PALEO
Revue d'archéologie préhistorique

Hors-série | Décembre 2022
Sociétés humaines et environnements dans la zone circumméditerranéenne du Pléistocène au début de l'Holocène

A technical adaptation? Shell dye extraction on the eve of the roman conquest in Gaul (Port-Blanc, Hoedic island, France)

Une adaptation technique ? L'extraction de colorant sur coquillages à l'aube de la conquête romaine en Gaule (Port-Blanc, île d'Hoedic, France)

Catherine Dupont, Anna Baudry, Marie-Yvane Daire and Laurent Barillé

OpenEdition Journals

Electronic version
URL: https://journals.openedition.org/paleo/8114
DOI: 10.4000/paleo.8114
ISSN: 2101-0420

Publisher
Musée national de Préhistoire

Printed version
Date of publication: November 15, 2023
Number of pages: 144-161
ISBN: 978-2-911233-24-1
ISSN: 1145-3370

Electronic reference
Catherine Dupont, Anna Baudry, Marie-Yvane Daire and Laurent Barillé, "A technical adaptation? Shell dye extraction on the eve of the roman conquest in Gaul (Port-Blanc, Hoedic island, France)", *PALEO* [Online], Hors-série | Décembre 2022, Online since 15 November 2023, connection on 05 December 2023. URL: http://journals.openedition.org/paleo/8114 ; DOI: https://doi.org/10.4000/paleo.8114

A TECHNICAL ADAPTATION? SHELL DYE EXTRACTION ON THE EVE OF THE ROMAN CONQUEST IN GAUL (PORT-BLANC, HOEDIC ISLAND, FRANCE)

Catherine Dupont[a], Anna Baudry[b], Marie-Yvane Daire[a], Laurent Barillé[c]

a. *CNRS, CReAAH, Centre de Recherche en Archéologie Archéosciences Histoire, UMR 6566, Rennes University, Campus Beaulieu, bât. 24-25 -CS74205, FR-35042 Rennes Cedex ; catherine.dupont@univ-rennes1.fr, marie-yvane.daire@univ-rennes1.fr*

b. *Inrap Nouvelle-Aquitaine et Outre-Mer, CReAAH, Centre de Recherche en Archéologie Archéosciences Histoire, UMR 6566, 122 rue de la Bugellerie, FR-86000 Poitiers ; anna.baudry-dautry@inrap.fr*

c. *Université de Nantes, ISOMER, Faculté des Sciences et des Techniques, BP 92208, 2 rue de la Houssinière, FR-44322 Nantes ; laurent.barille@univ-nantes.fr*

HORS-SÉRIE

Colloque hommage à Émilie Campmas (1983-2019)

Sociétés humaines et environnements dans la zone circumméditerranéenne du Pléistocène au début de l'Holocène

DÉCEMBRE 2022

THÈME 1 | Les occupations côtières de la Préhistoire à l'actuel : adaptations des populations humaines au milieu littoral, utilisation des ressources marines et réseaux de diffusion

PAGES 144 À 161

KEY-WORDS Iron Age, Romans, dog whelks, murex, dye, shell, archaeomalacology, maritime archaeology, island, protohistory.

ABSTRACT

Islands are variously interpreted either as areas closed in on themselves or open to different horizons, depending on the point of view. Excavations at the Port-Blanc site, on Hoedic Island, dated to the Iron Age, record both these aspects in the northwest of France, from the Middle La Tène to the end of the Final La Tène. They shed light on the evolution of this settlement, from its installation to its abandonment. The inclusion of faunal remains from the outset of the excavation allows to describe a varied exploitation of animals, including mammals, fish, birds, crustaceans and marine molluscs. The latter are the subject of this article.

The sampling protocol implemented at the time of excavation revealed a rarely equalled diversity of marine invertebrates in archaeology along the European Atlantic coast. This variety is linked to the multiple origins of these shellfish. The malacofaunal spectrum of small species (< 10 mm), composed of juvenile to adult individuals, points to aeolian transport with algae during storms for some of them. Others were indeed processed by the occupants of Port-Blanc. Two uses are highlighted: food and dyeing. The first implies the consumption of limpets, followed by mussels, thick top shells and European clams. The second is the exploitation of the dog whelk *Nucella lapillus* and the murex and oyster drill *Ocenebra erinaceus*. The proportions of these species vary along with the different phases of occupation of Port-Blanc. The beginning of the occupation in the Middle La Tène indicates an intentional exploitation of the low foreshore levels by the presence of the *Ocenebra erinaceus*. This species identified at Port-Blanc is the French Atlantic murex, which is most similar in appearance to the flagship species of Mediterranean purple dye production: *Hexaplex trunculus*. We thus postulate a possible technical transfer of this high added value activity via Mediterranean influences. This scenario is compared to other archaeological and historical data. In the Late La Tène period, dye extraction was transferred to another species, the dog whelk. Using biometric data and fragmentation data for species used for dyeing, we describe the different stages of exploitation, from collection to abandonment in the Port-Blanc dumping areas.

RÉSUMÉ

Une adaptation technique ?
L'extraction de colorant sur coquillages à l'aube de la conquête romaine en Gaule (Port-Blanc, île d'Hoedic, France)

Les îles sont interprétées, suivant les points de vue, soit comme des espaces refermés sur eux-mêmes, soit ouverts vers différents horizons. Les fouilles du site de Port-Blanc, daté de l'âge du Fer, documentent ces deux aspects du territoire de l'île d'Hoedic au nord-ouest de la France, de La Tène moyenne à la fin de La Tène finale. Elles permettent de suivre l'évolution de cet habitat, de son installation à son abandon. La prise en compte, dès la fouille, des vestiges fauniques permet d'y décrire une exploitation variée d'animaux dont des mammifères, des poissons, des oiseaux, des crustacés et des mollusques marins. Ces derniers font l'objet de cet article.

Le protocole de prélèvement mis en place dès la fouille permet de décrire une diversité d'invertébrés marins rarement égalée en archéologie le long du littoral atlantique européen. Cette variété est liée aux origines multiples de ces coquillages. Le cortège malacofaunique d'espèces de petites dimensions (< 10 mm) composé d'individus juvéniles à adultes témoignent du transport éolien de certains d'entre eux avec des algues lors de tempêtes. D'autres ont bel et bien été exploités par les occupants de Port-Blanc. Deux utilisations sont mises en évidence : l'alimentation et la teinture. La première implique la consommation de patelles suivies de la moule, de la monodonte et de la palourde européenne. La seconde correspond à l'exploitation du pourpre *Nucella lapillus* et du murex *Ocenebra erinaceus*. Les proportions de ces espèces varient dans les différentes phases d'occupation de Port-Blanc. Le début de l'occupation à La Tène moyenne témoigne d'une exploitation volontaire des bas niveaux de l'estran. Elle est mise en évidence par plusieurs observations faites sur le murex *Ocenebra erinaceus* telles ses proportions par rapport aux autres espèces, la taille de ses individus et son biotope. L'espèce de murex identifiée à Port-Blanc est celle présente en Atlantique français, qui s'apparente le plus, par son aspect, à l'espèce phare de la production de colorant pourpre en Méditerranée : l'*Hexaplex trunculus*. L'hypothèse est posée d'un possible transfert technique de cette activité de haute valeur ajoutée via des influences méditerranéennes par mimétisme sur une espèce de forme apparentée. Ce scénario est confronté aux autres données archéologiques ou historiques. À La Tène finale, l'extraction de colorant est transférée sur une autre espèce, le pourpre. Les données biométriques et liées à la fragmentation des espèces tinctoriales permettent de décrire les étapes de leur exploitation, de leur collecte à leur abandon dans les zones de rejets de Port-Blanc.

MOTS-CLÉS Âge du Fer, Romains, pourpre, murex, teinture, coquillages, archéomalacologie, archéologie maritime, île, Protohistoire.

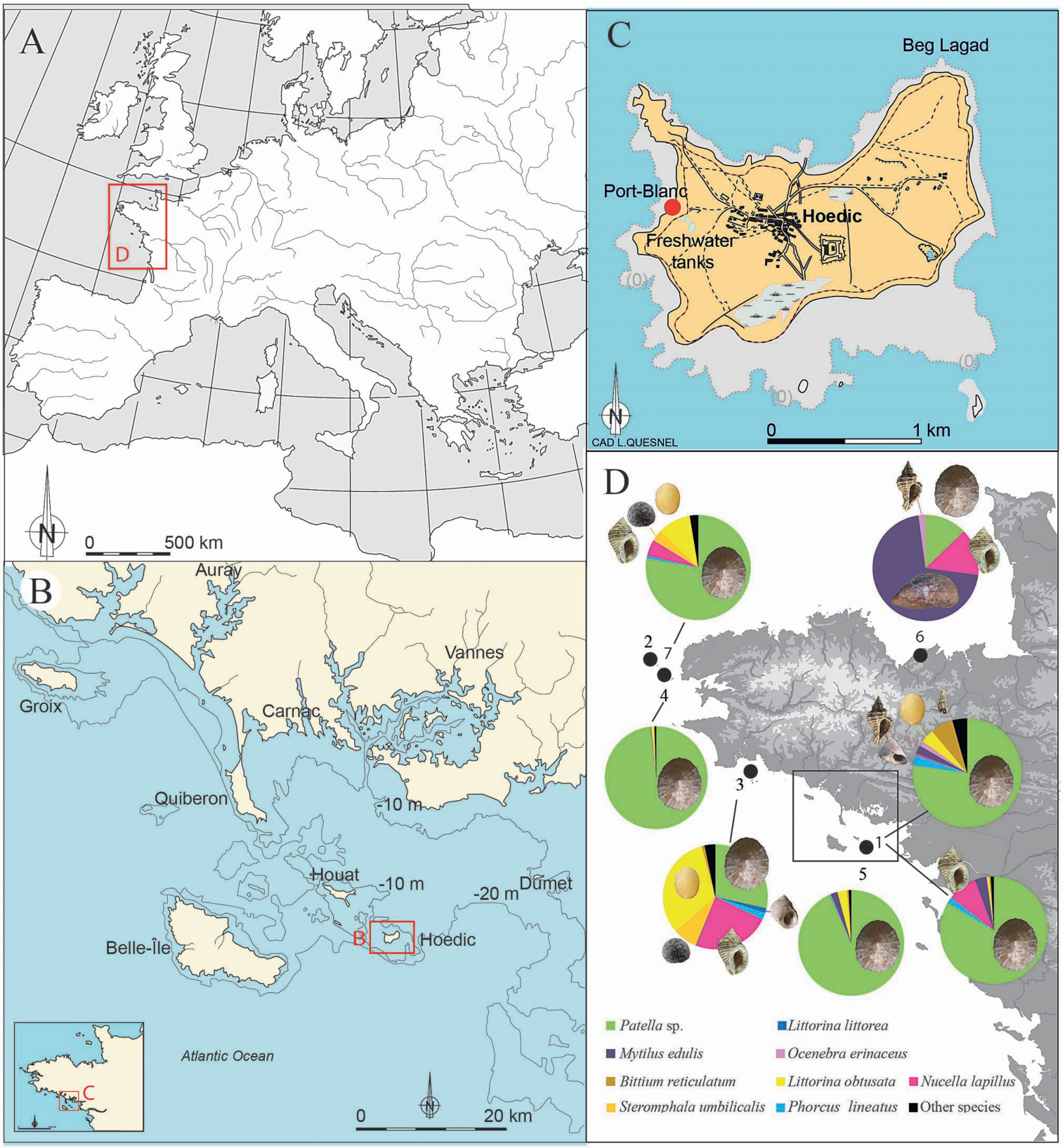
INTRODUCTION

The perception of the ocean varies depending on whether one lives on an island or on the continental coast. It is also influenced by the past of each civilisation (Rainbird 2000). The ocean may be a barrier for some, but may be a privileged area of passage, for others. Scenarios of isolation and interaction with islands are varied (Erlandson 2008). The French coastline and its islands are a magnificent playground for archaeologists (Billard 2019). Indeed, the smallest islands have escaped massive urbanisation and some of them are genuine heritage reserves where archaeological remains are very well represented and preserved (Daire 2009). Hoedic is one of those islands with archaeological records dating back to prehistoric times (Péquart and Péquart 1954). It contains one of the rare emblematic Mesolithic shell middens in France, combining a living place and a prehistoric cemetery. Alignments of standing stones also document Neolithic presence on the island (Large and Mens 2009). Our paper deals with a later site dating from the Metal Ages (Protohistory) located on Port-Blanc beach. On account of current erosion, amputation by anthropic action and very promising scientific potential, a research project was set up to study and excavate the site (Daire and Baudry 2018). The aim of the fieldwork was to record a coastal activity, namely salt extraction, in association with domestic settlement. The site had been detected on the cliff prior to excavation by the presence of clay-lined pits characteristic of salt extraction. Archaeological fieldwork has led to the description, not only of this specialised activity, but also of a settlement occupied during the late Iron Age, comprising waste from other activities (Daire and Baudry 2018). This last point is developed in this article focusing on marine shell exploitation and use. Here, we describe the methodology implemented in the field and in the laboratory, and present the activities revealed by the shells. Their variations over time are examined in relation to historical trends of great geographical scope, such as potential Mediterranean influences.

THE SITE OF PORT-BLANC

Description of the site

The Port-Blanc site is located along the western facade of the island of Hoedic (**fig. 1**). Excavations were carried out from 2004 to 2010 under the direction of M.-Y. Daire (**fig. 2-A**). Port-Blanc is made up of diverse structures, some of which are linked to salt extraction, and others to domestic settlement (Daire and Baudry 2018). The excavated dumps are composed of a wide variety of faunal remains (Daire and Baudry 2018). Several phases of Iron Age occupation have been identified owing to the associated archaeological artefacts (Daire and Baudry 2018). Phase 1, dated to the Middle La Tène (second half of the third century BC) corresponds to the initial settlement with salt production. Phases 2, 3 and 4 are successive Late La Tène settlements (early second to mid-first century BC). Phase 2 corresponds to the formation of several dumps, as well as to the development and structuring of the domestic settlement, which undergoes reorganisation in phase 3. At the same



— FIGURE 1 —

A to C - Location of Port-Blanc and D- malacofaunal spectra of Iron Age island sites (1 Port-Blanc: top Middle La Tène, MNI = 666; bottom Late La Tène, MNI = 94 812; 2 Mez Notariou, first Iron Age, MNI <50; 3 Ile aux Moutons, La Tène, MNI = 1157; 4 Triélen, La Tène, MNI = 436; 5 Sterflant, Late La Tène, MNI = 1479) and earlier sites with dye production (6 Prés Biards, Early La Tène, MNI = 140, 7 Tariec vraz, Bronze Age, MNI = 117, CAD L. Quesnel & C. Dupont, after Dupont and Mougne 2015, Daire and Baudry 2018).

A à C- Localisation du site de Port-Blanc et D- spectres malacofauniques des sites insulaires de l'âge du Fer (1 Port-Blanc : en haut La Tène moyenne, MNI = 666 ; en bas La Tène finale, MNI = 94812 ; 2 Mez Notariou, premier âge du Fer, NMI <50 ; 3 Ile aux Moutons, La Tène, MNI = 1157 ; 4 Triélen, La Tène, MNI = 436 ; 5 Sterflant, La Tène finale, MNI = 1479) et des sites antérieurs à production de pourpres (6 Prés Biards, La Tène ancienne, MNI = 140, 7 Tariec vraz, Bronze Age, MNI = 117, DAO L. Quesnel & C. Dupont, D d'après Dupont et Mougne 2015, Daire et Baudry 2018).

time, some structures are dismantled and the salt production activity is abandoned. In the middle of the first century BC, which corresponds to phase 4, the habitat is intentionally abandoned and quickly covered by a sandy dune. Sporadic occupations of the site are visible during phase 5 (end of the first century BC to the beginning of the first century AD).

Field excavation methods

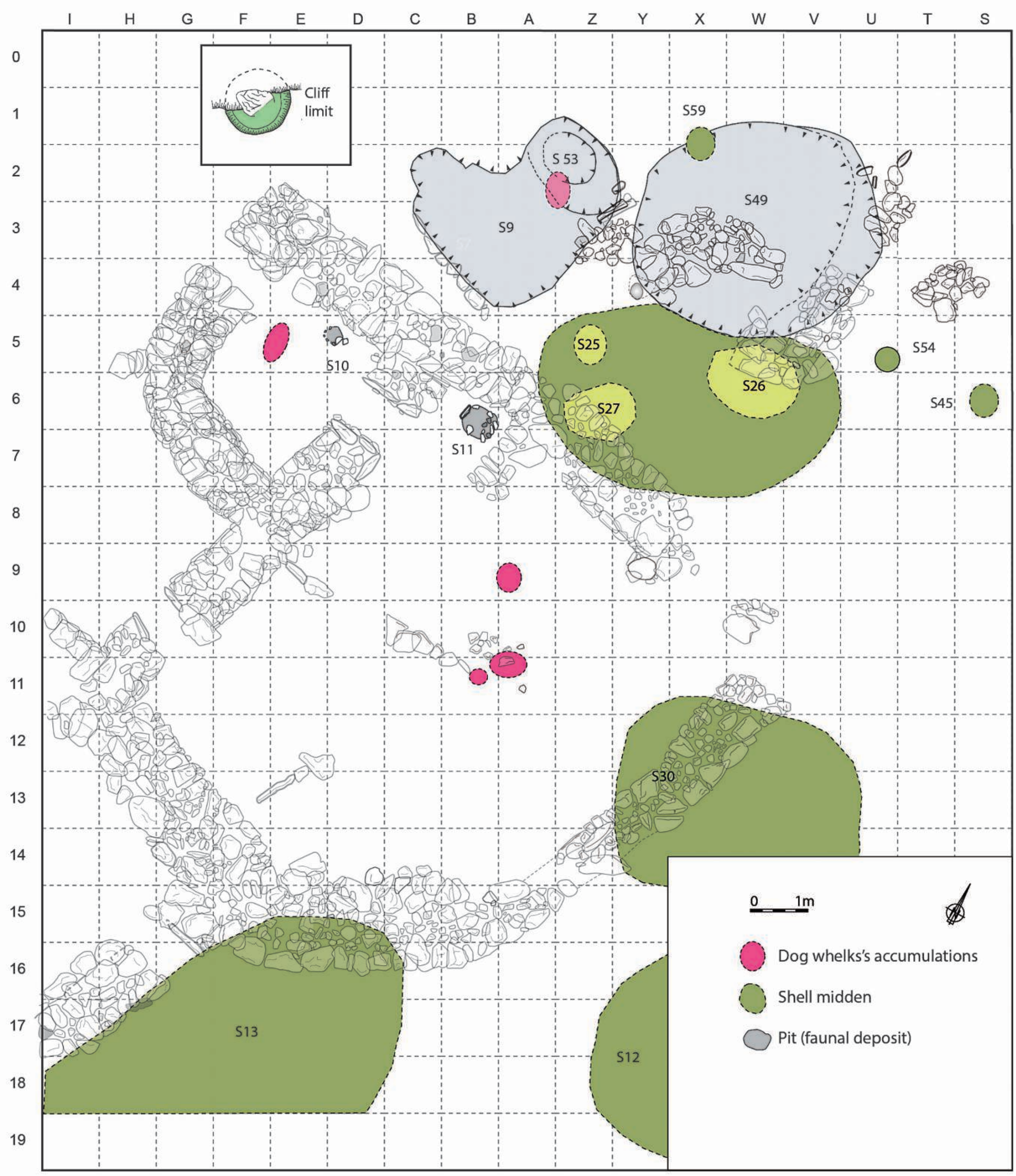
The faunal remains were integrated with the scientific issues at the outset of the excavation program. A sampling protocol adapted to faunal ecofacts and artefacts was implemented under the responsibility of A. Baudry (Baudry 2018, p. 41-44) (**fig. 2-B**). Collection of the largest elements

— FIGURE 2 —

Different stages in the study of the Port-Blanc fauna; A- Excavation, B- Sieving of the sediments with fresh water through 2 and 4 mm meshes, C- Concentration of limpets in the field, D- Concentration of dog whelk shells in the field, E- Drying of the sieved sediments, F- Sorting and studying of the artefacts in the laboratory (Photos A and B: M.Y. Daire, C to E: A. Baudry, F: C. Dupont).

Différentes étapes de l'étude de la faune de Port-Blanc ; A- La fouille, B- Le tamisage des sédiments à l'eau douce à 2 et à 4 mm, C- Concentration de patelles en cours de fouille, D- Concentration de pourpres en cours de fouille, E- Séchage des refus de tamis, F- Tri et étude des artefacts en laboratoire (Photos A et B : M.Y. Daire, C à E : A. Baudry, F : C. Dupont).

observed on sight was completed by the fresh-water sieving of sediments on columns of 4 mm and 2 mm square meshes (**fig. 2-B**). Subsequently, all fractions larger than 4 mm were sorted. The density of the material was so high that the treatment of the finest fraction was only partially carried out (10 %). During the excavation, concentrations of limpets and dog whelks were observed (**fig. 2-C** and **D, fig. 3**). The sieving of more than 3,000 litres of sediment revealed numerous bone and shell fragments including: terrestrial and marine mammals, marine and terrestrial birds, small mammals, marine fish, amphibians, reptiles, echinoderms, crustaceans and molluscs (Daire and Baudry 2018, p. 161).



— FIGURE 3 —

Superposition of excavated levels and location of shelly concentrations (CAD L. Quesnel, M.Y. Daire; after Daire and Baudry 2018).

Superposition des niveaux fouillés et localisations des concentrations coquillères (DAO L. Quesnel, M.Y. Daire ; d'après Daire and Baudry 2018).

Methods of analysis of marine molluscs

All the marine invertebrates extracted on sight during the excavation were analysed. Sampling was carried out on large quantities of the shells recovered on sieves, in order to represent all the phases of site occupation.

Mollusc identification is based on the shape and thickness of shells, its hinge for bivalves, the shape of the peristome for gastropods, ornamentation, as well as the imprints left on the shell by the animal's flesh, in particular muscular and ligament imprints. Shell identification was based on reference works (Tebble 1966; Lindner 1976; Poppe and Goto 1991, 1993; Hayward and Ryland 2007) and the comparative reference collection of the CReAAH Gruet & Dupont (CReAAH, University of Rennes 1). The scientific names have been updated according to the WoRMS (WoRMS, 2022).

Marine invertebrate fragments were sorted and weighed (unit = gram). For counts, the NISP or number of remains and the MNI or minimum number of individuals were used (Dupont 2006, Dupont *in* Daire and Baudry 2018).

For periwinkles, limpets, thick top shells (Dupont 2006), dog whelks and oyster drills (Dupont 2011), fragmentation typologies were applied in order to evaluate the state of preservation of the malacofaunal remains, and also to determine the origin of breakage (anthropogenic or natural), and even the action generating fragmentation (crushing, lateral breakage). The best-preserved shells were then measured. When they were broken, correlation equations were sought to establish the link between part of the test and its original size. Such reconstruction was possible for dog whelks based on the longest peristome length.

THE SHELLS OF PORT-BLANC

Origins of the presence of shells

A total of 181 kg of marine molluscs were studied, with a MNI of 109 366 and a NR of 579 979 (**fig. 4, tabl. 1**). A complete study of these molluscs is presented in the site monograph (Daire and Baudry 2018, p. 182-222). The key points are summarized below. Observed specific diversity is high with the identification of at least 35 gastropods, 29 bivalves, a chiton polyplacophore and a cuttlefish cephalopod. This high diversity is linked to several factors, such as the good conservation at Port-Blanc, the excavation techniques that allowed for the specific identification of infra-centimetric species, and the multiplicity of factors at the origin of the presence of these shells in the formation of the archaeological site.

The proportions, dimensions and recurrent presence of molluscs on other archaeological sites make it possible to identify at least six species as food products, with sizes generally exceeding 20 mm. We have shown in previous works that this can be considered as a cut-off size for the consumption of molluscs since prehistory (Dupont 2006). The consumed species are, in decreasing order of proportions (MNI): the three species of limpets, the mussel, the thick top shells and the European clam. In the **table 1**, the limpets are listed as *Patella* sp. because not all shells counted as individuals could have been determined at the species level. This fact is linked to the poor state of preservation of their external surface of some limpets' shells. Among these species, the limpet (*Patella vulgata, P. ulyssiponensis, P. depressa*) totally dominates the corpus. This is not new for island territories during Protohistoric times in the north-western part of France. It confirms the attraction for this convenient species in terms of its mass of flesh. This gastropod is easily visible and readily accessible on the foreshore (Dupont and Mougne 2015; Mougne 2015). Other secondarily exploited species are mussels *Mytilus edulis* and thick top shells *Phorcus lineatus,* which can also be readily collected on rocky foreshores with no technical investment. The exploitation of the European clam *Ruditapes decussatus* seems to be marginal. The presence of dog whelks *Nucella lapillus* and oyster drills *Ocenebra erinaceus* in Port-Blanc is linked to dyeing. Although *Nucella lapillus* (Russell *et al.* 1995; Dupont and Marchand 2021) and *Ocenebra erinaceus* (Dupont 2021) are known to have been consumed, the systematic breakage of these species attests to the extraction of a gland with dyeing properties (**fig. 5**). These breaks are not observed on other gastropods, which were probably boiled to gain access to the animal's flesh. The dog whelk and the oyster drill were broken one by one to reach their hypobranchial gland with dyeing properties. Their biotope is similar to that of consumed species: the rocky foreshore (Poppe and Goto 1993).

Among the identified species in Port-Blanc, many gastropods do not exceed 20 or even 15 mm in length at the adult stage (e.g., **fig. 4** species n° 49 to 66; Daire and Baudry 2018, p. 203). They show no evidence of death before transport to the site, such as shape deformation linked to marine erosion. This observation rules out their presence in marine sand at the site, of which they would have been a constituent. The most abundant of these small species show that all individuals are represented, from juveniles to adults (Daire and Baudry 2018, p. 203). Most of them live on rocks and particularly in algae (Mougne *et al.* 2013; Daire and Baudry 2018, p. 203).

These gastropods could therefore have been transported alive to Port-Blanc, while they were attached to seaweed. This scenario is possible via several agents: people and the wind. Indeed, algae can be used by humans as food, fodder, litter, fuel, or to keep food in a cool and humid marine atmosphere (Bonsall *et al.* 1994; O'Sullivan and Breen 2011; Mooney 2018; Blanz *et al.* 2022). Seaweed can also be transported by the wind and streams (Wickham *et al.* 2020), during storms for example. Only preferential locations could back up one of these hypotheses. Storm action is recurrent in archaeology and small marine gastropods (for example, *Steromphala* sp. and *Littorina obtusata*) are regularly found with dune snails, such as in pre- and protohistoric island sites (Dupont 2019). At Port-Blanc, the wind is the only identified accumulator of these algae. This explains the sporadic abundant presence of certain species on the site, such as during the Middle La Tène period: presence of small species, such as *Littorina obtustata* and *Bittium reticulatum* with sand snails. Their presence could correspond to a phase of site opening, or even abandonment, between two main occupation phases; the Middle La Tène and the Late La Tène. In addition, we observe the fortuitous presence of small bivalves at Port-Blanc. They may have accompanied storm deposits transported from the beach to the site by the wind. They may also have stuck to the containers used to transport shellfish.

Larger bivalves were probably less conspicuous. Amongst these, several are subtidal or occupy low foreshore levels. However, they were not transported alive to the site (for example, marine worms may have settled on the inner surface of their valve). They could have been used as containers or as spoons, but these two uses do not necessarily leave traces and therefore cannot be confirmed.

— FIGURE 4 —

Determined molluscs at Port-Blanc; ●: food; ■: dye; 1 Mytilus edulis *46 mm, 2* Pecten maximus *65 mm, 3* Ostrea edulis *93 mm, 4* Mimachlamys varia *14 mm, 5* Anomia ephippium *12 mm, 6* Cerastoderma *sp, 2 mm, 7* Laevicardium crassum *49 mm, 8* Parvicardium minimum *4 mm, 9* Acanthocardia tuberculata *63 mm, 10* Ruditapes decussatus *27 mm, 11* Venus verrucosa *37 mm, 12* Solen marginatus *15 mm, 13* Lutraria *sp. 38 mm, 14* Callista chione *44 mm, 15* Spisula subtruncata *17 mm, 16* Chamelea striatula *7 mm, 17* Striarca lactea *8 mm, 18* Lucinella divaricata *13 mm, 19* Hiatella arctica *11 mm, 20* Dosinia *sp.4 mm, 21* Lasaea adansoni *3 mm, 22* Nucula nucleus *8 mm, 23* Irus irus *7 mm, 24* Corbula gibba *9 mm, 25* Lasaea rubra *2 mm, 26* Gari *sp. 18 mm, 27* Loripes orbiculatus *8 mm, 28* Gouldia minima *8 mm, 29* Erycinacea *3 mm, 30* Chiton *sp. 7 mm, 31* Patella depressa *33 mm, 32* P. vulgata *34 mm, 33* P. ulyssiponensis *40 mm, 34* Lepeta caeca *15 mm, 35* P. pellucida *14 mm, 36* Haliotis tuberculata *50 mm, 37* Diodora gibberula *6 mm, 38* Trivia monacha *9 mm, 39* Tritia pygmaea *7 mm, 40* Tritia incrassata *8 mm, 41* Ocenebra erinaceus *15 mm, 42* T. reticulata *24 mm, 43* Nucella lapillus *20 mm, 44* Steromphala cineraria *8 mm, 45* S. umbilicalis *15 mm, 46* Phorcus lineatus *24 mm, 47* S. pennanti *13 mm, 48* Littorina littorea *21 mm, 49* L. saxatilis *5 mm, 50* Lacuna pallidula *13 mm, 51* L. parva *5 mm, 52* Littorina obtusata *13 mm, 53* Calliostoma zizyphinum *23 mm, 54* Lacuna pallidula *3 mm, 55* Tricolia pulus *4 mm, 56* Melarhaphe neritoides *3 mm, 57* Lacuna vincta *6 mm, 58* Peringia ulvae *3 mm, 59* Ecrobia ventrosa *3 mm, 60* Onoba semicostata *3 mm, 61* Cingula trifasciata *3 mm, 62* Manzonia crassa *3 mm, 63* Rissoa parva *4 mm, 64* Eulimella *sp. 3 mm, 65* Bittium reticulatum *5 mm, 66* Epitonium *sp. 7 mm (greatest length in mm / Photos and CAD C. Dupont).*

Mollusques déterminés à Port-Blanc ; ● : nourriture ; ■ : extraction de colorant ; 1 *Mytilus edulis* 46 mm, 2 *Pecten maximus* 65 mm, 3 *Ostrea edulis* 93 mm, 4 *Mimachlamys varia* 14 mm, 5 *Anomia ephippium* 12 mm, 6 *Cerastoderma* sp, 2 mm, 7 *Laevicardium crassum* 49 mm, 8 *Parvicardium minimum* 4 mm, 9 *Acanthocardia tuberculata* 63 mm, 10 *Ruditapes decussatus* 27 mm, 11 *Venus verrucosa* 37 mm, 12 *Solen marginatus* 15 mm, 13 *Lutraria* sp. 38 mm, 14 *Callista chione* 44 mm, 15 *Spisula subtruncata* 17 mm, 16 *Chamelea striatula* 7 mm, 17 *Striarca lactea* 8 mm, 18 *Lucinella divaricata* 13 mm, 19 *Hiatella arctica* 11 mm, 20 *Dosinia* sp. 4 mm, 21 *Lasaea adansoni* 3 mm, 22 *Nucula nucleus* 8 mm, 23 *Irus irus* 7 mm, 24 *Corbula gibba* 9 mm, 25 *Lasaea rubra* 2 mm, 26 *Gari* sp. 18 mm, 27 *Loripes orbiculatus* 8 mm, 28 *Gouldia minima* 8 mm, 29 *Erycinacea* 3 mm, 30 *Chiton* sp. 7 mm, 31 *Patella depressa* 33 mm, 32 *P. vulgata* 34 mm, 33 *P. ulyssiponensis* 40 mm, 34 *Lepeta caeca* 15 mm, 35 *P. pellucida* 14 mm, 36 *Haliotis tuberculata* 50 mm, 37 *Diodora gibberula* 6 mm, 38 *Trivia monacha* 9 mm, 39 *Tritia pygmaea* 7 mm, 40 *Tritia incrassata* 8 mm, 41 *Ocenebra erinaceus* 15 mm, 42 *T. reticulata* 24 mm, 43 *Nucella lapillus* 20 mm, 44 *Steromphala cineraria* 8 mm, 45 *S. umbilicalis* 15 mm, 46 *Phorcus lineatus* 24 mm, 47 *S. pennanti* 13 mm, 48 *Littorina littorea* 21 mm, 49 *L. saxatilis* 5 mm, 50 *Lacuna pallidula* 13 mm, 51 *L. parva* 5 mm, 52 *Littorina obtusata* 13 mm, 53 *Calliostoma zizyphinum* 23 mm, 54 *Lacuna pallidula* 3 mm, 55 *Tricolia pulus* 4 mm, 56 *Melarhaphe neritoides* 3 mm, 57 *Lacuna vincta* 6 mm, 58 *Peringia ulvae* 3 mm, 59 *Ecrobia ventrosa* 3 mm, 60 *Onoba semicostata* 3 mm, 61 *Cingula trifasciata* 3 mm, 62 *Manzonia crassa* 3 mm, 63 *Rissoa parva* 4 mm, 64 *Eulimella* sp. 3 mm, 65 *Bittium reticulatum* 5 mm, 66 *Epitonium* sp. 7 mm (plus grande mesure en mm / Photos et DAO C. Dupont).

Despite a rarely equalled diversity of marine mollusc species in archaeology along the French Atlantic coast, the exploitation of shellfish from Port-Blanc focused on two uses: food and dye extraction. Other natural contributions, such as storm deposits, may have increased the diversity of species found. In terms of this specific diversity, Port-Blanc is a good marker of the biodiversity of Breton waters during the Iron Age, with more than 65 species. The identification of different phases of use enables us to follow the exploitation of shellfish from the second half of the third century BC to the middle of the first century BC.

Malacofaunal spectrum and chronology

Littorina obtusata and *Bittium reticulatum* from the Middle La Tène period deposits are natural contributions. If we exclude these species from the malacofaunal spectrum, variations in the proportions of the main species emerge. The percentage of oyster drills in the Middle La Tène (**fig. 6**), which is over 1 %, is unprecedented at the scale of the French Atlantic coast for dye production (Dupont 2013). Its rate never exceeds this percentage and it is always linked to a greater proportion of *Nucella lapillus* (Dupont 2013). At Port-Blanc, the dominating presence of *Ocenebra erinaceus* indicates an intentional search for this shellfish. Indeed, this species is less accessible than *Nucella lapillus* as it is only accessible from the lowest foreshore levels. Proportions of dog whelks increase throughout time. These markers of dye production at Port-Blanc occur before the physical presence of Romans in Western Gaul (Galliou 2016). This may point to the possible imitation of this coeval Mediterranean activity. Indeed, *Ocenebra erinaceus* is more similar in appearance to *Hexaplex trunculus* than *Nucella lapillus* (**fig. 7A**) and this murex was the most commonly used for the production of purple dye in Antiquity (Macheboeuf 2005, p. 7). Another element argues in favour of a more intense exploitation of the low foreshore levels in the Middle La Tène, i.e., the proportions of limpet species. *Patella ulyssiponensis*, found in lowest tidal levels, is predominant in contrast to the other species from higher levels (Poppe and Goto 1993). Limpets' proportions vary inversely to those of dog whelks, i.e., their proportions are higher for all the intentionally exploited species by human populations at the beginning of the occupation. These changes are validated by statistical tests applied to proportions using the MNI and the length of limpets. After checking normality with the Shapiro Wilk test, the Box-Cox transformation was used to normalize data. Confidence intervals at 95% of *Nucella lapillus* and *Patella ulyssiponensis* proportions found for each phase were obtained using the Clopper-Pearson method. The difference between each proportion and the linear trend in proportions was tested with Chi-square tests. The average length of all *Patella* species between each phase was compared with a one-way ANOVA followed by a posteriori Tukey pairwise comparisons for a significance level of 1 %. All univariate tests were performed using PAST 4.05 (Hammer *et al.* 2001). The percentage of *Nucella lapillus* was significantly different between each phase and there was a significant linear increase from the first (0.6 %) to the last phase (37.7 %) (Chi-square tests, $P<0.01$) (**fig. 8-A**). There was an inverse significant trend for this species of *Patella* (**fig. 8-B**). The percentage of *Patella ulyssiponensis* was significantly different between each phase and there was a significant linear decrease from the first phase (43.6 %) to the last (12.1 %) (Chi-square test, $P<0.01$). Significant differences were observed between the average lengths of all *Patella* sp. during the five phases (One-way ANOVA, $p<0.01$) (**fig. 8-C**). Average length significantly increased from phase 1 to phases 3-4 (Tukey *a posteriori*, $P<0.01$), except for *P. vulgate*. The latest increased from phase 3-4 to phase 4-5 (Tukey *a posteriori,* $P<0.01$), but an opposite trend was observed for the two other species.

Thus, the consumption of this seafood could have been more intense at the beginning of the occupation. Gathering pressure could even have led to a decrease in the average size of limpets accessible on the foreshore in the first phase of occupation._

All oyster drills and dog whelks are systematically broken (more than 99 % of the MNI). The study of the fragmentation typology shows that these two molluscs underwent the same processing, i.e., they were broken one by one at their largest spire (**fig. 5; fig. 7B** and **C**). The broken area corresponds to the location of the dye gland. Another feature makes Port-Blanc stand out from other dye extraction sites (Dupont, Doyen 2017) ; the exploited sizes at Port-Blanc show that individuals smaller than 20 mm were frequently collected and processed (**fig. 9**). The average length of dog whelks reaches 16 mm for the last phase of site occupation and is 17 mm, if all phases are considered together. For oyster drills, it was impossible to reconstruct original sizes by correlation due to the lack of complete individuals. However, if we compare the longer length of the peristome to the total length of this murex, at least 25 % of them were smaller than 20 mm (**fig. 9**). This result is unprecedented at the scale of the Atlantic coast of France, as the oyster drill is generally less exploited and processed individuals are larger than 20 mm. This observation is one more element pointing to a deliberately targeted collection of this murex.

CONCLUSIONS

In recent years, studies of marine invertebrates increased for the Iron Age along the north-western French Atlantic coast (Le Bihan and Villard 2001; Daire *et al.* 2008; Maguer *et al.* 2009; Dupont *in* Daire and Hamon 2013; Mougne *et al.* 2013, 2014; Daire *et al.* 2015a), with a synthesis at the scale of the Atlantic coast of France (Mougne 2015) and island sites (Dupont and Mougne 2015, **fig. 1D**). The exceptional quantity and quality of preservation of the invertebrate remains from Port-Blanc enhance our knowledge of the use and processing of these molluscs on the islands during the Iron Age. They confirm that this protohistoric group took advantage of the local island environment with an outlet beyond the foreshore of the island of Hoedic.

Variations in the composition of the malacofaunal spectrum and shell dimensions tend to show significant pressure on low foreshore levels during the Middle La Tène period. The oyster drill was deliberately collected in the low levels of the rocky foreshores with limpets. The former is related to dyeing activities, the latter to food. Subsequently, dye extraction was developed on dog whelks, which remained accessible at low tide for longer than the oyster drill. From the Middle La Tène period onwards, limpets were one of the main consumed shellfish. This characteristic is typical of the long rocky shores of Breton island sites in Protohistoric periods (Dupont and Mougne 2015; Mougne 2015, fig. 1-D). Limpets could be collected with rudimentary tools, such as pebbles. The mussel may have been caught with bare hands. It seems that large mussel shells were selected directly from the rocks, located in areas exposed to swells. The thick top shell was also collected from rocks with bare hands. Given

Species	Weight (g)	% Weight	Right Valve	Left Valve	MNI	% MNI	NISP	% NISP
Gastropod								
Bittium reticulatum	5.61	0.00	-	-	500	0.46	535	0.09
Calliostoma zizyphinum	1.41	0.00	-	-	2	0.00	3	0.00
Cingula trifasciata	0.27	0.00	-	-	21	0.02	21	0.00
Diodora gibberula	0.01	0.00	-	-	1	0.00	1	0.00
Ecrobia ventrosa	0.01	0.00	-	-	1	0.00	1	0.00
Epitonium sp.	0.02	0.00	-	-	1	0.00	1	0.00
Eulimella sp.	0.01	0.00	-	-	1	0.00	1	0.00
Indeterminate Gastropod	0.52	0.00	-	-	3	0.00	41	0.01
Haliotis tuberculata	25.91	0.01	-	-	2	0.00	17	0.00
Lacuna pallidula	0.69	0.00	-	-	8	0.01	7	0.00
Lacuna parva	0.70	0.00	-	-	27	0.02	34	0.01
Lacuna vincta	0.37	0.00	-	-	2	0.00	2	0.00
Lepeta caeca	0.43	0.00	-	-	1	0.00	1	0.00
Littorina littorea	15.12	0.01	-	-	18	0.02	18	0.00
Littorina obtusata	83.40	0.05	-	-	653	0.60	605	0.10
Littorina saxatilis	0.06	0.00	-	-	1	0.00	1	0.00
Littorina sp.	0.09	0.00	-	-	1	0.00	2	0.00
Manzonia crassa	0.02	0.00	-	-	2	0.00	2	0.00
Melarhaphe neritoides	0.01	0.00	-	-	1	0.00	1	0.00
Nucella lapillus	22 408.60	12.36	-	-	13 716	12.54	44 245	7.63
Ocenebra erinaceus	267.47	0.15	-	-	207	0.19	575	0.10
Onoba semicostata	0.01	0.00	-	-	3	0.00	3	0.00
Patella pellucida	2.52	0.00	-	-	5	0.00	5	0.00
Patella sp.	132 799.60	73.26	-	-	87 754	80.24	378 611	65.28
Peringia ulvae	0.01	0.00	-	-	1	0.00	1	0.00
Phorcus lineatus	5 403.82	2.98	-	-	2082	1.90	2074	0.36
Rissoa parva	0.41	0.00	-	-	76	0.07	78	0.01
Steromphala cineraria	27.17	0.01	-	-	49	0.04	50	0.01
Steromphala pennanti	69.26	0.04	-	-	90	0.08	90	0.02
Steromphala sp.	54.87	0.03	-	-	152	0.14	438	0.08
Steromphala umbilicalis	214.47	0.12	-	-	330	0.30	403	0.07
Tricolia pulus	1.21	0.00	-	-	16	0.01	16	0.00
Tritia incrassata	1.73	0.00	-	-	16	0.01	18	0.00
Tritia pygmaea	0.81	0.00	-	-	7	0.01	6	0.00
Tritia reticulata	33.66	0.02	-	-	36	0.03	47	0.01
Tritia sp.	4.71	0.00	-	-	21	0.02	62	0.01
Trivia monacha	1.36	0.00	-	-	7	0.01	17	0.00
Bivalve								
Acanthocardia sp.	2.56	0.00	0	0	1	0.00	1	0.00
Acanthocardia tuberculata	5.79	0.00	1	0	1	0.00	1	0.00
Anomia ephippium	2.66	0.00	0	6	6	0.01	12	0.00
Callista chione	134.52	0.07	1	5	5	0.00	21	0.00
Cerastoderma sp.	0.01	0.00	0	0	1	0.00	1	0.00
Chamelea striatula	0.12	0.00	0	0	1	0.00	6	0.00
Indeterminate Bivalve	6.22	0.00	1	1	1	0.00	42	0.01
Corbula gibba	0.16	0.00	1	0	1	0.00	2	0.00
Dosinia sp.	0.01	0.00	0	1	1	0.00	1	0.00
Erycinacea	0.23	0.00	0	1	1	0.00	2	0.00
Gari sp.	0.03	0.00	1	0	1	0.00	1	0.00
Gouldia minima	0.03	0.00	0	1	1	0.00	1	0.00
Hiatella arctica	0.56	0.00	4	3	4	0.00	18	0.00
Irus irus	0.10	0.00	0	3	3	0.00	5	0.00
Laevicardium crassum	11.90	0.01	0	0	1	0.00	1	0.00
Lasaea adansoni	0.01	0.00	2	0	2	0.00	2	0.00

Lasaea rubra	0.01	0.00	0	0	1	0.00	1	0.00
Loripes orbiculatus	0.48	0.00	2	3	3	0.00	11	0.00
Lucinella divaricata	0.29	0.00	3	3	3	0.00	7	0.00
Lutraria sp.	3.20	0.00	1	0	1	0.00	1	0.00
Mimachlamys varia	6.19	0.00	0	1	1	0.00	8	0.00
Mytilus edulis	18 340.41	10.12	3 429	3 295	3 429	3.14	15 0985	26.03
Nucula nucleus	0.11	0.00	1	0	1	0.00	2	0.00
Ostrea edulis	133.94	0.07	1	1	1	0.00	8	0.00
Parvicardium minimum	0.01	0.00	0	1	1	0.00	2	0.00
Pecten maximus	712.86	0.39	1	0	1	0.00	41	0.01
Ruditapes decussatus	363.17	0.20	49	49	49	0.04	592	0.10
Solen marginatus	0.41	0.00	0	1	1	0.00	2	0.00
Spisula sp.	0.05	0.00	0	1	1	0.00	1	0.00
Spisula subtruncata	0.25	0.00	0	2	2	0.00	2	0.00
Striarca lactea	0.22	0.00	1	0	1	0.00	5	0.00
Veneridae	1.72	0.00	4	4	4	0.00	10	0.00
Venus verrucosa	106.78	0.06	7	6	7	0.01	31	0.01
Polyplacophore								
Chiton sp.	0.02	0.00	-	-	1	0.00	1	0.00
Cephalopod								
Sepia officinalis	0.89	0.00	-	-	3	0.00	20	0.00
Undetermined molluscs	7.22	0.00	0	0	10	0.01	98	0.02
Total	**181 269.49**	**100.00**	**3 510**	**3 388**	**109 366**	**100.00**	**579 979**	**100.00**

— TABLE 1 —

Quantification of marine molluscs identified at Port-Blanc.

Bilan quantitatif des mollusques marins identifiés à Port-Blanc.

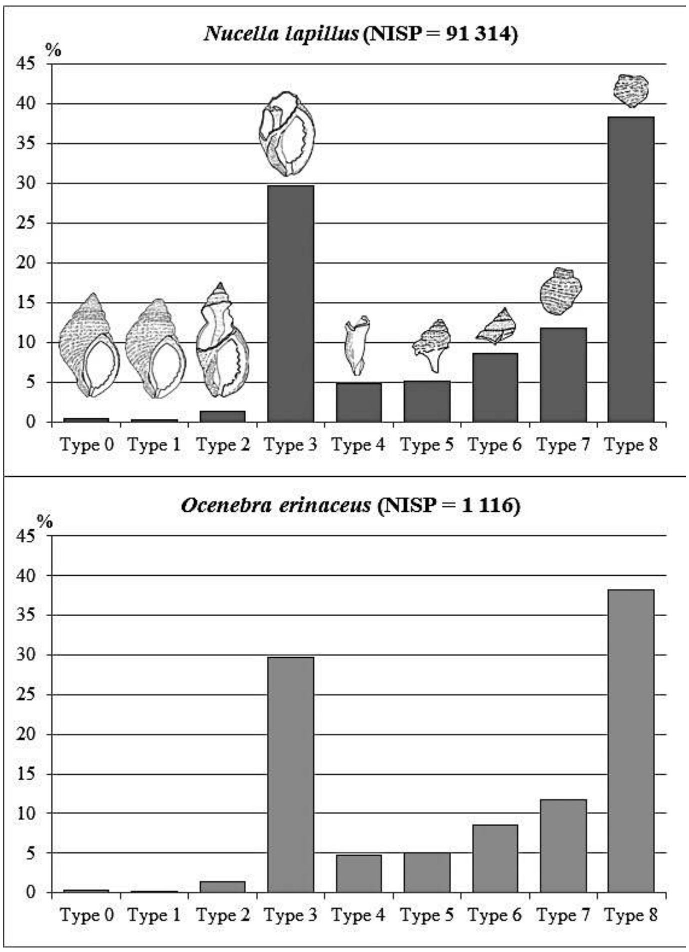
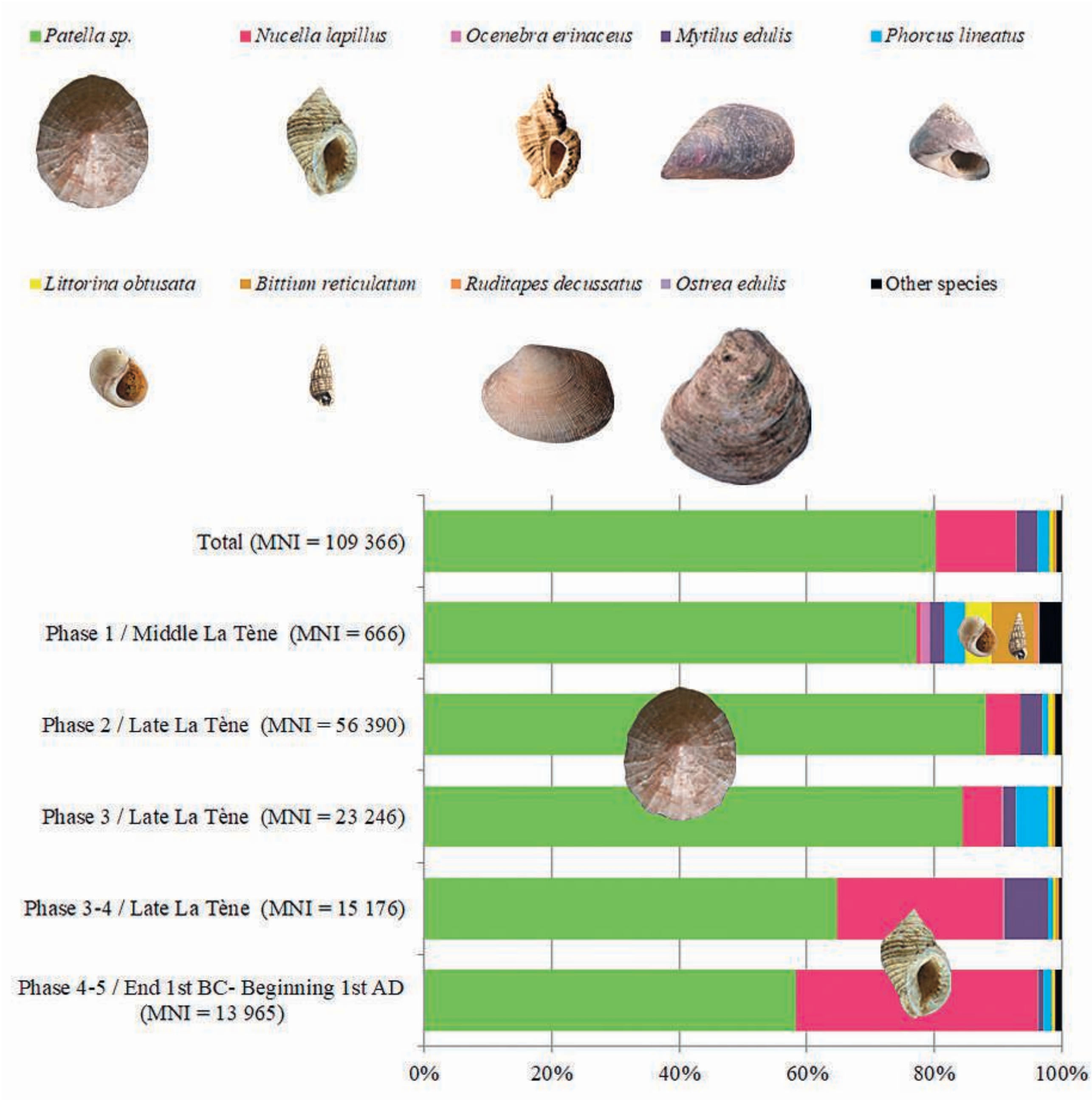


FIGURE 5

Histograms of distribution of dog whelks and oyster drill fragment types (drawing, Y. Gruet, CAD C. Dupont and L. Quesnel).

Histogrammes de distribution des types de fragments de pourpres et de murex (dessin, Y. Gruet, DAO C. Dupont et L. Quesnel).



— FIGURE 6 —

Malacofaunal spectra of Port-Blanc according to occupation phases (photos and CAD C. Dupont).

Spectres malacofauniques en fonction des phases d'occupation de Port-Blanc (photos et DAO C. Dupont).

the small quantities of European clams found, it is highly likely that this species was collected in a few sandy channels in rocky areas.

Nucella lapillus and *Ocenebra erinaceus* were collected barehanded at low tide (**fig. 10**). The objective to catch as many molluscs as possible at each tide is clearly visible in the high representation of small-sized individuals. The low value of the average length of dog whelks during the last occupation phase of Port-Blanc points to an over-exploitation of this species at the end of the Late La Tène period, at the beginning of the first century AD.

The first evidence of oyster drill exploitation during the Middle La Tène points to the antiquity of purple extraction along the French Atlantic coast. The current state of research along the French Atlantic coast identifies two other older occurrences of dyeing: the survey attributed to the Early Bronze Age at Tariec Vraz (Finistère; Pailler and Sparfel 2008) and the recent excavation of Les Prés Biards (Erquy, Côtes-d'Armor, unpublished; supervisor of the excavation Mélanie Levan, Inrap), tracing this activity back to Early La Tène period (**fig. 1-D**). The Bronze Age evidence is tenuous as it is based on an insufficient number of shells (N = 6 *Nucella lapillus*). Thus, it is possible that dyeing properties were known along the northwestern coasts of Gaul before the Roman conquest and that the

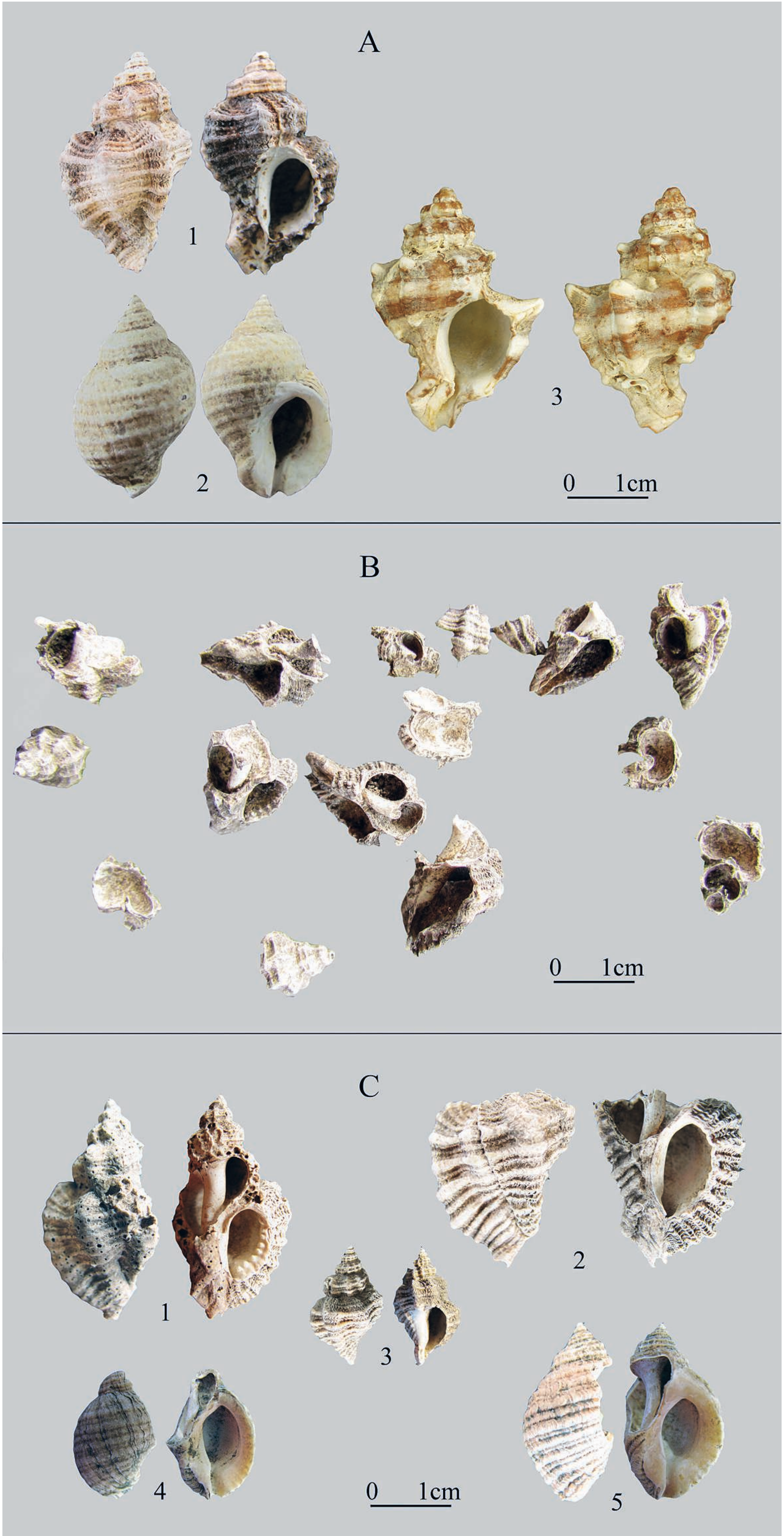


FIGURE 7

Shellfish and dyeing; A: Shellfish mentioned in the text, 1- Ocenebra erinaceus, *2-*Nucella lapillus, *3-* Hexaplex trunculus*; B: Broken* O. erinaceus *from Port-Blanc, C: Examples of breakage from Port-Blanc, on* O. erinaceus *(1 to 3), on* N. lapillus *(4 to 5) (Photos and CAD C. Dupont, except photo A-3 H. Zell).*

Coquillages et teinture ; A : Coquillages cités dans le texte, 1- *Ocenebra erinaceus*, 2- *Nucella lapillus*, 3- *Hexaplex trunculus* ; B : *O. erinaceus* cassés de Port-Blanc, C : Exemples de cassure de Port-Blanc, sur *O. erinaceus* (1 à 3), sur *N. lapillus* (4 à 5) (Photos et DAO C. Dupont, sauf photo A-3 H. Zell).

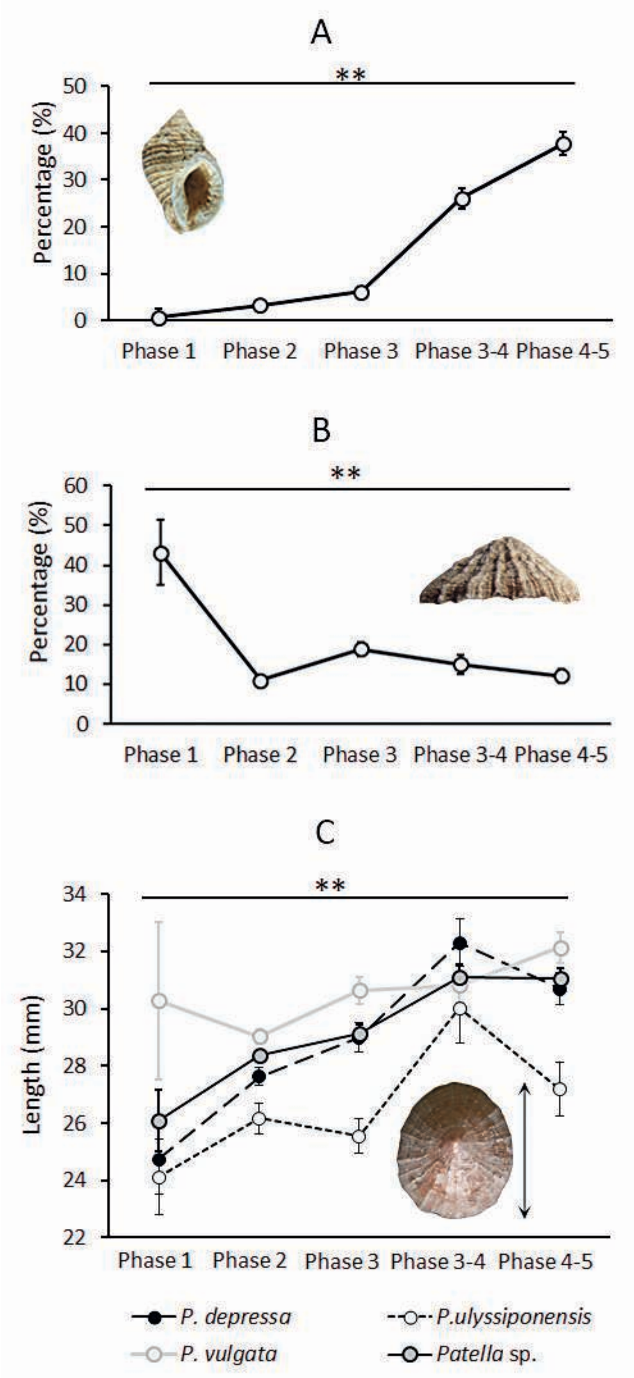


FIGURE 8

Variations of the proportions (x100 = percentage MNI) and sizes of dog whelks and limpets during the five phases; A. Percentage of *Nucella lapillus* with 95% confidence intervals. B. Percentage of *Patella ulyssiponensis* with 95% confidence intervals. C. Average length (mm) of all *Patella* species with 95% confidence intervals. The double asterisk indicates a highly statistically significant difference (p<0.01) between each percentage (A and B) and for the average lengths of all Patella sp. (C).

Variations des proportions (x 100 = pourcentage NMI) et taille des pourpres et patelles pendant les cinq phases d'occupation ; A. Pourcentage de Nucella lapillus *avec un intervalle de confiance de 95 %. B. Pourcentage de* Patella ulyssiponensis *avec un intervalle de confiance de 95 %. C. Longueur moyenne (mm) de toutes les espèces de* Patella *avec un intervalle de confiance de 95 %. Le double astérisque indique une différence hautement significative (p<0.01) entre chaque pourcentage (A et B) et pour la moyenne des longueurs des* Patella sp. *(C).*

Romans influenced the development of this activity. The intentional search for *Ocenebra erinaceus* in Port-Blanc, the mimicry between this species and *Hexaplex trunculus*, and the fact that this latter murex species is the leading species in dye production in Italy (Marzano 2013), are perhaps not coincidental. Is there early evidence of Roman presence in Armorica from the Middle La Tène onwards? Continuities are visible in certain religious sites in western Gaul from the Middle La Tène to the Gallo-Roman period (Bouvet *et al*. 2003), but indications of the influence of a physical Roman presence from the Middle La Tène are absent in the current state of knowledge (Galliou 2016). Caesar's maritime campaign against the Venètes tribe with the massive arrival of Romans occurs later on, and only dates from the first century BC (Merlat 1954). Several possible scenarios must be considered: either this shell was drawn on an exported medium, or a Roman emissary or merchant travelled to Hoedic and tested the activity there. The hypothesis of a local discovery could be possible but is not obvious because of the greater accessibility of *Nucella lapillus* compared to *Ocenebra erinaceus* and the repeated uses of dog whelks from prehistoric times in symbolic activities. The scenario of Roman emissary or merchant is likely, as long-distance trade with products of Mediterranean origin existed from the early Iron Age onwards (Hill 1995; Gibbons and Gibbons 2004). Sea-lanes such as those proposed for the first century AD could already have been active during the Middle La Tène (Cunliffe 1984). The ocean was not a limit then, since products from the Mediterranean were known as far away as Ireland, for example. Looking more closely at the Mediterranean, "the current evidence available

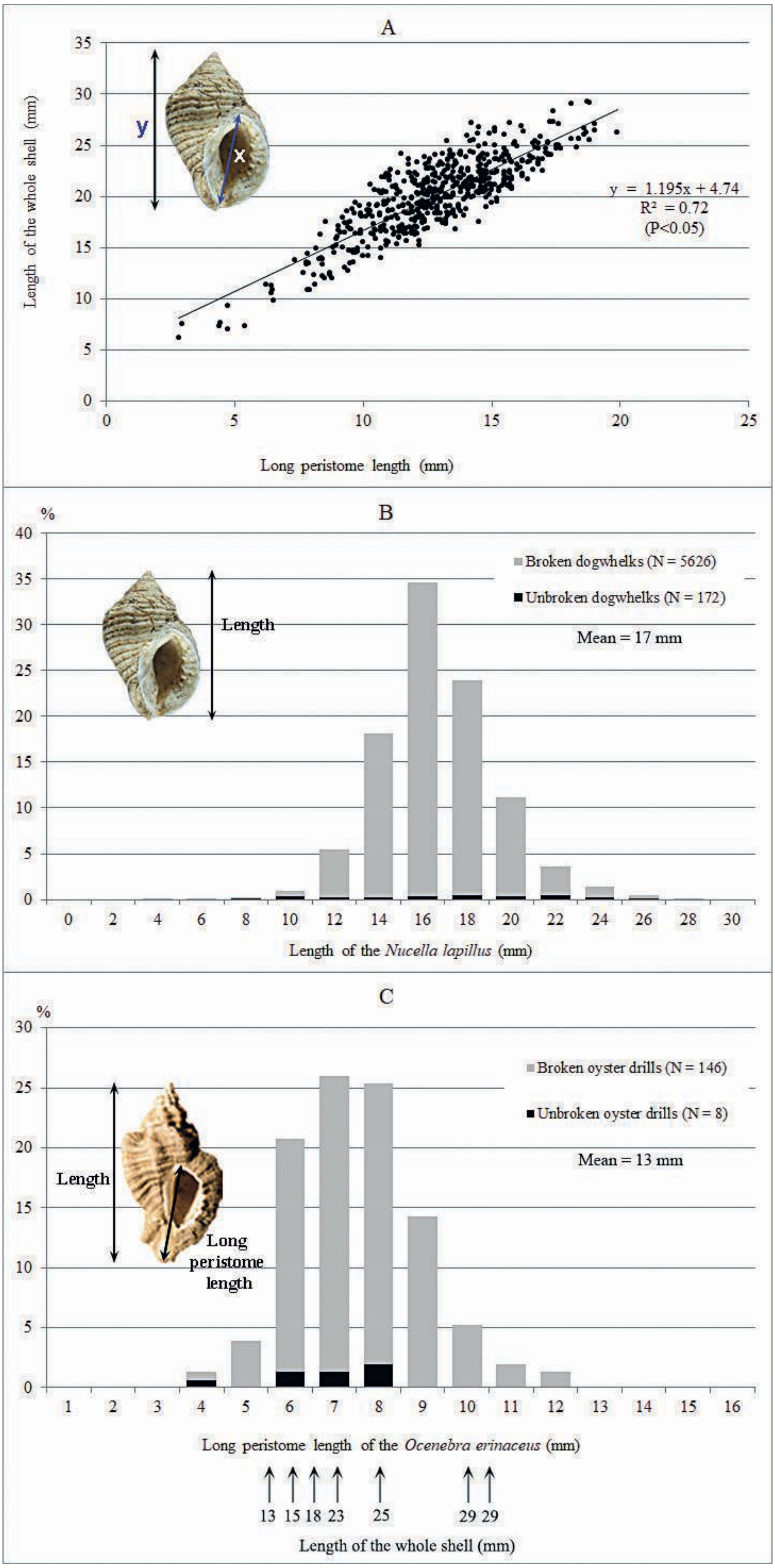
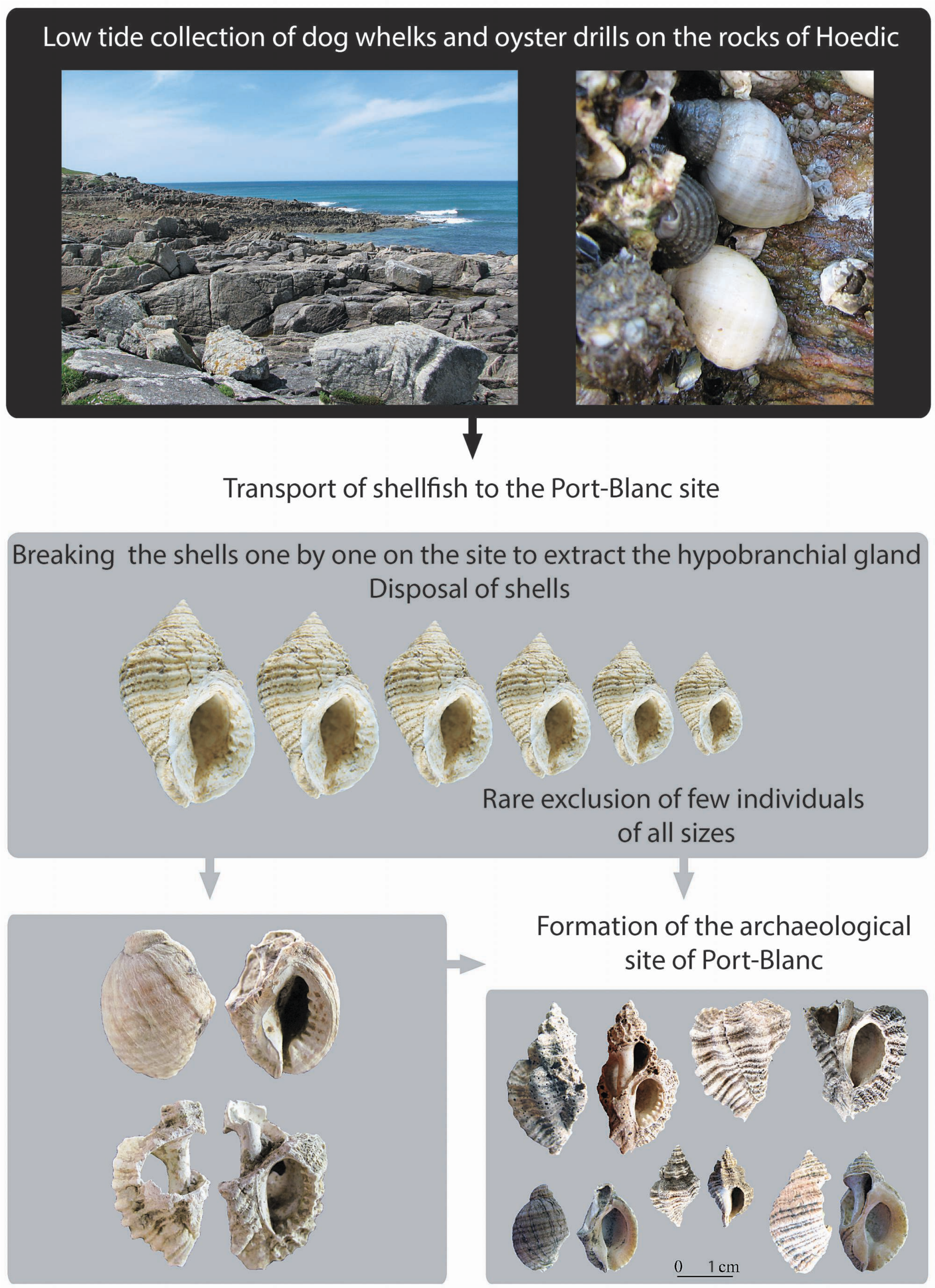


FIGURE 9

Reconstruction of the original sizes of dog whelks and oyster drills; A: Correlation equation of shell length versus longest peristome length, B: Histogram of the distribution of the total lengths of dog whelks, C: Histogram of the distribution of the longest peristome lengths of oyster drill (CAD C. Dupont).

Reconstitution des tailles originales de pourpres et de murex ; A : Équation de corrélation de la longueur de la coquille en fonction de la plus grande longueur du péristome, B : Histogramme de distribution des longueurs totales des pourpres, C : Histogramme de distribution des plus grandes longueurs de péristome des murex) (DAO C. Dupont).



— FIGURE 10 —

Different stages related to the exploitation of dog whelks and oyster drills at Port-Blanc (Photos and CAD C. Dupont).

Synthèse des étapes liées à l'exploitation des pourpres et des murex à Port-Blanc (Photos et DAO C. Dupont).

suggests that purple dye was produced in the Bronze Age Aegean and in Italy first" (Marzano 2013, p. 3). Thus, purple production may have been driven by Mediterranean influences, but may have predated the continental Roman conquest. We do not know if the final product was a powder or a liquid, and if the dye was used either in Port-Blanc or for exportation. This last scenario is plausible due to the importance of such products in the Mediterranean area. What is new at Port-Blanc, in relation to other ocean-transported goods at the same period, is that the know-how seems to have travelled from the Mediterranean area to north-western France, from where "purple gold" could have circulated in return.

The molluscs of the Atlantic coast of France are less lucrative than the Mediterranean murex due to their size. Why did this activity last for so long in Hoedic Island? This presence can be justified by the fact that this dye was a luxurious product for Mediterranean populations and elites (Pline l'Ancien 1955; Vicente 1995, p. 100; Desrosiers and Cardon 2000; Sotiropoulou 2004, p. 170). This luxury is linked to the difficulty of obtaining the dye following various time-consuming stages, from collection to heating the glands with different recipes and additives, and also to the colossal number of sacrificed shells (Marzano 2013), broken one by one (**fig. 10**). In fact, investment is very high (Macheboeuf 2005). On the other hand, some production centres are controlled and the product is reserved for an elite. This is the case, for example, for the manufacturers at Tyre under the control of the state from the time of Diocletian in the late fourth century AD, where the use of some purple colours by private individuals was forbidden (Marzano 2013). Was Hoedic a means of obtaining purple dye by clearing areas of imperial Mediterranean control? We could even be dealing with smugglers.

Far from being isolated, Hoedic Island could have participated in more or less distant exchange networks, as has already been proposed for other protohistoric island sites (Daire and Hamon 2013; Le Bihan and Villard 2013; Le Bihan and Daire 2015; Baudry 2018). Purple dye may have played an active part in these exchanges with other local productions, such as salt, for example, or even salted products. Among the short-distance imports from the mainland or neighbouring islands to Hoedic, we can mention domestic pottery, firewood or construction wood, raw materials such as schist or iron, but also animals, including cows or horses. Other long-distance transports are evidenced by the quantity of wine amphorae from Mediterranean areas, mostly found on late coastal and island settlements of Brittany (Daire *et al.* 2015b).

Thus, far from being constrained, these island populations took advantage of the diversity and natural renewal of food resources to gain a certain territorial independence. On the other hand, the island could, from the islander's point of view, be seen as a controlled opening to the continent.

REFERENCES

BAUDRY A. 2018 - *Ressources animales et alimentation carnée à l'âge du Fer : le cas du nord-ouest de la France (Bretagne et Basse-Normandie).* Recherches archéologiques 13, Paris : CNRS éditions-Inrap, 216 p. https://hal-inrap.archives-ouvertes.fr/hal-02295660

BILLARD C. (dir.) 2019 - *Estrans, l'archéologie entre terre et mer*. Les Nouvelles de l'archéologie, 156, 71 p.

BLANZ M., STEWART S., MAINLAND I., ASCOUGH P., RAAB A., FELDMANN J., TAGGART M.A. 2022 - Trace element ratios in tooth enamel as palaeodietary indicators of seaweed consumption and coastal grazing, and their broader applicability. *Journal of Archaeological Science*, 139, 105551.

BONSALL C., SUTHERLAND D.G., RUSSELL N.J., COLES G., LAWSON T.J. 1994 - Excavations in Ulva Cave, western Scotland 1990-1991: a preliminary report. *Mesolithic Miscellany*, 15 (1), p. 8-21.

BOUVET J.P., DAIRE M.Y., LE BIHAN J.B., NILLESSE O., VILLARD-LE TIEC A., BATT M., BIZIEN-JAGIN C. 2003 - La France de l'Ouest (Bretagne, Pays de la Loire). *Gallia - Archéologie de la France antique*, 60, p. 75-105.

CUNLIFFE B. 1984 - Relations between Britain and Gaul in the First Century A.D. *In: Cross Chanel Trade between Gaul and Britain in the Pre-Roman Iron-Age.* London: Society of Antiquaries of London, p. 3-23.

DAIRE M.Y. 2009 - Islands and archaeological research in Western France. Summary of a very long story of romance... Shima, *The International Journal of Research into Island Cultures*, 3 (2), p. 52-69.

DAIRE M.Y., BAUDRY A. (dir.) 2018 - *Hoedic, une île d'Armorique à la veille de la Conquête romaine. 10 ans d'étude pluridisciplinaire*. Les Dossiers du CeRAA, supplément AM-2016, 296 p.

DAIRE M.Y., BAUDRY A., DUPONT C., LEROUX V.E., DRÉANO Y., TRESSET A., QUESNEL L., LE GALL J.-Y., BOURLES D. 2008 - Suivi archéologique sur l'île de Triélen (Archipel de Molène) : un site Gaulois au péril de l'érosion... *Bretagne vivante*, p.19. http://www.bretagne-vivante.org/images/stories/Reserves/reseau_reserves/bilan_reseau_reserves_2008.pdf

DAIRE M.Y., HAMON G. (dir.) 2013 - *L'Île aux Moutons (Fouesnant, Finistère) Un établissement gaulois dans son contexte atlantique. Étude pluridisciplinaire*. Saint-Malo : Centre Régional d'Archéologie d'Alet, supplément –AJ, 234 p.

DAIRE M.Y., LE BIHAN J.P., LORHO T. 2015b - Une première approche des modes d'occupation du littoral Manche-Atlantique à l'Âge du Fer. *Les Gaulois au fil de l'eau. Actes du 37e colloque de l'AFEAF, Montpellier, 8-11 mai 2013.* Bordeaux : Ausonius, p. 143-166.

DAIRE M.Y., OLMOS P., LANGOUËT L., MONRÓS M., MOUGNE C., BERNARD Y., QUESNEL L., LARGE J.-M., DUPONT C. 2015a - Sterflant, un site archéologique sous haute surveillance à Hoedic. *Melvan - La revue des Deux îles*, 12, p. 187-198.

DESROSIERS S., CARDON D. 2000 - Vraies pourpres conservées en Europe. *In:* CARDON D. (dir.), *Teintures précieuses de la Méditerranée Pourpres–Kermes-Pastel*. Carcassonne: Musée des Beaux-arts de Carcassonne, p. 96-99.

DUPONT C. 2006 - *La malacofaune de sites mésolithiques et néolithiques de la façade atlantique de la France : Contribution à l'économie et à l'identité culturelle des groupes concernés.* Oxford: British Archaeological Reports, International Series 1571, 438 p.

DUPONT C. 2011 - The Dog Whelk *Nucella lapillus* and Dye Extraction Activities from the Iron Age to the Middle Ages along the Atlantic Coast of France. *Journal of Island and Coastal Archaeology*, 6 (1), p. 3-23.

DUPONT C. 2013 - Teinture et exploitation du pourpre *Nucella lapillus* le long du littoral atlantique français. *In:* DAIRE M.Y., DUPONT C., BAUDRY A., BILLARD C., LARGE J.M., LESPEZ L., NORMAND E., SCARRE C. (Éds.), *Actes du colloque HOMER2011. « Ancient maritime communities and the relationship between people and environment along the European Atlantic coasts*. British Archaeological Reports, BAR S2570, Oxford: Archeopress, p. 459-467.

DUPONT C. 2019 - Exploitation des invertébrés marins au III^e^ millénaire av. n.è. *In:* Pailler Y., Nicolas C. (dir.), *Une maison sous les dunes : Beg ar Loued, Île Molène, Finistère. Identité et adaptation des groupes humains en mer d'Iroise entre les III^e^ et II^e^ millénaires avant notre ère*. Leiden: Sidestone Press, p. 621-645. https://www.sidestone.com/books/une-maison-sous-les-dunes

DUPONT C. 2021 - Au Mésolithique, il ne suffit pas qu'une coquille soit bonne à décorer, encore faut-il qu'elle soit bonne à penser. *Bulletin de la Société Archéologique Champenoise*, 113 (2-3), p. 275-291.

DUPONT C., DOYEN D. 2017 - La couleur pourpre de la mer : l'extraction de colorant à partir des coquillages à Saint-Michel-Chef-Chef au 1^er^ s. ap. J.-C. (Loire-Atlantique). *In:* R. GONZÁLEZ VILLAESCUSA, K. SCHÖRLE, F. GAYET, F. RECHIN (dir.) *Actes des XXXVII^e^ Rencontres internationales d'archéologie et d'histoire d'Antibes. L'exploitation des ressources maritimes de l'Antiquité. Activités productives et organisation des territoires*. Antibes – France, 10-13 octobre 2016. Antibes : Éditions APDCA, p. 53-66.

DUPONT C., MARCHAND G. 2021 - New Paradigms in the Exploitation of Mesolithic Shell Middens in Atlantic France: the example of Beg-er-Vil, Brittany. *Quaternary International*, 584, p. 59-71. DOI: 10.1016/j.quaint.2020.09.043

DUPONT C., MOUGNE C. 2015 - Comme une bernique sur son rocher : les coquillages marins reflètent-ils l'adaptation des populations humaines au milieu insulaire du Mésolithique à l'âge du Fer ? *In:* L. AUDOUARD, B. GEHRES (dir.), *« Somewhere Beyond The Sea » The islands of Brittany (France): an archaeological, geographical and historical point of view, Actes du Séminaire Archéologique de l'Ouest, 1 avril 2014, Rennes - France*. BAR S2705. Oxford: Archeopress, p. 22-33.

ERLANDSON J. M. 2008 - Isolation, Interaction, and Island Archaeology, *The Journal of Island and Coastal Archaeology*, 3:1, p. 83-86. DOI: 10.1080/15564890801999939

GALLIOU P. 2016 - *Les Vénètes d'Armorique*. Spézet : Éditeur Coop Breizh, 576 p.

GIBBONS MI., GIBBONS MY. 2004 - Dyeing in the Mesolithic? *Archaeology Ireland*, 18, 1, p. 28-31.

HAMMER Ø., HARPER D.A.T., RYAN P.D. 2001 - Past: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica*, 4, 1, p. 178.

HAYWARD P.J., RYLAND J.S. (Éds.) 2007 - *Handbook of the Marine Fauna of North-West Europe*. Oxford: Oxford University Press, 800 p.

HILL J.D. 1995 - The Pre-Roman Iron Age in Britain and Ireland (ca. 800 B.C. to A.D. 100): An overview. Journal of World Prehistory, 9, p. 47-98.

LARGE J.-M., MENS E. 2009 - The Douet alignment on the island of Hoedic (Morbihan, France): New insights into standing stone alignments in Brittany. *Oxford Journal of Archaeology*, 28, p. 239 - 254. DOI: 10.1111/j.1468-0092.2009.00327.x

LE BIHAN J.P., DAIRE M.Y. 2015 - Les îles de Bretagne continentale et de plein océan : un monde (habité), un réseau (de communication), un vecteur (d'acculturation). *Les Gaulois au fil de l'eau. Actes du 37^e^ colloque de l'AFEAF, Montpellier, 8-11 mai 2013.* Bordeaux : Ausonius, p. 235-258.

LE BIHAN J.P., VILLARD J.-F. 2001 - *Archéologie d'une île à la pointe de l'Europe -1- Le site de Mez-Notariou et le village du premier âge du Fer*. Quimper : éd. Centre de recherche archéologique du Finistère et Revue Archéologique de l'Ouest, 350 p.

LE BIHAN J.-P., VILLARD J.-F. 2013 - Trafic maritime et franchissement de la pointe de Bretagne de l'âge du Bronze à l'Antiquité romaine. Étude fondée sur l'archéologie des sites de Ouessant et de Quimper. *In:* DAIRE M.Y., DUPONT C., BAUDRY A., BILLARD C., LARGE J.M., LESPEZ L., NORMAND E., SCARRE C. (Éds.), *Actes du colloque HOMER2011 « Anciens peuplements littoraux et relations homme/milieu sur les côtes de l'Europe atlantique»*. Oxford: British Archaeological Reports, Archeopress, p. 233-246.

LINDNER G. 1976 - *Guide des coquillages marins*. Paris : Delachaux et Niestlé, 255 p.

MACHEBOEUF C. 2005 - *Exploitation et commercialisation de la pourpre dans l'Empire romain.* Dunkerque : Thèse de l'Université du littoral Côte d'Opale, 4t., 249 p., Doctoral thesis.

MAGUER P., LANDREAU G., DUPONT C., MARTIN H., BARDOT X., POUPONNOT G., BRIAND D., DUVAL A. 2009 - L'habitat littoral des Ormeaux à Angoulins (Charente-Maritime) : activités vivrières et salicoles entre marais et océan. *In:* BERTRAND I., DUVAL A., GOMEZ DE SOTO J., MAGUER P. (dir.), *Les Gaulois entre Loire et Gironde, Actes du XXXI^e^ Colloque international de l'Association Française pour l'Étude de l'Age du Fer, 17-20 mai 2007, Chauvigny - Vienne - France,* Tome I, Chauvigny: ed. Association des Publications Chauvinoises, Mémoire XXXIV, p. 57-102.

MARZANO A. 2013 - *Harvesting the Sea: The Exploitation of Marine Resources in the Roman Mediterranean*. Oxford Scholarship Online: University Press Scholarship Online, DOI: 10.1093/acprof:oso/9780199675623.001.0001

MERLAT P. 1954 - César et les Vénètes. *Annales de Bretagne*, 61 (1), 1954. p. 154-183.

MOONEY D.E. 2018 - Charred *Fucus* - Type Seaweed in the North Atlantic: A Survey of Finds and Potential Uses. *Environmental Archaeology*, 26, p. 1-13. DOI: 10.1080/14614103.2018.1558805

MOUGNE C. 2015 - *Exploitation des invertébrés marins (mollusques, crustacés et oursins) durant la Protohistoire sur le territoire littoral et continental de la façade atlantique et de la Manche de la France*. Thèse d'Archéologie, Université de Rennes 1, 707 p., Doctoral thesis.

MOUGNE C., DUPONT C., BAUDRY A., QUESNEL L., DAIRE M.Y. 2014 - Acquisition and management of the marine invertebrates resources on a pre-roman coastal settlement: Dossen-Rouz (Locquémeau-Trédez, Brittany, France). *In:* SZABÓ K., DUPONT C., DIMITRIJEVIC V., GASTÉLUM GÓMEZ L. G., SERRAND N. (Éds.), *Archaeomalacology: Shells in the Archaeological Record. Proceedings of the 11th ICAZ International Conference. Paris - Archaeomalacology Working group, 23-28 August 2010, France*, BAR International Series 2666. Oxford: Archeopress, p. 203-216.

MOUGNE C., DUPONT C., LEPAUMIER H., QUESNEL L. 2013 - Exploitation of marine Shells during the Late Iron Age: Gathering territory, diatery choices and circulation networks «The example of Cormelles-le-Royal (Plain of Caen, Lower-Normandy, France)». *In*: DAIRE M.Y., DUPONT C., BAUDRY A., BILLARD C., LARGE J.M., LESPEZ L., NORMAND E., SCARRE C. (Éds.), *Actes du colloque HOMER2011 «Ancient maritime communities and the relationship between people and environment along the European Atlantic coasts»*. British Archaeological Reports, BAR S2570, Oxford: Archeopress, Oxford, p. 527-534.

O'SULLIVAN A., BREEN C. 2011 - *Maritime Ireland: an archaeology of coastal communities*. Stroud, Gloucestershire : History Press, 256 p.

PAILLER Y., SPARFEL Y. (dir.) 2008 - *Rapport de sondage d'urgence sur un site de l'âge du bronze ancien, île de Tariec vraz en Landéda (Finistère).* Rennes : SRA Bretagne, inédit, 34 p.

PÉQUART M., PÉQUART S.-J. 1954 - *Hoëdic, deuxième station-nécropole du Mésolithique côtier Armoricain*. Anvers : De Sikkel, 93 p.

PLINE L'ANCIEN 1955 - *Histoire naturelle, livre IX*. Paris : Les Belles Lettres, 159 p.

POPPE T., GOTO Y. 1991 - *European Seashells: Polyplacophora, Caudofoveata, Solenogastra, Gasteropoda*. Germany: Verlag Christa Hemmen, Vol.1, 352 p.

POPPE T., GOTO Y. 1993 - *European Seashells: Scaphopoda, Bivalvia, Cephalopoda*. Germany: Verlag Christa Hemmen, Vol.2, 221 p.

RAINBIRD P. 2000 - Islands Out of Time: Towards a Critique of Island Archaeology. *Journal of Mediterranean Archaeology,* 12(2), p. 216–234. DOI: 10.1558/jmea.v12i2.29971

RUSSELL N.J., BONSALL C., SUTHERLAND D.G. 1995 - The exploitation of marine molluscs in the Mesolithic of western Scotland evidence from Ulva Cave, Inner Hebrides. *In:* Fischer A. (ed.) *Man and Sea in Mesolithic*. Oxford: Oxbow Books, p. 273-288.

SOTIROPOULOU S. 2004 - La pourpre dans l'art Cycladique : identification du pigment dans les peintures murales d'Akrotiri (Thera, Grece), *Preistoria Alpina*, 1 40, p. 167-176.

TEBBLE N. 1966 - *British Bivalve Seashells. A handbook for identification*. Londres : Trustees of The British Museum Natural History, 213 p.

VICENTE N. 1995 - Les mollusques, l'homme et l'imaginaire. Mémoires de l'Institut océanographique, p. 99-108.

WICKHAM S.B., SHACKELFORD N., DARIMONT C.T., NIJLAND W., RESHITNYK L.Y., REYNOLDS J.D., STARZOMSKI B.M. 2020 - Sea wrack delivery and accumulation on islands: factors that mediate marine nutrient permeability. *Marine Ecology Progress Series,* 635, p.37-54. DOI: 10.3354/meps13197

WoRMS 2022 - The World Register of Marine Species, *http://www.marinespecies.org/*, accessed on 01/02/2022.