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FROM PAPER TO DATA: A GEOREFERENCED LIST OF PREHISTORIC PERSONAL ORNAMENTS OF BIOLOGICAL ORIGIN FROM THE ITALIAN ARCHAEOLOGICAL RECORD

Abstract: Personal ornaments can be broadly defined as objects that hold and display information about the wearer and their social group. These artefacts are therefore fundamental when reconstructing past human behavior and culture, and their evolution through space and time. Unfortunately, there is no unique repository for data on archaeological ornaments. Furthermore, the information is typically published in scientific articles or grey literature that are written in the local language and are often only available in print (or as scanned copies), making them difficult to locate. Moreover, publications often report information with different degrees of detail, depending on the focus of the work. Extracting information from the literature and translating it into open and accessible data enables scientific research to advance more rapidly and effectively. Here we screened a range of publications available online containing information about personal ornaments from Palaeolithic, Mesolithic and Neolithic sites in Italy. We extracted published data on geographical location, geochronology, archaeological context, raw material, genus, class, species, anatomical district (if possible), type of ornament, and state of preservation. We then georeferenced our database using a GIS software and produced maps. Our aim was to create an online open access spatial database of personal ornaments, which can be consulted, edited and updated by other researchers, so that, in future, current representation and sampling biases can be corrected. Our work represents a first step towards a more normalised and data-rich approach to the analysis of personal ornaments.

Keywords: Personal Ornaments, Italian Prehistory, Biological Materials, Database, Open Data.

1. Introduction

The analysis of material culture in the archaeological record offers important insights into the minds that produced it. Here we are especially concerned with personal ornaments, defined as "objects used to display information concerning personal or social identity", e.g. group affiliation, age, gender, personal achievements, and wealth of the wearer (Paulsen, 1974; Taborin, 1974, 1993, 2004; Trubitt, 2003; Bar-Yosef Mayer, 2005; Borrello, 2005a; Borrello & Micheli, 2005; Vanhaeren & d'Errico, 2006; Kuhn & Stiner, 2007; Giacobini, 2007; Bonnardin, 2009; Zilhão et al., 2010; Ifantidis & Nikolaidou, 2011; Micheli, 2012; Cuozzo & Guidi, 2013; Borrello, 2015; Langley, 2015; Bar-Yosef Mayer et al., 2017; Coolidge & Wynn, 2009/2018; Baysal, 2019; d'Errico et al., 2020).

While research on personal ornaments in archaeology began in the 20th century (Beck, 1928) and has been especially fruitful with regard to typological studies, these objects have become the focus of renewed attention in the last two decades, especially for the period encompassing the emergence of *Homo sapiens* and the final stages of the evolution of other human groups (e.g. Neanderthals). This is because ornaments have been considered as proxies of behavioural modernity, and thus used in order to gain insights into the cognitive evolution of people (Bouzouggar et al., 2007; d'Errico et al., 2005, 2020; Botha, 2008; Coolidge & Wynn, 2009/2018). Furthermore, hundreds of European Upper Palaeolithic sites yielded personal ornaments, which could be catalogued and considered as a proxy for ethno-linguistic groupings (Vanhaeren & d'Errico, 2006). From the Mesolithic onwards there was a gradual change in the type of ornaments produced, but it is with the Neolithic that a veritable shift occurred in ornament-making practices. This has been studied by many authors, but here we highlight the methodological work of Rigaud and colleagues (Rigaud et al., 2015, 2018). They collected a georeferenced database of published data on personal ornaments in Europe, spanning from the Early Mesolithic to the Final Early Neolithic, and performed a range of statistical analyses. Their study confirmed diachronic and geographic variations in the manufacture and use of personal ornaments in the continent. More importantly, their work highlighted that large sets of archaeological data on personal ornaments can be used to infer ancient human behaviour and cultural affinities. Using a similar approach Windler (2019) pooled, homogenised and published an open dataset of *Spondylus gaederopus* shell ornaments containing more than 8037 artefacts dated to between 5500 and 5000 BC.

Overall, recent reviews on personal ornaments have emphasised the importance of gathering and normalising data that are scattered across several publications, many of which are written in the local language and thus not readily available for a non-native speaker audience, or older articles which are not available in digital format. Furthermore, data that are presented in tables in pdf documents are not editable or usable directly, they need to be transformed. This may seem a trivial issue, but this process of "datafication" is the first step towards a better appreciation of diachronic and macro-regional patterns.

The aim of this article is therefore to create an open spatial dataset of personal ornaments from Palaeolithic, Mesolithic and Neolithic sites in Italy, drawing from different published sources, both Italian and international, which we hope will facilitate future analysis.

2. Materials and methods

2.1 Definition and boundaries

Personal ornaments are intended here as any "small, durable, and portable items made of various materials (i.e. organic materials, fig.1, e.g. bone, or inorganic, e.g. stone and clay) that could be stringed and displayed on the body or attached to clothing (i.e., beads, pendants, bracelets, plaques, rings, buttons)" (Langley, 2015).

Given the enormous scope of the subject and the different levels of information contained in the bibliography (Dataset; "References" datasheet), we have defined several boundaries:

- Only on-line publications were considered (due to the ongoing COVID-19 pandemic which prevented us from accessing archives and libraries).
- Only ornaments made of organic raw materials (more specifically, biominerals), i.e. bone, claw, coral, mollusc shell (freshwater/marine), tooth, antler, ivory were included (a selection of these materials is shown in fig. 1). This choice was dictated by the recognition of an urgent need to reassess many of these objects with regard to their biological origin (taxonomic identification), also using scientific analytical methods, in order to gain insights into the materiality of the artefacts and to contribute to the reconstruction of their biographies (Demarchi et al., 2014; von Holstein et al., 2014; Micheli & Bernardini,

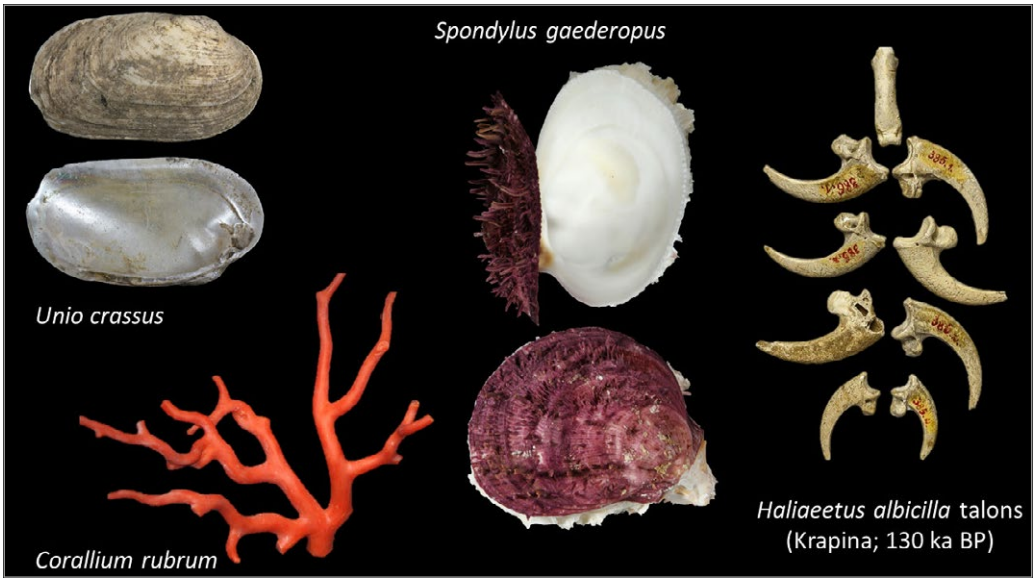

fig. 1. Examples of raw materials of biological origin used to make ornaments during prehistory. Image credits and sources: Jérôme Thomas, Biogéosciences, UMR CNRS 6282, University of Burgundy-Franche-Comté (*Spondylus gaederopus*, *Unio crassus*). *Corallium rubrum*, adapted from: *Corallium rubrum* (Linnaeus, 1758) – red coral (Field Museum of Natural History, Chicago, Illinois, USA, James St. John, CC BY 2.0). *Haliaeetus albicilla* talons from Krapina, reproduced from: Radovčić D, Sršen AO, Radovčić J, Frayer DW (2015): "Evidence for Neandertal Jewelry: Modified White-Tailed Eagle Claws at Krapina." PLoS ONE 10(3): e0119802. doi:10.1371/journal.pone.0119802, Luka Mjeda, Zagreb, CC BY 4.0.

2018; McGrath et al., 2019; Sakalauskaite et al., 2019). In this phase of the work we did not include any inorganic raw materials, but this will be considered in the future. For example, Martínez-Sevilla et al. (2021) recently published an overview of Neolithic stone bracelets from the Mediterranean basin. Their database could be merged with the one described here.

- The sites considered here span the period between the end of the Middle Palaeolithic (~49 ka BP) and the full Neolithic. Items from Copper, Bronze or Iron Age sites were not included at this stage.
- We are aware of the fundamental importance of typology when organizing a research database; however, we could not carry out a reassessment of the materials, as it was beyond the scope of this work. Therefore, we chose to report the typology originally assigned by the authors of the source papers.

2.2 Creation of the Database

A total of 106 archaeological sites (fig. 2) were included in the database. We started by extracting the data from reviews and systematic work on personal ornaments conducted in the past twenty years by authors such as Maria Angelica Borrello and Roberto Micheli. We further expanded the search using online search engines (e.g. *Google Scholar*) and repositories widely used by archaeologists to store their publications, such as *Researchgate* and Academia.edu. The published works include scientific reviews, manuals, annual reports, doctoral and master's dissertations, monographs and conference proceedings (all online). In total, 224 publications were consulted (listed in the "References" tab of the "Database_Italian_Prehistoric_Ornaments").

Geographical coordinates (latitude and longitude of the archaeological site, or, if not available, of the center of the municipality) as well as administrative Region and Province, were

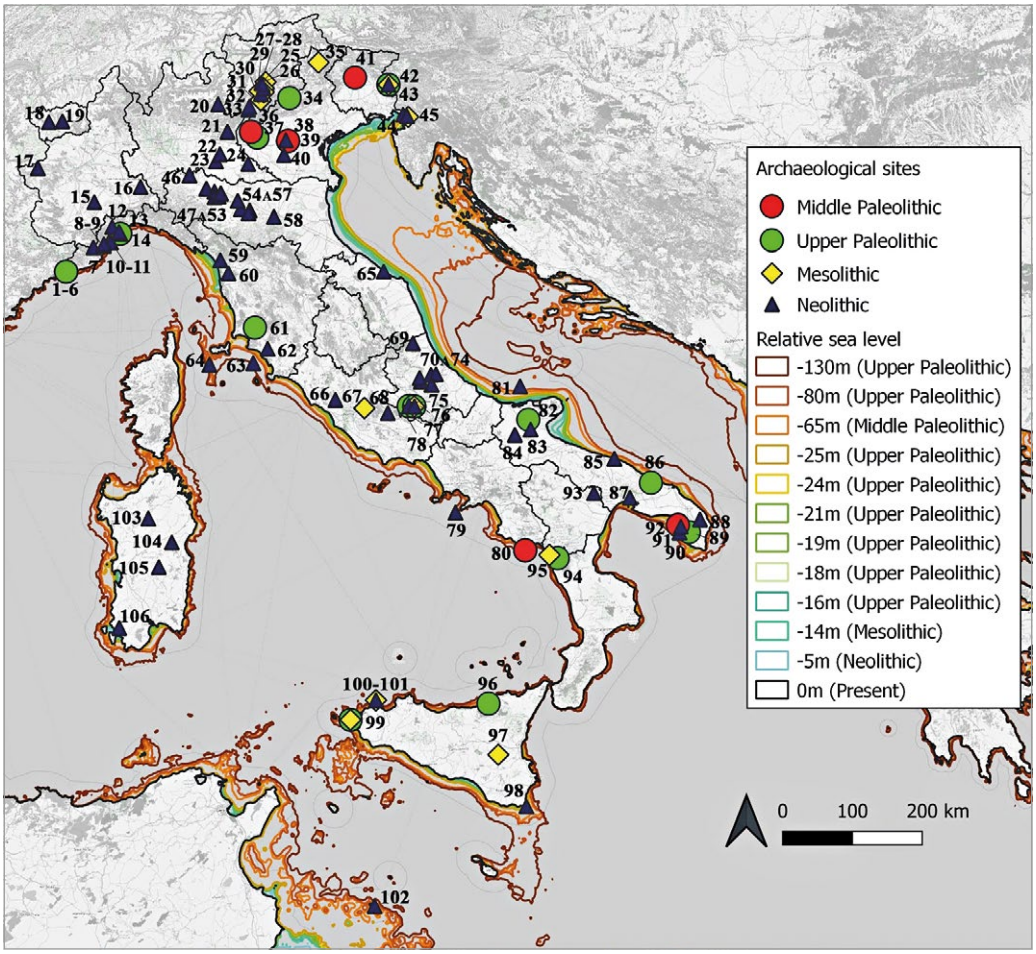

fig. 2. Map of Italian archaeological sites included in the spatial database; distribution of the ornaments according to broad time periods: Middle/Upper Palaeolithic, Mesolithic, Neolithic. Link to the full database: tinyurl.com/bdz7a4fc. Sea level data from Zickel et al. (2016). LIST OF SITES: Liguria: 1-6 Balzi Rossi (Barma Grande, Balzo della Torre, Caviglione, Riparo Mochi, Riparo Bombrini, Grotta dei Fanciulli); 7 Arma dello Stefanin; 8-9 Caverna di San Pietrino, Tana della Colombina; 10-11 Arma delle Anime e Grotta Pollera; 12 Grotta Mandurea; 13 Grotta del Galluzzo; 14 Arene Candide. Piemonte: 15 Alba; 16 Tortona, Corso Romita; 17 La Maddalena, Chiomonte. Val d'Aosta: 18 S. Nicolas Arvier; 19 Vollein. Lombardia: 20 Castel di Breno; 21 Monte Covolo; 22 Cascina Bocche; 23 Ostiano-Dugali-Alti; 24 San Giorgio, via Raffaello. Trentino: 25 Galgenbühel/Dos de la Forca; 26 Borgonuovo; 27-28 Riparo Pradestel, Bus de la Vecia; 29 Riparo Gaban; 30 La Vela; 31 Romagnano Loc III; 32-33 Riparo di Molletta Patone, Riva del Garda via Brione; 34 Riparo Dalmeri. Veneto: 35 Mondeval de Sora; 36 Grotta di Fumane; 37 Riparo Tagliente; 38 Riparo Broion; 39 Molino Casarotto; 40 Ca' Bissara. Friuli Venezia Gliulia: 41 Rio Secco; 42 Riparo Biarzo; 43 Caverna dell'Orso; 44 Grotta degli Zingari; 45 Grotta dei Ciclami. Emilia Romagna: 46 Le Mose; 47-48-49-50-51-52-53 Ponte Ghiara, Ponte Taro, Parma-Benefizio, via Guidorossi, Botteghino, Gaione, Collecchio; 54-55-56-57 Rivaltella, Chiozza, Cave Gazzuoli, Fornaci Carani; 58 Casalecchio di Reno. Toscana: 59 Grotta all'Onda; 60 Grotta del Leone; 61 Grotta di Vado all'Arancio; 62 Grotta del Frontino; 63 La Scola; 64 Cala Giovanna Piano. Marche: 65 Ripabianca di Monterado. Lazio: 66 La Marmotta; 67 Grotta Polesini; 68 Grotta Mora Cavorso. Abruzzo: 69 Grotta Sant'Angelo; 70-71-72-73-74 Villa Badessa, Catignano, Grotta delle Marmitte, Capo d'Acqua, Grotta dei Piccioni; 75 Santo Stefano; 76 Grotta di Pozzo; 77 Grotta Continenza; 78 Grotta La Punta. Campania: 79 Grotta delle Felci; 80 Grotta della Cala. Puglia: 81 Cala Tramontana; 82 Grotta Paglicci, 83 Passo di Corvo; 84 Ripa Tetta; 85 Scamuso; 86 Santa Maria di Agnano, 87 Grotta di Sant'Angelo di Statte; 88 Carpignano Salentino; 89 Grotta delle Veneri; 90 Grotta del Fico; 91 Torre Sabea; 92 Grotta del Cavallo. Basilicata: 93 Trasano. Calabria: 94 Grotta del Romito; 95 Grotta del Santuario della Madonna. Sicilia: 96 Grotta di San Teodoro; 97 Perriere Sottano; 98 Vulpiglia; 99 Grotta d'Oriente; 100-101 Isolidda, Grotta dell'Uzzo; 102 Cala Pisana. Sardegna: 103 Grotta Bariles; 104 Grotta Rifugio; 105 Belvì-Pitzu-Pranu; 106 Riparo Su Carroppu.

TAXONOMY FROM PUBLICATIONS		REVISED TAXONOMY (source: WoRMS)	
GENUS	SPECIES	GENUS	SPECIES
Astralium	*rugosus*	*Bolma*	*rugosa*
Cardium	*tuberculatum*	*Acanthocardia*	*tuberculata*
Cassis	*undulata*	*Semicassis*	*undulata*
Conus	*mediterraneus*	*Conus*	*ventricosus*
Cyclope	*neritea*	*Tritia*	*neritea*
Cyclope sp.		*Tritia* sp.	
Cyclope	*donovani*	*Tritia*	*pellucida*
Cyclope	*pellucida*	*Tritia*	*pellucida*
Cypraea	*lurida*	*Luria*	*lurida*
Dentalium	*dentalis*	*Antalis*	*dentalis*
Glycymeris	*violacescens*	*Glycymeris*	*nummaria*
Mitra	*zonata*	*Episcomitra*	*zonata*
Monodonta	*turbinata*	*Phorcus*	*turbinatus*
Nassarius	*incrassatus*	*Tritia*	*incrassata*
Nassarius	*gibbosulus*	*Tritia*	*gibbosula*
Nassarius	*pygmaeus*	*Tritia*	*varicosa*
Nassarius	*mutabilis*	*Tritia*	*mutabilis*
Nassarius	*corniculus*	*Tritia*	*corniculum*
Neritula	*neriten*	*Tritia*	*neritea*
Pectunculus	*violascenses*	*Glycymeris*	*nummaria*
Pectunculus	*pilosus*	*Glycymeris*	*pilosa*
Pectunculus sp.		*Glycymeris* sp.	
Pisania	*maculosa*	*Pisania*	*striata*
Purpura	*haemastoma*	*Stramonita*	*haemastoma*
Radula sp.		*Lima* sp.	
Strombus	*bubonius*	*Thetystrombus*	*latus*
Triton	*nordiferus*	*Charonia*	*lampas*
Turritella	*communis*	*Turritellinella*	*tricarinata*

tab. 1. Revised taxonomy for molluscan shell species included in the database.

included for each site. For each item we recovered, wherever possible, the following information: archaeological context, type of context (open/close), raw material, geochronological information, layer, minimum number of individuals (MNI; when this was not specified in the publication we assumed a value ≥1), type of ornament ("ornament" was used to indicate a generic ornament for which a description was not available).

We included information on the archaeological culture of the site as reported in the sources we consulted. Only a few records are not associated with specific cultures, and this was due to the lack of stratigraphic information for some of the ornaments coming from older excavations. Whenever numerical age information was available, we decided to standardise it as follows:

- Wherever radiocarbon dates were available and had been published in the last 10 years (i.e. post 2010), we reported the dates as found in the article.
- If radiocarbon dates were published before 2010, we recalibrated them using OxCal 4.4 (https://c14.arch.ox.ac.uk/oxcal.html), calibration curve: IntCal13 (Reimer et al., 2013).
- Where dating information was not available for the context of the ornament, we used the dates for the whole site (recalibrated where needed).
- When more than one date was available (e.g. from multiple samples), we reported the minimum-maximum range.

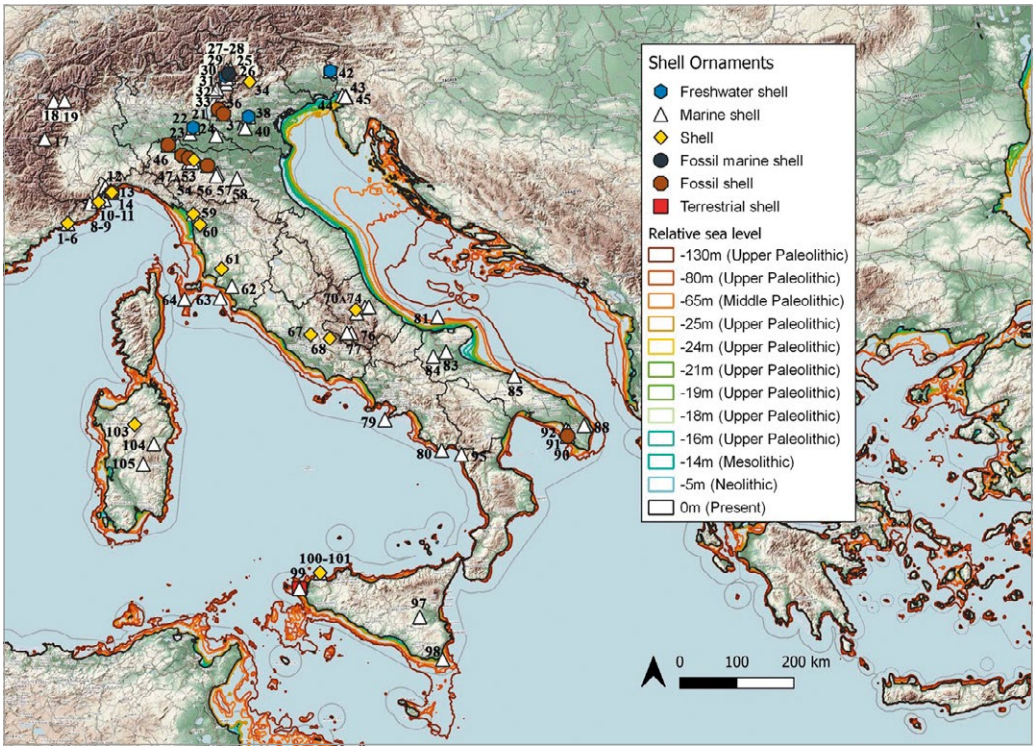

fig. 3A. Distribution of ornaments made of mollusc shell.

For items that were of animal origin (e.g. tooth, antler, bone, coral, shell) we reported information, i.e. class, genus, species and anatomical district, wherever available. We chose to follow the taxonomic nomenclature of the original publications in order to facilitate retrieval of the information from the literature. However, this may be obsolete and will need to be revised according to international standards, e.g. WoRMS-World Register of Marine Species (www.marinespecies.org; tab. 1). The identification of the raw material can be extremely complex and sometimes problematic, particularly for biological materials (Taborin, 2004; Borrello, 2005b; Dimitrijević & Tripković, 2006; Girod, 2015; Allen, 2017). Biomolecular methods (palaeogenomics, palaeoproteomics), have shown good potential for solving some of these debates (Demarchi et al., 2014; von Holstein et al., 2014; McGrath et al., 2019; Sakalauskaite et al., 2019, 2020) and the hope is that they will be applied in future to the rich corpus of materials from Italy. Here we simply reported the identification derived from the literature, highlighting that our database might become a starting point for re-evaluating some of these determinations.

Additional information recorded included: presence of ochre (either as "yes" or as the number of ornaments with traces of ochre, when this was reported by the original publication); presence of perforations (*Dentalium* shells were considered as naturally perforated). Wherever information was not available, we filled the field with "n.s." (not specified). The field "Notes" contains various information on specific/less frequently observed features of the ornaments. The presence of burning, striations, notches, incisions, cut-marks was also reported in the same "Notes" column, and not as a separate category despite their importance for reconstructing environmental, anthropogenic or taphonomic processes.

The georeferenced data were plotted using the open source QGIS 3.16.6 "Hannover" software. Geographical coordinates were reprojected onto cartographic coordinates. We used the UTM 32 N Datum WGS84 coordinate system. Vector layers for "Period" (Middle

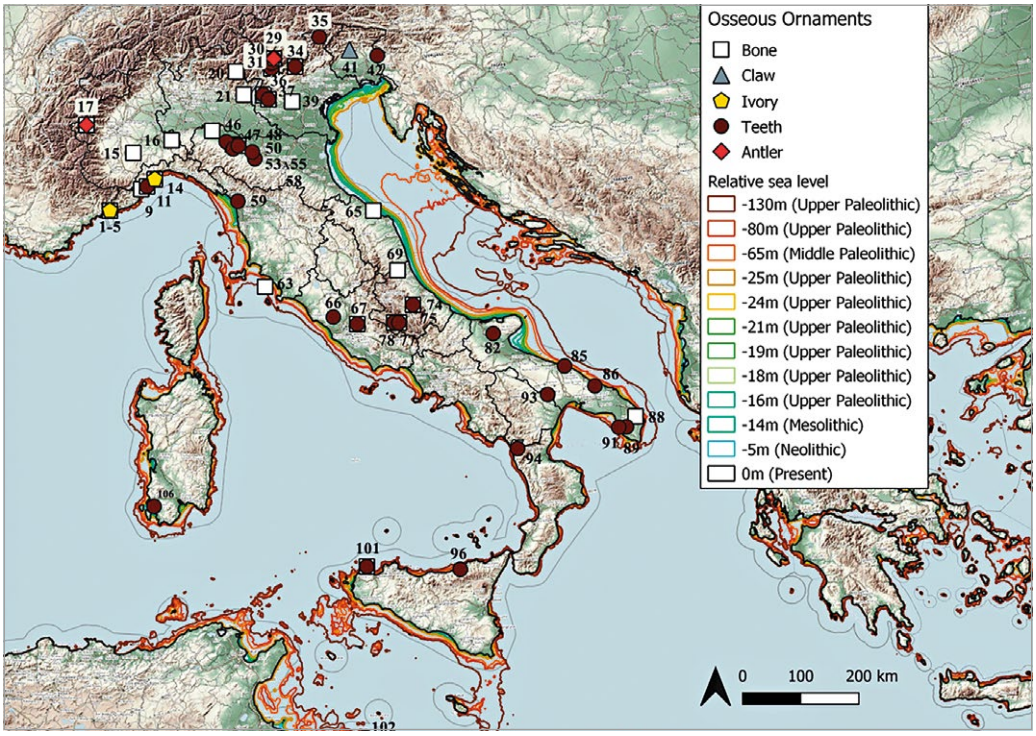

fig. 3. Distribution of ornaments made of bone/antler/tooth.

Palaeolithic, Upper Palaeolithic, Mesolithic, Neolithic) and "Material" (shell, bone, tooth, coral, ivory, fossil) were created and plotted on a map (fig. 3) which includes also palaeocoastline data from Zickel et al. (2016). The shapefiles of the layers and the complete database can be found in the dataset: Shapefiles_Italian Prehistoric_Ornaments.

3. Description of the dataset

The sites included in our pilot dataset are located throughout peninsular and insular Italy (figs. 2 and 3). Overall, we gathered information on 438 items. The complete database reporting the whole information for each site and item can be found in the dataset files: "Database_Italian_Prehistoric_Ornaments" and at the link tinyurl.com/bdz7a4fc The "References" tab includes the published literature on the ornaments, essential bibliography for the site, as well as any related articles which were used to obtain geochronological information.

From the analysis of the dataset it is possible to highlight several broad patterns, which have been extensively discussed in the literature, and which we summarise briefly:

For the Palaeolithic, the first reviewed evidence of personal ornaments dates back to the Late Mousterian; these are the bone remains of raptors (which were exploited in order to obtain claws and feathers) at Rio Secco and Grotta di Fumane (Peresani et al., 2011; Romandini et al., 2014; Fiore et al., 2016). The recent study by Arrighi et al. (2020) is an excellent example of the value of the analysis of ornaments of biological origins for gaining insights into transitional and/or early Upper Palaeolithic complexes.

Although limited data were available for the Mesolithic, in this period a predominant presence of red deer canine and *Columbella rustica* can be observed (Micheli, 2012). For the latter, Borrello & Dalmeri (2004) highlight the case of Romagnano Loc III in Trento with 76 specimens.

During the Neolithic 'traditional' as well as 'novel' types of raw materials were used to craft ornaments. An interesting pattern, pointed out by several authors (e.g. Borrello & Micheli, 2006), was that ornaments made of the Mediterranean bivalve *Spondylus* were widespread during the Neolithic in Central Europe, but were fairly rare in Italy. This was despite the proximity of the sites to the sea (i.e primary source of raw material). Nevertheless, one of the most famous specialised centers for the production of *Spondylus* artefacts was located in northern Italy, Arene Candide in Liguria (Borrello & Rossi, 2004). Coral is also found in Neolithic contexts: pendants can be found in different sites throughout Italy (Arene Candide, Grotta dei Piccioni, Carpignano Salentino, Grotta di Sant'Angelo di Statte) as well as in other Western Mediterranean countries and Switzerland (Borrello et al., 2012).

4. Conclusions and future perspectives

We set out to review the literature on prehistoric personal ornaments recovered from present-day Italy and were able to recover data for 106 sites, including geographical and geochronological information, context, raw material, presence of special features (e.g. ochre) and state of preservation. This has been done for archaeological sites covering a wide time span, from the Palaeolithic to the Neolithic. However, some areas have been the subject of more frequent and detailed archaeological investigation, thus introducing a bias in the distribution, quality and quantity of the data.

Despite the biases that affect our approach, the value of this database for the archaeological community is at least twofold. First, it will ultimately enable spatial analysis, which represents the basis for reconstructing exchange and supply networks. For example, a recent Master's dissertation (Capo, 2021) reports on the use of the QGIS 3.16.6 "Hannover" software to carry out kernel density estimation analyses on the distribution of the archaeological sites and of the personal ornaments and to calculate the distance between some categories of findings (e.g. *Spondylus gaederopus, Corallium rubrum*) and the nearest potential source (mapped using the Global Biodiversity Information Facility datasets). Secondly, it can be used to plan a diverse range of research projects (e.g., as mentioned above, a reassessment of the biological origin of these objects). Our hope is that users will also contribute to its expansion and to the normalisation of the data. Overall, we intend this work as a first step towards a more data-rich approach to the spatial analysis of personal ornaments.

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