1992
25	FR	Grotte du Puits Segond	1		NA	Vigié-Chevalier, 1992
25	FR	Le Grand Congloué	1	+	NA	Cleyet-Merle, 1990 ; Joncheray, 1975
26	FR	Les Ferrages, Signes	3		NA	Navarro, 2024
27	FR	Olbia, Var	28		YES	Daveau et al., 2007 ; Bats et al., 2001
28	FR	Cap Camarat B		+	NA	Beltrame, 2002
28	FR	Cap Lardier 4	25		NA	Beltrame, 2002
28	FR	Cavalière	18		YES	Charlin, Gassend et Lequément, 1978
28	FR	Heraclea Caccabaria	19		NA	Dumont et al., 2009
28	FR	Le Titan, Île du Levant, Hyères		+	NA	Parker, 1992
29	FR	Chrétienne C	3		NA	Joncheray, 1975
29	FR	Chrétienne M	13		NA	Joncheray, 2002
29	FR	Dramont G	1		NA	Joncheray, 1987
30	FR	Port d'Antipolis, le Pré aux Pêcheurs	28		NA	Daveau, 2019
31	IT	Grotta della Arene Candide	3		YES	Tiné (Ed.), 1999
31	IT	San Antonino di Perti	18		NA	De Vingo et Fossati, 2001
32	IT	Altinum	35	+	NA	Universita di Bologna, 2026
33	IT	Iulia Felix shipwreck		+	YES	Beltrame, 2002
34	IT	Fortuna Maris	54		NA	Rossi, 1990
34	IT	Valle Ponti		+	NA	Parker, 1992
35	IT	San Rossore	3	+	NA	Camilli et al., 2006 ; Grandinetti, 2000 ; Gatto, 2023
36	FR	Marine de Meria	1		NA	Grizeaud, 2024
37	IT	Castiglione		+	NA	Angle et Guidi, 2007
38	IT	Giglio	6		NA	Bound, 1991
39	FR	Palazzi	1		NA	Chapon et Ben Chaba, 2011
40	FR	Porto-Vecchio	111		NA	Feugère, 1994
41	FR	Cavallo	1		YES	Beltrame, 2002
42	IT	Sa Osa	32		YES	Depalmas et Di Gennaro, 2015
43	IT	Cronicario	1		YES	Pompianu, 2008
44	IT	Villagio delle Macine		+	NA	Angle et Guidi, 2007
45	IT	Grotta dell'Uzzo	9		YES	Tagliacozzo, 1993
46	IT	Asciutta (Villa Regina), Pompeii	41	+	NA	Stefani, 1990
			4			

46	IT	Herculaneum		+	NA	Bernal Casasola, 2010 ; Deiss, 1995 ; Stefani, 1990
46	IT	Insula Occidentalis, Pompeii	1		NA	Stefani, 1990
46	IT	Maison du Grand Hôtel, Pompei	120		NA	Surintendance Pompéi, 2015
46	IT	Pompei	12		YES	Stefani, 1990
47	IT	Punta Chiarito		+	NA	Alecu, 2005 ; Giardino et Zappatore, 2022
47	IT	Punta D'Alaca	2		YES	Giardino et Zappatore, 2022
48	IT	Malophoros di Selinunte	1		NA	Gabrici, 1928
49	IT	Gela	3		NA	Panvini, 2001
49	IT	Gela II	1		NA	Panvini, 2001
50	IT	Portopalo	3		YES	Vargas Girón et al., 2021
50	IT	Vendicari	4		NA	Vargas Girón, Bernal Casasola et Mazzaglia, 2021
51	IT	Locri Epizephyrii	10		NA	Barra Bagnasco, Dotta et Lattanzi, 1989
52	IT	Grotta della Cala	2		NA	De Grossi Mazzorin et Rugge, 2009
53	IT	Grotta di Latronico, Potenza		+	NA	Cremonesi, 1978
54	IT	Passo di Corvo	1	+	NA	Isetti, 1983
55	IT	Eraclea		+	YES	Hänsel, 1973
56	IT	Laterza	2		NA	Biancofiore, 1967
57	IT	Scamuso	5		YES	Biancofiore et Coppola, 1997
58	IT	Scoglio del Tonno	1		NA	Giardino et Zappatore, 2022
59	IT	Egnazia	8	+	YES	Giardino et Zappatore, 2022
59	IT	Piazza Palmieri	1		YES	Wilkens, 1998
60	IT	Le Pazze di Ugento, Lecce	1	+	NA	Bianco, 1980
61	IT	Grotta Porcinara	1		NA	D'Andria, 1978
62	IT	Carpignano Salentino (Lecce)	1		NA	De Grossi Mazzorin et Rugge, 2009
62	IT	Castro	2		NA	Giardino et Zappatore, 2022
62	IT	Grotta Dei Cervi, Porto Badisco		+	NA	Giardino et Zappatore, 2022
62	IT	Grotta Zinzulusa, Castro	1		NA	Giardino et Zappatore, 2022
62	IT	Roca Vecchia	17		NA	Scarano, 2012
62	IT	San Foca		+	NA	D'Andria, 1980
63	IT	Punta le Terrare	1		YES	Wilkens B, 1998
63	IT	Punta Patedda		+	NA	Parker, 1992