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A Question of Size! The Importance of Marine Crabs in Food Remains from Mesolithic Fisher-Hunter-Gatherers at Beg-er-Vil (Quiberon, Morbihan, France)

Une question de taille ! L'importance des crabes marins dans les vestiges alimentaires des pêcheurs-chasseurs-cueilleurs de Beg-er-Vil (Quiberon, Morbihan, France)

Catherine Dupont, Yves Gruet, Mathis Arthur, Oriane Digard

Abstract: Mesolithic shell middens were excavated along European Atlantic coasts as early as the first half of the 19th century. At the end of the same century, researchers still showed little interest in the composition of these archaeological sites. While bones from mammals have been identified for this type of site, marine invertebrates have often been overlooked. A few short lines were dedicated to them in papers describing shell middens. The development of new disciplines in archaeology soon showed the limitations of past excavations. In fact, only the elements considered to be useful to the person in charge of the excavation have been preserved, such as flint, large mammal bones and ornaments, with an emphasis on burial components. Despite the sieving of sediments, past excavations yielded a very partial version of the food remains of these populations, where marine invertebrates are often the poor relations of the archaeozoological remains. In the 2000s, developments in sieving techniques combined with laboratory sorting made it possible to expand our vision of the diversity of marine and terrestrial resources exploited by these coastal populations. The visible minority, represented by crabs and other invertebrates, is now more commonly described in shell middens. On account of the high meat yield of crustaceans, they may even have been key components in the diet of coastal populations. Moreover, sieving and sorting of remains show that these shell middens are not homogeneous layers of shell. The example of the Beg-er-Vil shell midden shows that our vision of the way of life of fisher-hunter-gatherers along the European Atlantic coast depends on excavation techniques. The methods of excavation applied in the field have a direct impact on our description of the activities of these coastal populations. They were not solely focused on hunting large mammals.
Keywords: Fisher-hunter-gatherers, crab, crustacean, Mesolithic, seafood, diet, methodology, taphonomy, sieving.

Résumé : Des fouilles ont été menées dans les amas coquilliers dès la première moitié du XXe siècle le long de la côte atlantique européenne. Plus de 330 d'entre eux sont actuellement recensés pour le Mésolithique. Ils doivent leur conservation partielle à un ralentissement de l'augmentation du niveau de la mer. Pour le littoral atlantique français, les plus anciens datent d'il y a 8000 ans. L'intérêt pour la composition en coquillages de ces accumulations était encore peu développé à la fin du XXe siècle ; si une liste d'animaux était parfois publiée, les invertébrés marins y étaient souvent oubliés ou ne représentaient que quelques lignes dans les articles. Force est de constater qu'ils sont souvent associés à du sédiment au pH basique qui a permis la conservation des ossements. Par le passé, seuls les éléments jugés utiles à la fouille étaient conservés, comme les silex, les ossements de grands mammifères. L'hégémonie de la chasse aux grands gibiers et les valeurs qu'elle véhicule n'y sont sans doute pas étrangères. De même, les parures et éléments associés aux sépultures étaient privilégiés à la fouille. Ainsi, malgré le tamisage des sédiments, ces fouilles passées nous ont donné

une image très partielle des restes alimentaires de ces populations, où les invertébrés marins sont souvent les parents pauvres des vestiges archéozoologiques.
Le développement de nouvelles disciplines en archéologie a rapidement montré les limites de ces fouilles anciennes et les hiatus liés au choix des archéologues. Le retour sur le terrain dans les années 2000 a permis, grâce au tamisage combiné au tri en laboratoire, d'accroître notre vision de la diversité des ressources marines et terrestres exploitées par les populations côtières mésolithiques. Désormais, mollusques et crustacés accompagnent poissons, oiseaux et mammifères marins au côté des mammifères et oiseaux terrestres.
Une minorité visible a été conservée jusqu'à nous sous la forme de fragments de crabe mesurant moins de 1 cm. Souvent, un crabe consommé par ces populations mésolithiques se traduira, pour l'archéologue, par la découverte de minuscules fragments d'extrémités de doigts de pince. Le rendement élevé de ces crustacés – si le poids de leur squelette est considéré par rapport à celui de la chair qu'il fournit – pourrait pourtant en faire un des éléments clés de l'alimentation de ces peuples du bord de mer.
La question posée par cet article est de savoir si la méthode de prélèvement influe sur notre vision du mode de vie des populations mésolithiques. Pour y répondre, le site de Beg-er-Vil, localisé au nord-ouest de la France, sur la côte sud de la Bretagne, a été choisi. Dans les années 1980, O. Kayser avait fouillé cet amas. Il avait alors réalisé un tamisage à sec des sédiments de l'amas à 4 mm et avait stocké les refus de tamis dans des sacs en papier kraft. Lors de la reprise de l'étude de l'amas, dans les années 2000, ces refus ont été tamisés en laboratoire, à l'eau douce, sur des mailles de 5 mm et de 2 mm. Dans les années 2010, le site a été fouillé à nouveau, sous la responsabilité de G. Marchand et de C. Dupont. Avec leur équipe, ces derniers ont tamisé tout le sédiment à l'eau de mer, puis ils l'ont rincé à l'eau douce avec des tamis de 4 et de 2 mm. Le matériel de 1980 a subi un tamisage en laboratoire lors de la reprise de l'étude des composants de l'amas dans les années 2000. Il a été réalisé à l'eau douce sur des mailles de 5 et de 2 mm. Les crabes de ces différentes campagnes de fouille ont en partie été étudiés : ceux retenus sur la maille de 5 mm pour les fouilles des années 1980, avec un contrôle visuel de ce qui a été retenu sur la plus petite maille ; et l'intégralité des restes retenus sur les refus de tamis de 4 mm et de 2 mm pour les fouilles des années 2010. Les restes de crabe ont été décomptés suivant les méthodes classiques de l'archéozoologie : nombre de restes, nombre minimum d'individus et poids. Des reconstitutions de la largeur des carapaces ont aussi été réalisées. Cette étude met en évidence des interprétations différentes de l'exploitation du crabe par les derniers chasseurs-cueilleurs de la côte atlantique française en fonction de la maille de tamisage utilisée. La maille la plus fine permet de déterminer plus d'espèces. Les petites espèces ont clairement été évincées lors de l'analyse sur la maille de 5 mm. Au total sept espèces ont pu être déterminées : le dormeur ou tourteau *Cancer pagurus* Linnaeus, 1758, le crabe verruqueux *Eriphia verrucosa* (Forskål, 1775), le crabe vert *Carcinus maenas* (Linnaeus, 1758), l'étrille *Necora puber* (Linnaeus, 1767), le crabe enragé *Xantho* sp. (Leach, 1814), le crabe marbré *Pachygrapsus marmoratus* (J.C. Fabricius, 1787) et l'araignée de mer *Maja squinado* (Herbst, 1788). Cette diversité observée aussi sur les gabarits des crabes montre une exploitation de tous les individus accessibles sur l'estran, qu'ils soient grands ou petits. Le cas de l'araignée de mer mérite d'être souligné. En effet, de nos jours, cette espèce est généralement subtidale. Elle se rapproche des côtes lorsque l'eau de mer se réchauffe, actuellement à la fin du printemps. Elle a pu être pêchée à ce moment-là par les populations mésolithiques.
Les fragments de crabe prélevés en 2013 sur les tamis de 4 mm et de 2 mm ont été observés en fonction de la stratigraphie : ils montrent une conservation plus importante au cœur de l'amas. Les parties sommitales et basales de ce dernier semblent encore subir l'acidité du milieu. Ce résultat est intéressant et pourrait expliquer le fait que, dans les années 1980, certains doigts de crabe ont été isolés à vue à la fouille, à la différence des années 2010 où ces vestiges étaient tellement petits qu'ils n'ont pas été repérés lors la phase de terrain. Ils montrent que le système représenté par l'amas n'est sans doute pas stabilisé.
Quoi qu'il en soit, cette étude indique que les crabes doivent, comme tout artefact, être pris en compte. Ils permettent de décrire des activités liées à la mer, comme la pêche à pied sur estran et peut-être même l'exploitation des laisses de haute mer. Ils ont participé à la diversité des aliments consommés par ces populations et, par leur rendement, peuvent constituer des sources non négligeables de nourriture. Ainsi, malgré leur faible lisibilité et la petitesse des fragments conservés, les crabes méritent d'être considérés comme un autre indice du mode de vie des populations de pêcheurs-chasseurs-cueilleurs de nos côtes.
Mots-clés : pêcheurs chasseurs-cueilleurs, crabe, crustacé, Mésolithique, fruits de mer, alimentation, méthodologie, taphonomie, tamisage.

INTRODUCTION

Every year, new Mesolithic shell middens are discovered, excavated or re-studied (for example Gutiérrez-Zugasti et al., 2016; Finlay et al., 2019; Moe Astrup et al., 2021). To date, more than 330 of these Prehistoric shell middens have been recorded from northern Norway to southern Portugal (Dupont, 2016). New studies of material from older excavations are regularly undertaken (for example Moreno Nuño, 2017; Jackes et al., 2019). These are linked to variations in researchers' interests and to recent developments in archaeological disciplines (Dupont and Marchand, 2021). Thus, in the first half of the 20th century, most archaeologists tended to only consider lithics, human skeletons and ornaments. The other components of shell middens were considered as sediment or remains bereft of archaeological interest. It was not until the end of the century that publications began to take stock of the scientific interest of these archaeological sites and their components such as fish, mammals, birds, molluscs, crustaceans, charcoal and seeds (Dupont and Marchand, 2021). The example of north-western France and the shell middens of Téviec and Hoëdic excavated between 1928 and 1934 is telling in this regard. The first study of shell ornaments was not carried out there until 1971 (Taborin, 1971). Isotopic analyses of the human skeletons from these two necropolises (Schulting, 1996) and the study of the lithic industry (Marchand, 1999) cast new light on these shell accumulations, which are places of life and death of the last populations of fisher-hunter-gatherers along the French Atlantic coast. However, these two sites are no exception to the rule, as the first artefacts to be studied were ornaments, human skeletons, and lithics. The mammals, birds, crustaceans and molluscs collected by the Péquart couple in the middle of the 20th century had to wait until the beginning of the 21st century to be analysed and published. This newfound scientific impetus can now be observed along the European Atlantic coast (Gutiérrez-Zugasti et al., 2011). It is reflected in the adaptation of excavation techniques to the search for minute remains, less than a centimetre long (for example Dupont, 2006; Gutiérrez Zugasti, 2010 and 2011).

Among these remains, crabs are still given little consideration in archaeology despite the fact that they have been detected in at least 59 of the Mesolithic shell middens on the European Atlantic coast (fig. 1). This count is possible thanks to a database that lists all the published archaeological components of Mesolithic shell middens (for a succinct description of the database see Dupont, 2016). These listed crustaceans would therefore be present in 18% of known shell middens and a relationship can be established between their discovery and the application of sieving during excavation (Dupont and Gruet, 2022). However, this proportion should be treated with caution as it only takes into account published data. Only 47% of sites where crabs were identified give the name of one or more species (Dupont and Gruet, 2022). Only 20% of crab quantifications are published (Clark, 1971; Zilhão, 2000; Dupont and Gruet, 2005; Gutiérrez Zugasti, 2010; Pickard and Bonsall, 2009; Dupont et al., 2010; Dupont, 2011; Gutiérrez-Zugasti et al. 2016). The low proportion of crab presence in Mesolithic shell middens can be explained by several factors. Some fisher-hunter-gatherer populations may not have consumed these crustaceans, either because they were not accessible near the sites, or because populations chose not to consume these crabs despite their existence. It is also possible that the skeletal parts of consumed crabs were dissolved by taphonomic factors. Such factors may have led to the fragmentation of the entire crab exoskeleton. Like all archaeological remains, the study of crabs is dependent on the sampling techniques used during excavation. As with molluscs (Dupont and Marchand, 2021), the absence of sieving may have led to the erasure of exoskeletal remains of crabs from the archaeologist's regard.

These questions of the visibility of crabs in Mesolithic contexts is addressed using the example of the Beg-er-Vil site (Quiberon, France). Excavations were carried out in the 1980s under the direction of O. Kayser (1987) and then in the 2010s by G. Marchand and C. Dupont (Marchand et al., 2018). The fact that these two excavation phases were thirty years apart enables us to compare the effects of sieve meshes on the interpretations of crustacean selection on the seashore by the last fisher-hunter-gatherers of north-western France. The present article also gives us the opportunity to describe the complete methodology of the study of the Beg-er-Vil crabs, from their identification and quantification to the reconstitution of crab sizes fished by the Mesolithic populations.

1- MATERIALS AND METHODS USED ON THE BEG-ER-VIL CRABS

1.1- In the field

The Beg-er-Vil shell midden was identified in the 1970s in an eroded part of a cliff section (Kayser, 1987). This archaeological site was already eroding at that time, as it still is today (fig. 1). The midden's minimum surface area has been estimated at 130 m², but its original extent is not known (Dupont and Marchand, 2021). Its current thickness is 50 to 40 cm. This shell level is protected by a dune with a height of 0.5 to 2 m (Dupont and Marchand, 2021). The shell midden takes the form of a black organic layer comprised of concentrated waste from the daily life of the Mesolithic people who occupied the site (Dupont et al., 2009). The observed structures include pits, hearths and post holes delimiting one or even two presumed huts (Marchand et al. 2019). Most dates obtained for this level are from twigs or burnt fruit and fall within the same 7300-7200 BP range (uncalibrated; Marchand and Schulting, 2019).

Between 1985 and 1988, O. Kayser excavated 22 m² of the Beg-er-Vil shell midden (Kayser and Bernier, 1988; for a plan see Marchand et al., 2019). The excavation was carried out in arbitrary levels in the shell midden and pit infills were separated from the rest of the material. All the sediment was dry sieved with a 4-mm mesh. At the excavation, only the most significant artefacts were separated from the sieves (large faunal remains, burnt fruit, perforated shells and lithics). The rest of the sediment was stored in kraft paper bags.

A new excavation over an area of 350 m² was undertaken in the Beg-er-Vil site between 2012 and 2018 (Marchand et al., 2018). The aim was to excavate in detail not only the shell midden but also its periphery. As in the 1980s, the layer of shells was excavated in arbitrary horizontal levels and material from the structures was identified. All the sediment was sieved with seawater and then rinsed with fresh water on 4- and 2-mm square meshes. Systematic sampling of the sediment was also carried out to measure the acidity of the soil. Some elements were removed on sight during the excavation, such as armatures, macro tools and large faunal remains. Some of the sieved sediments were directly sorted dry during the excavation in a makeshift laboratory. All of the crab fragments were isolated from the small and large meshed sieves. They were then placed in bags for analysis.

1.2- In the laboratory

The material from O. Kayser's excavations in the 1980s was studied in the early 2000s. This material was sieved with fresh water on 5- and 1-mm meshes and sorted by C. Dupont (2006). Initially, only crabs from the 5-mm mesh were selected and analysed by Y. Gruet (2002). A quick visual check of the 1-mm sieved sediments was carried out. During this study in the early 2000s, the crab remains were not deemed to be very informative in relation to what was studied from the larger meshed sieve. Therefore, they were not sorted or analysed. The studied crabs from the 5-mm mesh correspond to about 8 m² of the shell midden for this phase of the excavation. They consist of some rare fragments of crabs collected on sight during the excavation, material from four quarters of a square metre (sub-squares: AE20B, AE23B, AF21B, AG23B) and from the infill of structures considered to be

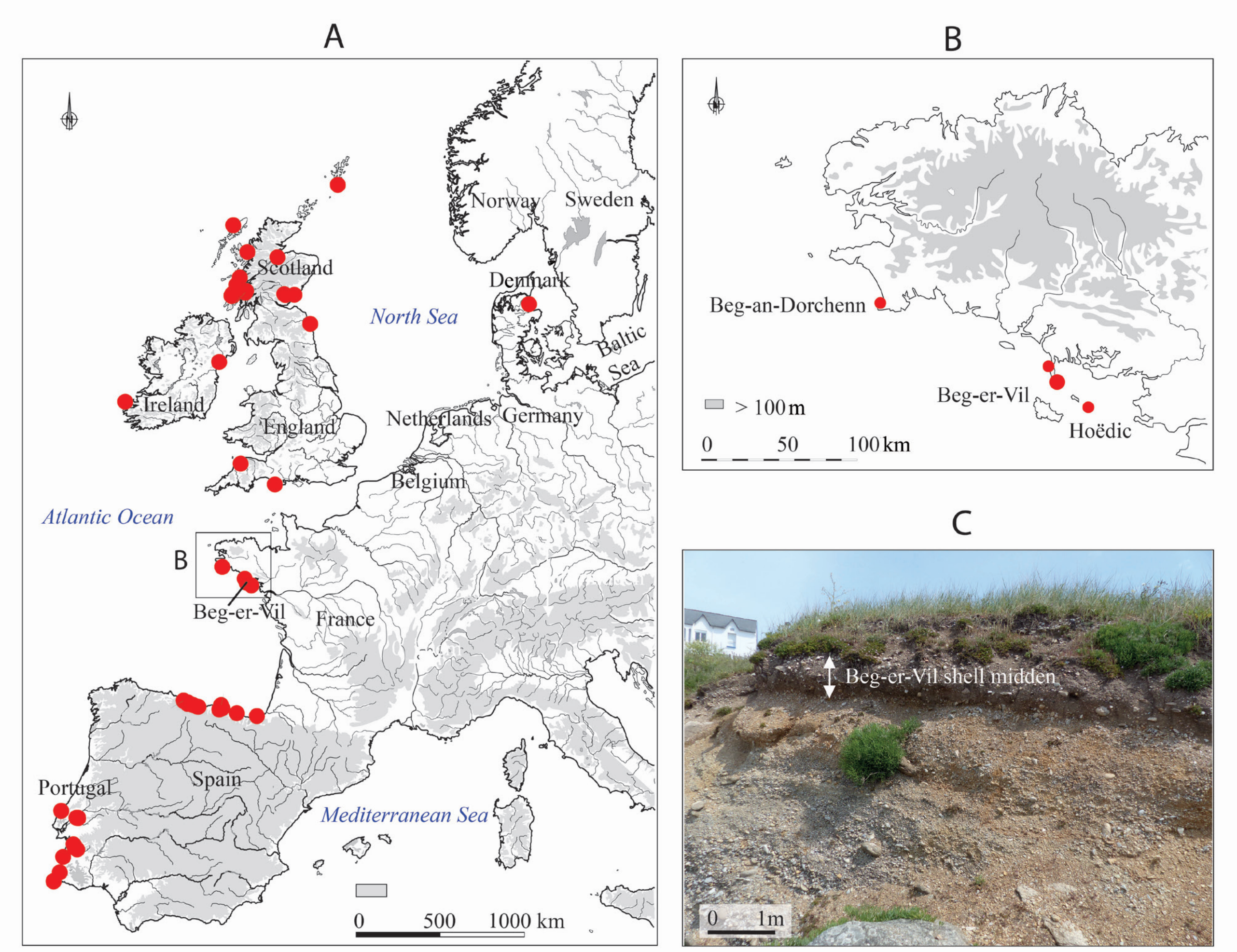

Fig. 1 – A. Distribution of Mesolithic shell-middens for which reports of crabs have been published and the quoted site locations (Grieve, 1874; Ribeiro, 1884; Anderson, 1898; Bishop, 1914; Péquart and Péquart, 1934; Stevenson, 1946; Péquart and Péquart, 1954; Roche, 1960 and 1965; Clark, 1971; Coles, 1971; Mellars, 1978; Woodman, 1978; González Morales, 1982; Lentacker, 1986; Ortea, 1986; Bell, 1987; Arnaud, 1989; Arias Cabal, 1991; Myers and Gourlay, 1991; Connock et al., 1993; Pollard et al., 1996; Tavares da Silva and Soares, 1997; Araújo, 1998; Woodman et al., 1999; Arnaud, 2000; Zilhão, 2000; Mannino et al., 2003; Melton and Nicholson, 2004; Dupont and Gruet, 2005; Bailey and Milner, 2007; Lubell et al., 2007; Zapata et al., 2007; Gutiérrez Zugasti, 2010; Valente, 2008; Milner, 2009; Pickard and Bonsall, 2009; Dupont et al., 2010; Iriate et al., 2010; Álvarez-Fernández, 2011; Dupont, 2011; Gutiérrez-Zugasti et al., 2016; Moreno Nuño, 2017; Evans, 2021; Araújo: unpublished for Vale Frade Portugal; CAD L. Quesnel and C. Dupont); B. Location of Beg-er-Vil (CAD G. Marchand, after Dupont et al., 2009); C. Eroded cliff showing Beg-er-Vil midden (Photo C. Dupont).

***Fig. 1** – A. Distribution des amas coquilliers du Mésolithique pour lesquels les crabes ont été publiés (Grieve, 1874; Ribeiro, 1884; Anderson, 1898; Bishop, 1914; Péquart et Péquart, 1934; Stevenson, 1946; Péquart et Péquart, 1954; Roche, 1960 et 1965; Clark, 1971; Coles, 1971; Mellars, 1978; Woodman, 1978; González Morales, 1982; Lentacker, 1986; Ortea, 1986; Bell, 1987; Arnaud, 1989; Arias Cabal, 1991; Myers and Gourlay, 1991; Connock et al., 1993; Pollard et al., 1996; Tavares da Silva and Soares, 1997; Araújo, 1998; Woodman et al., 1999; Arnaud, 2000; Zilhão, 2000; Mannino et al., 2003; Melton et Nicholson, 2004; Dupont et Gruet, 2005; Bailey et Milner, 2007; Lubell et al., 2007; Zapata et al., 2007; Gutiérrez Zugasti, 2010; Valente, 2008; Milner, 2009; Pickard et Bonsall, 2009; Dupont et al., 2010; Iriate et al., 2010; Álvarez-Fernández, 2011; Dupont, 2011; Gutiérrez-Zugasti et al., 2016; Moreno Nuño, 2017; Evans, 2021; pour Vale Frade, Portugal : Araújo, inédit; DAO L. Quesnel et C. Dupont); B. Localisation de Beg-er-Vil (DAO G. Marchand, d'après Dupont et al., 2009); C. Falaise en phase d'érosion montrant Beg-er-Vil (cliché C. Dupont).*

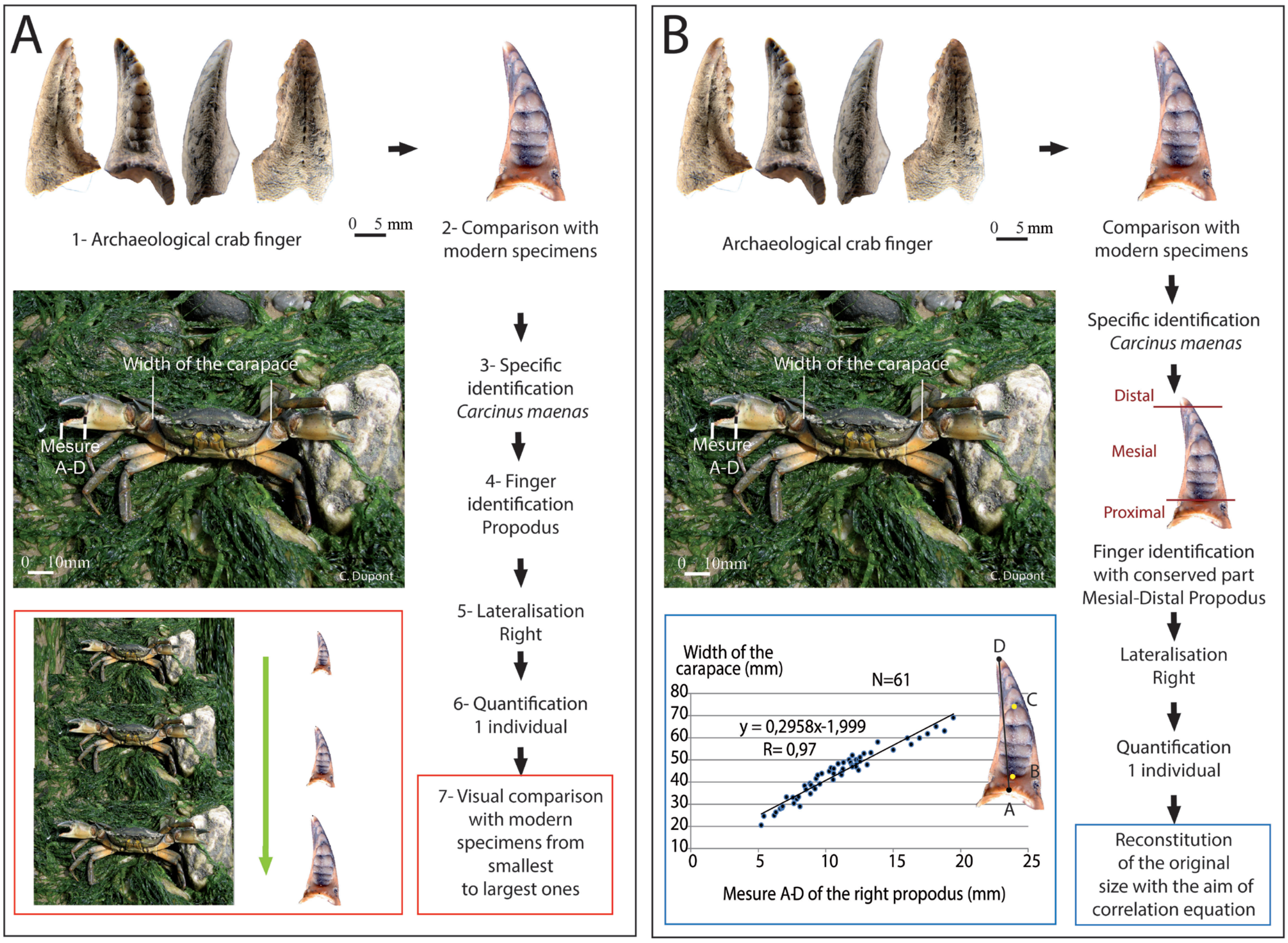

Fig. 2 – Method applied to archaeological remains of crabs on Beg-er-Vil, 1985-1988 (A); Beg-er-Vil, 2013 (B; photos and CAD: C. Dupont).

***Fig. 2** – Méthodologie appliquée aux restes archéologiques de Beg-er-Vil 1985-1988 (A) ; Beg-er-Vil 2013 (B ; clichés et DAO C. Dupont).*

anthropogenic (sub-squares: AE20-21, AE22-23/St87-5, AF20/St87-6, AG20- AG21/St87-7).

The material from the excavations of G. Marchand and C. Dupont in the 2010s was sorted in the field and during post-excavation sorting sessions. All the crustacean fragments retained on the 4- and 2-mm meshes were selected. For this study, only part of the crab remains from the 2012 excavation were taken into account. These were analysed by O. Digard and C. Dupont in 2019 and correspond to 2 m² of the midden (squares BB33 and BB35). All of the remains from 2013 were analysed by M. Arthur and C. Dupont in 2018. These correspond to an opened area of 44 m² (Marchand and Dupont, 2014).

1.2.1- Identification

All the crab fragments were counted from the 5-mm mesh for the 1980s material and on 2- and 4-mm meshes for the 2010s material. We summarise the various stages of our analyses once the crab appendages were extracted from sieved sediments in figure 2. These fingers were then compared with a comparative collection of modern crabs[(1)] for the purposes of determination (fig. 3). These determinations were based on the general shape of the appendages, the texture of their surface (smooth, granular, porosity, presence of grooves), and the shape and size of the different teeth that adorn the inside of the claw (fig. 3, Right). The scientific names used were taken from the DORIS database[(2)].

1.2.2- Quantification

Once determined, the appendages were identified as either dactyls or propodi (fig. 2). All the elements mentioned above were used for determining species. The orientation of fragments was proposed for the 2012 and 2013 material based on the natural position of the finger on an individual (fig. 2B). The proximal part of a dactyl or a propodus is the area closest to the body, their distal part is the furthest away and the mesial part is intermediate. The dactyls and propodi were then lateralised. The MNI (Minimal Number of Individuals) was obtained from the number of right and left dactyls and propodi.

All the crab exoskeleton fragments were also weighed as is common practice in archaeology. Weight is a value that can be compared to other artefacts and that can be used to judge the degree of preservation of faunal remains.

1.2.3- Size reconstruction

After quantifying the crabs, we sought to estimate the original size of the carapaces. This reconstruction was carried out using two methods. On the material from the 1980s, we made a visual comparison of the sizes of finger fragments from Beg-er-Vil with fingers from the modern comparative collection. Modern appendages were classified from the smallest to the largest to facilitate this stage of the study. This visual comparison was conducted on *Cancer pagurus, Eriphia verrucosa, Necora puber* and *Carcinus maenas*. On the 2012 material, comparative equations were used to reconstruct the dimensions of the *Cancer pagurus* crabs (fig. 4). These equations were calculated from the comparative collection (fig. 4). They show significant correlations of more than 90% between finger measurements (fig. 4 A-2 and B-2) and the width of the crab. The time available for this study did not allow us to reconstruct templates for the other species in the 2010 material.

2- BEG-ER-VIL CRABS

2.1- Stratigraphy and fragmentation

The archaeological material from 2013 corresponds to the analysis of two square metres (BB33 and BB35) located in the heart of the midden (Marchand et al., 2019). These are both adjacent to O. Kayser's survey, which may have accelerated the deterioration of archaeological remains, as observed at Beg-an-Dorchenn (Dupont et al., 2010). Crab fragments between 2 and 4 mm are

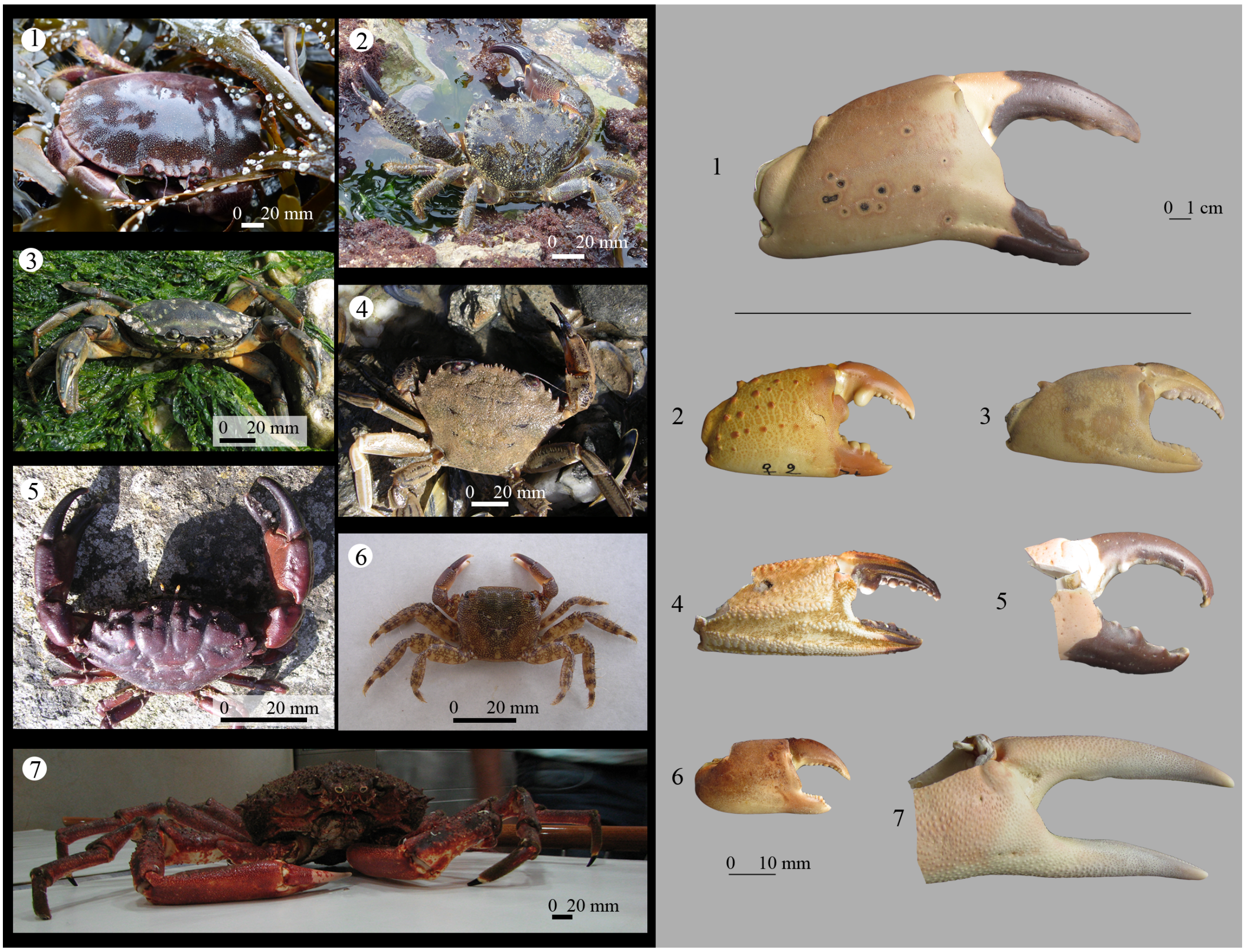

Fig. 3 – Modern crabs from the reference collection: Left, complete specimens; Right, right pincers: Edible crab *Cancer pagurus* (1); Warty crab *Eriphia verrucosa* (2); Green crab *Carcinus maenas* (3); Velvet swimming crab *Necora puber* (4); Furrowed crab *Xantho* sp. (5); Marbled rock crab *Pachygrapsus marmoratus* (6); Spider crab *Maja squinado* (7; right: Photos 1, 2, 3 and 7 C. Dupont; photos 4 to 6 Y. Gruet; left: Photos M. Arthur; CAD C. Dupont).

Fig. 3 *– Les crabes modernes de la collection de comparaison : à gauche, spécimens complets ; à droite, pince droite : Crabe dormeur* Cancer pagurus *(1) ; Crabe verruqueux* Eriphia verrucosa *(2) ; Crabe vert* Carcinus maenas *(3) ; Étrille* Necora puber *(4) ; Xanthe* Xantho *sp. (5) ; Crabe marbré* Pachygrapsus marmoratus *(6) ; Araignée de mer* Maja squinado *(7 ; à droite : clichés 1, 2, 3 et 7 C. Dupont, clichés 4 à 6 Y. Gruet ; à gauche : clichés M. Arthur ; DAO C. Dupont).*

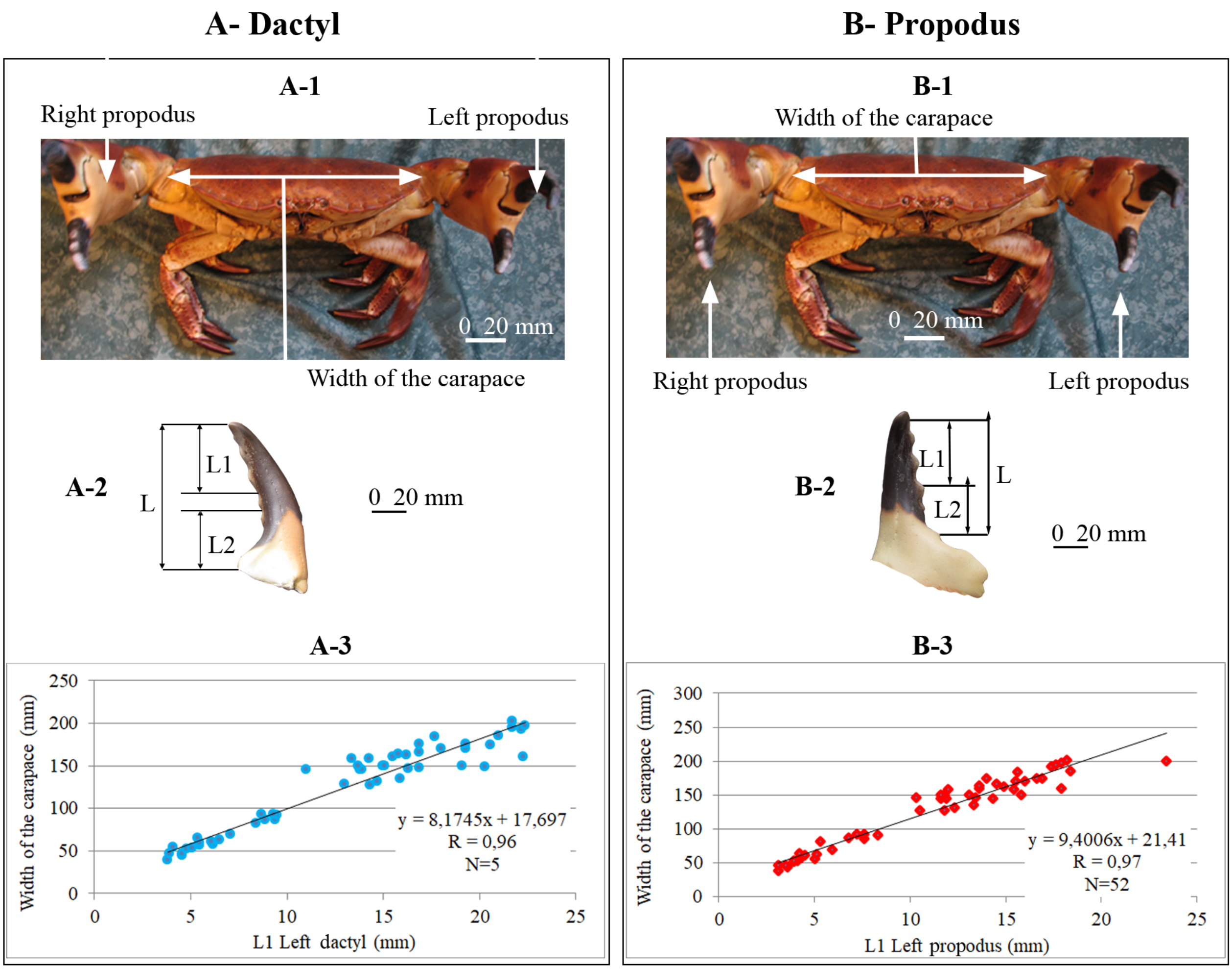

Fig. 4 – Example of correlations between a fragment of crab finger and the width of the carapace based on modern samples: Measure of the carapace and location of the fingers according to their lateralization (A); Different measures on a finger (B); Example correlation equation (C; Photos: pincers M. Arthur; complete crab C. Dupont; CAD C. Dupont).

Fig. 4 *– Exemple de corrélations entre un fragment de doigt de crabe actuel et la largeur de sa carapace ; mesure de la carapace et localisation des doigts en fonction de leur latéralisation (A) ; différentes mesures sur un doigt (B) ; exemple d'équation de corrélation (C ; photos pinces M. Arthur, crabe complet C. Dupont ; DAO C. Dupont).*

more frequent than fragments over 4 mm (fig. 5). The average weight of a crab fragment from the 2010 excavations was 0.15 g. The size of these fragments seems to vary depending on their position in the shell midden (fig. 5). The density of shells observed at the excavation seems to be in keeping with the numbers of crab remains, when these are cumulated. Level 4 is a transitional layer between the midden and the current ground surface with few shells. Level 5 is the heart of shell midden where shells are more concentrated. The shells are more dispersed in levels 6 and 7 which are located below the midden in contact with the substrate. The fact that the 4-mm fragments are predominantly present in the core of the midden may correspond to a lower acidity of the sediment in that area. The most basic pH value measured reaches 9.1 in layer 5.3 of BB35, and the least basic pH is 8 in layer 4.1 of BB33 (Querré and Le Bannier, 2013). This shows that the 'self-digestion' of the shell midden is probably still in progress, leading to an increase in the fragmentation of crab remains as time goes by.

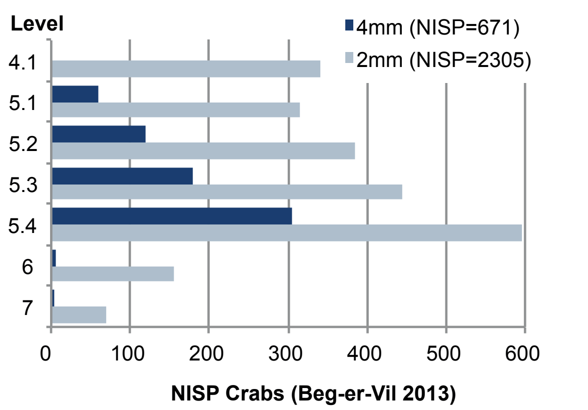

Fig. 5 – Number of Identified Specimens (NISP) of crabs counted at Beg-er-Vil 2013 according to sieve mesh size and archaeological level.

Fig. 5 *– Nombre de restes de crabe décomptés à Beg-er-Vil 2013, en fonction de la taille des mailles des tamis et du niveau archéologique.*

2.2- Represented species and sieve size

The most abundant crab fragments are the fingertips (fig. 6), as in most archaeological sites (Dupont and Gruet, 2022). This observation is correlated with a higher mineral density of the crab exoskeleton (Bosselmann et al., 2007, p. 67). The cumulative analysis led to the identification of seven species (table 1): the edible crab *Cancer pagurus* (Linnaeus, 1758), the warty xanthid crab *Eriphia verrucosa* (Forskål, 1775), the green crab *Carcinus maenas* (Linnaeus, 1758), the velvet swimming crab *Necora puber* (Linnaeus, 1767), the furrowed crab *Xantho* sp. (Leach, 1814), the marbled rock crab *Pachygrapsus marmoratus* (J.C. Fabricius, 1787), and the spider crab *Maja squinado* (Herbst, 1788). The latter three quoted species (*Xantho* sp. *Pachygrapsus marmoratus, Maja squinado*) were not observed in the material from the 1980s excavation (fig. 7 and table 1). They were identified in smaller quantities in the material from the 2010s. Their low proportions may account for their rarity in the material from the 1980s. Another factor may explain this absence: the natural small size of the furrowed crab and of the marbled rock crab *Pachygrapsus marmoratus* and their claws (fig. 8). The width of the carapace of these two species is at least twice as small as that of the velvet swimming crab. The fingertips of these two species may not have been retained in the 5-mm mesh. The size criterion may also have affected spider crab identification. The fingers of this species are relatively straight and thin and it is likely that sieving the sediments on a 5-mm mesh in the 1980s removed the smallest crabs and spider crab fragments.

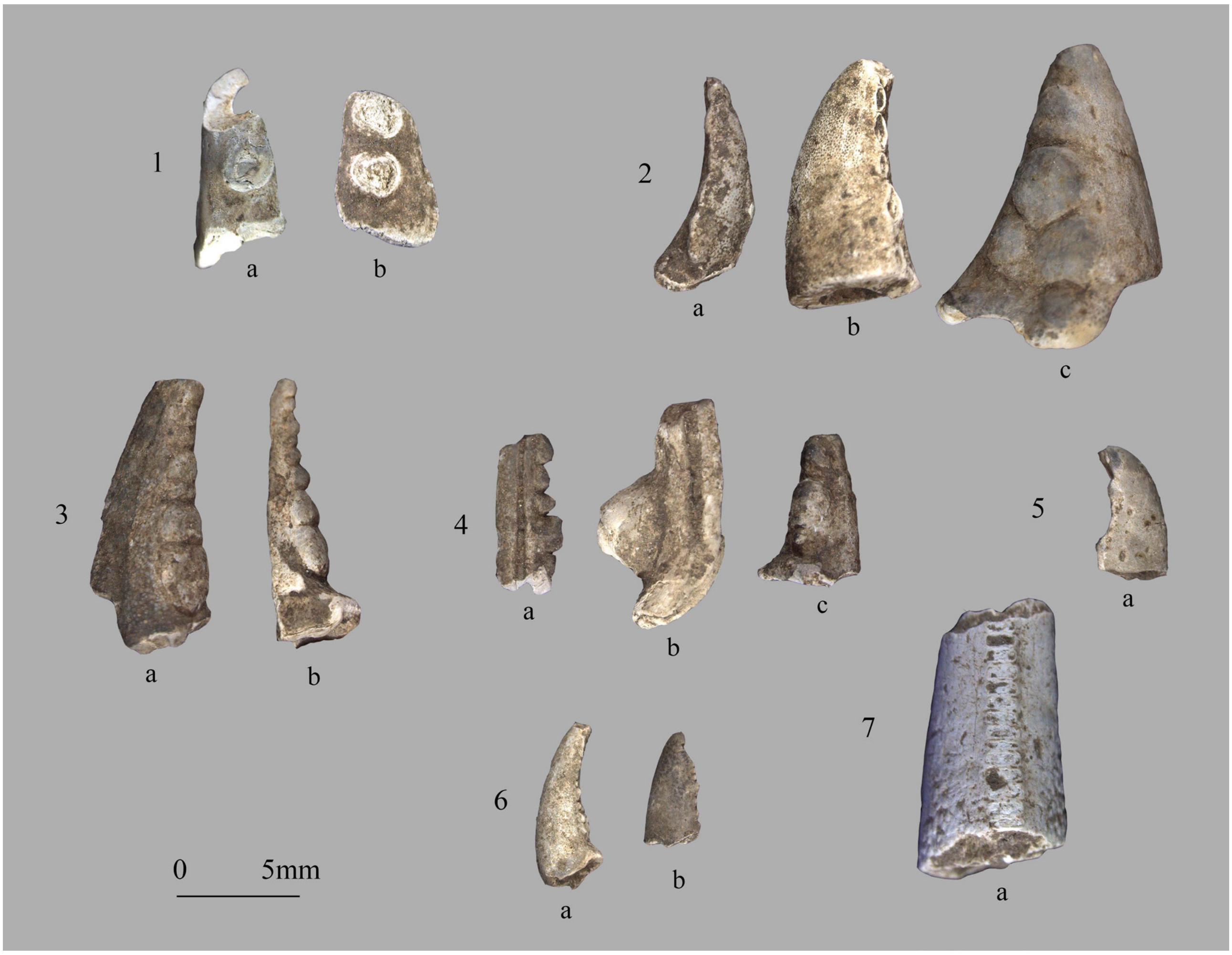

Fig. 6 – Best preserved crab fragments from Beg-er-Vil: Edible crab *Cancer pagurus* (1a left dactyl, 1b left propodus); Warty crab *Eriphia verrucosa* (2a right dactyl, 2b left dactyl, 2c right propodus); Green crab *Carcinus maenas* (3a and 3b right dactyl); Velvet swimming crab *Necora puber* (4a left dactyl, 4b right dactyl, 4c right propodus); Furrowed crab *Xantho* sp. (5a left dactyl); Marbled rock crab *Pachygrapsus marmoratus* (6a and 6b right dactyl); Spider crab *Maja squinado* (7; Photos M. Arthur except no. 1 O. Digard; CAD C. Dupont).

***Fig. 6** – Fragments les mieux conservés de Beg-er-Vil : Dormeur* Cancer pagurus *(1a dactylopode gauche, 1b propode gauche) ; Crabe verruqueux* Eriphia verrucosa *(2a dactylopode droit, 2b dactylopode gauche, 2c propode droit) ; Crabe vert* Carcinus maenas *(3a et 3b dactylopode droit) ; Étrille* Necora puber *(4a dactylopode gauche, 4b dactylopode droit, 4c propode droit) ; Xanthe* Xantho *sp. (5a dactylopode gauche) ; Crabe marbré* Pachygrapsus marmoratus *(6a et 6b dactylopode droit) ; Araignée de mer* Maja squinado *(7 ; clichés M. Arthur excepté le n° 1 O. Digard, DAO C. Dupont).*

Beg-er-Vil	1985-1988			2012			2013		
Opened area	8 m²			2 m²			44 m² (partial)		
Mesh	5 mm			2 and 4 mm			2 and 4 mm		
Crabs	NISP	MNI	Weight (g)	NISP	MNI	Weight (g)	NISP	MNI	Weight (g)
Cancer pagurus	64	39	136	136	35	10.18	2253	318	130.76
Eriphia verrucosa	21	19	2.4	27	10	2	351	104	3.28
Carcinus maenas	5	6	0.2	4	3	0.07	178	70	1.27
Necora puber	11	7	1.3	2	2	0.03	129	37	1.04
Xantho sp.	0	0	0	3	2	0.13	95	24	0.8
Pachygrapsus marmoratus	0	0	0	1	1	0.03	27	10	0.24
Maja squinado	0	0	0	1	1	0.3	16	8	0.19
Indetermined	294	-	51.81	39	-	1.29	696	-	-
Total	395	71	69.31	213	54	14.03	3049	571	137.58

Table 1 – Quantities of crabs according to excavation year and sieve mesh size
(NISP: Number of Identified Specimens; MNI: Minimum Number of Individuals).

***Tabl. 1** – Données quantitatives pour les crabes en fonction des années de fouille et de la taille de la maille des tamis (NISP: nombre de restes identifiés; MNI: Nombre Minimum d'Individus).*

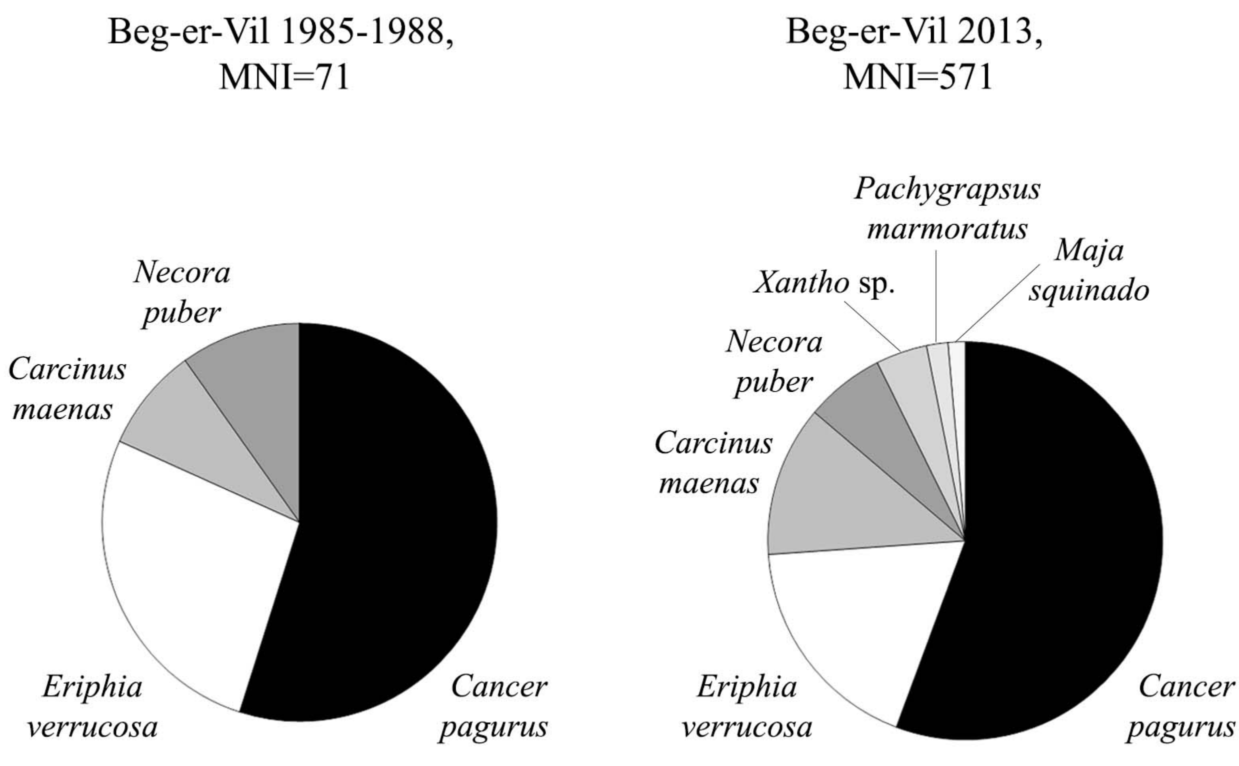

Fig. 7 – Crab spectra in Beg-er-Vil 1985-1988 and Beg-er-Vil 2013 (CAD C. Dupont).

***Fig. 7** – Spectre des crabes de Beg-er-Vil 1985-1988 et de Beg-er-Vil 2013 (DAO C. Dupont).*

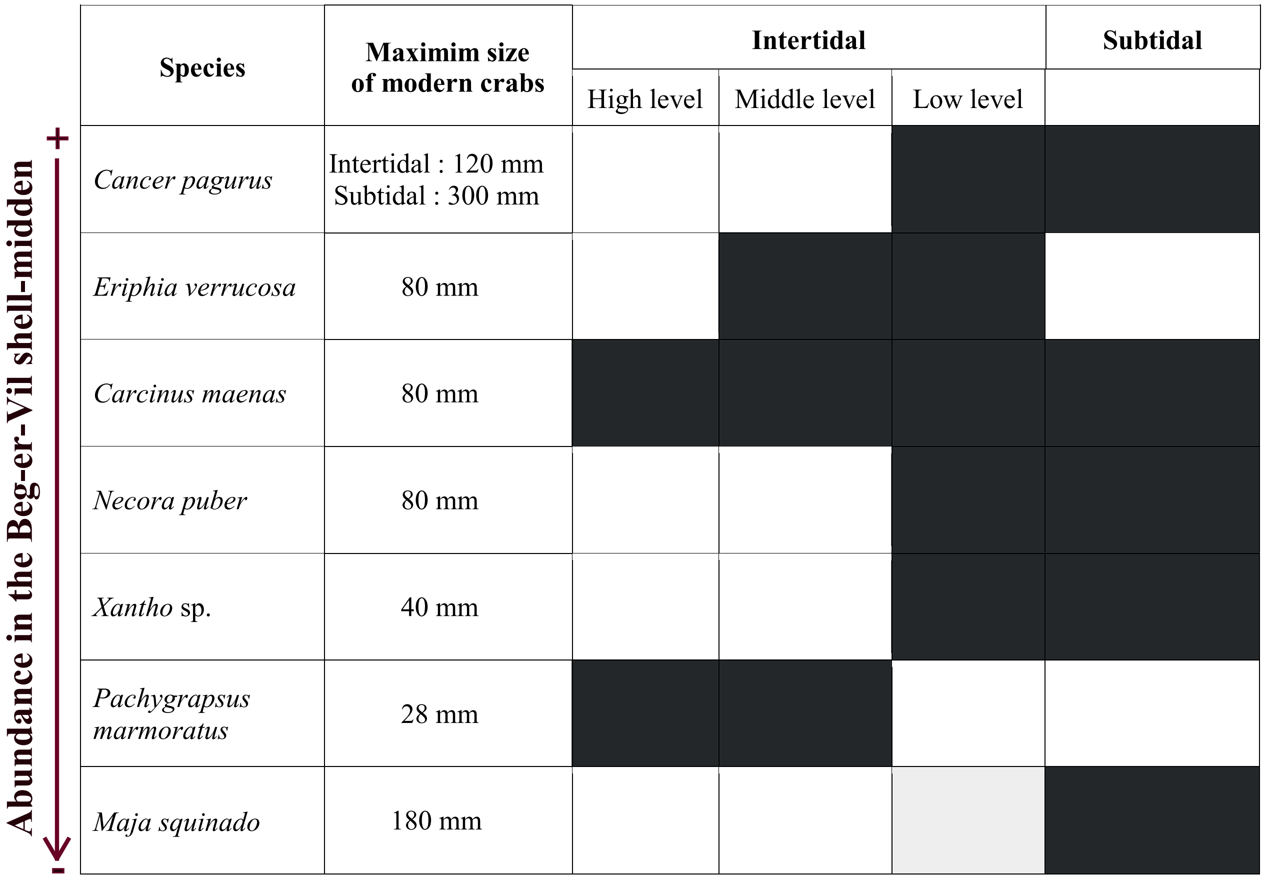

Fig. 8 – Altitude on the shore and maximum carapace size of the species determined at Beg-er-Vil based on data from present-day specimens (Photos C. Dupont and Y. Gruet; CAD C. Dupont).

Fig. 8 *– Altitude sur le littoral et largeur maximale de la carapace des espèces déterminées à Beg-er-Vil, à partir d'observations sur les spécimens actuels (clichés C. Dupont et Y. Gruet ; DAO C. Dupont).*

2.3- Spectra from archaeological crab remains

All the species determined at Beg-er-Vil are accessible on the foreshore, with the exception of the spider crab. Currently, this species moves closer to the coast when the sea water warms up in the late spring and may even be found washed up on the beaches. The low proportion in both the assemblages from the 2010s, representing less than 2%, can thus be explained by its lack of accessibility. The other species present percentages in accordance with the size of adult individuals: the bigger they are, the more abundant they are in the archaeological record. The most abundant are the largest, with proportions close to 56 to 65% for *Cancer pagurus*, 18 to 19% for *Eriphia verrucosa*, 6 to 12% for *Carcinus maenas*, 4 to 6% for *Necora puber*, 4% for *Xantho* sp. and 2% of the MNI for *Pachygrapsus marmoratus*, for the material from 2012 and 2013. These proportions do not seem to be strictly dependent on the foreshore level where crabs are accessible. The edible crab, velvet swimming crab and furrowed crab are indeed accessible from the lowest foreshore level. It is likely that the prehistoric populations turned to the larger and therefore more fleshy species. Another compelling question is: What about the sizes exploited within each species?

2.4- Impact of sieve mesh on crab size

The reconstruction of the carapace width of edible crabs caught by Mesolithic populations was performed for the material from the 1980s (N = 39) and the 2013 excavation (N = 18) at Beg-er-Vil (table 2). The reconstructed crab quantities are not proportional to the volume of sorted sediment. This observation may be linked to the different methods used for these size reconstructions (fig. 2 and fig. 4). The method based on correlation equations requires the preservation of the tubercles adorning the finger, while the other method is based on a visual comparison of the overall shape of the preserved finger part or its tubercles. The visual comparison method seems to be applicable to a greater quantity of fragments. Reconstructions show the presence of edible crabs between 40 and 170 mm. This result is interesting as it shows that these Mesolithic populations fished larger crabs than those currently available in the intertidal zone. The currently observed maximum carapace width of this animal on the foreshore is 120 mm (DORIS, 2020). It is possible that fishing gear, such as crab pots and dilly nets or traps, provided access to crabs in the subtidal zone. A second hypothesis that should also be considered is the current overexploitation of crabs on the foreshore.

This potential overexploitation is difficult to demonstrate because of the lack of current data on fished crabs or on the ethology of each species of crab (Hunter et al., 2013; Tully et al., 2016). For example, the maximum size that you can fish at low tide seems to be smaller than in the past, at the scale of a human lifetime. On the other hand, the observations on marine molluscs do not show any signs of capture from the subtidal zone. Reconstructions of the 2010s material show a shift towards smaller values compared with the 1980s and vice versa. This shift may be partly explained by the size of the sieve mesh used (5 mm for 1980 and 2 mm for 2010). The excavations by O. Kayser may have overlooked the smaller individuals because their smaller remains were not retained by the 5-mm sieve.

CONCLUSIONS

Several factors can affect the visibility of crabs to archaeologists. Not all parts of their exoskeleton are preserved in the same way. Most of the time, as at Beg-er-Vil, only the ends of crab claws are preserved and recorded by archaeologists for the Mesolithic sites of the Atlantic coast of Europe, whether in Ireland (Woodman et al, 1999, p. 96), England (Bailey and Milner, 2007; Milner, 2009), Scotland (Grieve, 1874, p. 46; Anderson, 1898; Coles, 1971; Myers and Gourlay, 1991, p. 21; Finlay et al., 2019), Spain (Fano Martínez, 1998) or Portugal (Lentacker, 1986; Pinto, 1986; Arnaud,1989; Valente, 2008). The study of crab fragments according to the stratigraphy of the Beg-er-Vil shell midden also shows that sediment acidity affects their degree of fragmentation. It is possible that the effects of soil acidity increased between 1980 and 2010.

This study of the crabs from a Mesolithic shell midden also shows the importance of sampling methods on the results obtained. The material found during O. Kayser's excavations in the 1980s was sieved with a 5-mm mesh and indicated that Mesolithic crab fishing targeted the largest species and individuals. The use of finer sieve meshes shows that some of the animals caught by the inhabitants of Beg-er-Vil had been invisible until now. New studies show a greater diversity of crab species, all of which are accessible on the foreshore. As with marine molluscs, everything that was edible and accessible at low tide was consumed (Dupont, 2021; Dupont and Marchand, 2021). The presence of the spider crab could also be a temporal indicator of site occupation as this species currently approaches the coast in late spring during the warming period. The spider crab is only accessible on the foreshore at that time. Size reconstruction of the identified species show that a wide range of crab sizes were consumed. Analysis of the 2010 material is underway, and the question remains open as to the cumulative presence of crabs that were consumed and other crabs transported with other marine resources (rock and/or seaweed, for example). The concomitant analysis of marine molluscs should make it possible to highlight such contributions. Due to their low food value in terms of quantity of flesh, the use of small crabs as bait is also sometimes

Cancer pagurus **Reconstitution of the width of the carapace (mm)**	**Beg-er-Vil 1985-1988 MNI (Gruet, 2002)**	**Beg-er-Vil 2013 MNI (Unpublished)**	
20	0	0	
30	0	0	
40	0	1	
50	0	7	
60	0	6	
70	3	1	
80	8	1	
90	9	0	
100	3	0	
110	3	1	Maximum size of modern intertidal *Cancer pagurus*
120	0	0	
130	7	0	
140	2	1	
150	3	0	
160	0	0	
170	1	0	
Total fragments	**N = 39**	**N = 18**	

Table 2 – Estimation of the size of the *Cancer pagurus* based on the archaeological fragments from Beg-er-Vil.
***Tabl. 2** – Estimation de la taille des tourteaux à partir des fragments archéologiques de Beg-er-Vil.*

mentioned (Lentacker, 1986, p. 18). However, even very small crabs can be used as food in the form of preparations such as soups, for example. Few reconstructions of crab sizes from Mesolithic shell middens have yet been attempted (for more details see Dupont and Gruet, 2022). Estimates from the Scottish site of Ulva Cave are similar to those described at Beg-er-Vil (Pickard and Bonsall, 2009). The four represented species all comprise juveniles and adults.

Many of the crab remains from Beg-er-Vil are charred, representing 45% of the 3049 fragments analysed in the 2013 survey. Such burn marks, when they are located at the tips of the fingers, have been associated with Mesolithic roasting of crabs (Milner, 2009). Unfortunately, it is difficult to identify the position of the burn marks at Beg-er-Vil. These burns may well have occurred during cooking, but also through exposure to fire after the crabs were eaten. Fires or the cleaning of waste by lighting fires are all possible explanations for these burn traces (Mougne, 2015).

The size of crab fragments largely explains the lack of interest in these animals by archaeologists in the past. Other factors may have influenced the fact that crab fishing was generally overlooked. The same scenario is observed for shellfish (Dupont and Marchand, 2021, p. 66) and shell middens. In the past, shell middens were only described in terms of lithic industry and large mammal remains (Dupont and Marchand, 2021, p. 60). The shellfish and crab catching activities by the fisher-hunter-gatherer populations were underestimated or even devalued by archaeologists in favour of the hunting of big game. This devaluation is even apparent in the hunter-gatherer appellation. It may also be due to 'an androcentric bias' (Milner, 2009).

Despite all these obstacles, the crab deserves to be considered in the archaeological record because upon closer inspection, it is undeniably present. Its meat yield is high, since more than a third of its fresh weight is meat and it contributes to food diversity. The food source represented by this meat was easily accessible and Mesolithic populations probably consumed a great deal of it. Furthermore, we now know that crabs are a good source of omega-3 fatty acids (Anacleto et al., 2016) and "essential elements such as K, Ca, Cu, Zn, Se and n - 3 PUFA, namely, EPA and DHA" (Maulvault et al., 2012, p. 6). These nutritional elements may have enabled coastal populations to overcome certain dietary deficiencies and may also have contributed to their prolonged presence in this part of the territory throughout the annual cycle.

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NOTES

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(2) Données d'observations pour la reconnaissance et l'identification de la faune et la flore subaquatiques (Doris, 2021) : *https://doris.ffessm.fr/*

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